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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

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TRANSCRIPT OF PROCEEDINGS

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Day 1

A P P E A R A N C E S

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DR. DENNIS PRICE, Technical Review Board
MR. WILLIAM COONS, Technical Review Board
DR. ELLIS VERINK, Technical Review Board
DR. PHANI RAJ, Technical Review Board
DR. RUSSELL MC FARLAND, Technical Review Board
DR. D. WARNER NORTH, Technical Review Board
DR. MELVIN CARTER, Technical Review Board
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MR. JIM CARLSON, DOE-HQ
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I N D E X

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I N D E X (CONTINUED)

DR. DEERE: Good morning. My name is Don Deere and I'm chairman of the Nuclear Waste Technical Review Board and an ex officio member of the Containers and Transportation Panel. I want to thank you for coming to the first meeting of the panel. We have an ambitious agenda for this three-day meeting, so we need to get started.

I would like to take this opportunity, for those of you not familiar with the Technical Review Board, to provide some background information. The Nuclear Waste Technical Review Board was created by the US Congress as an independent establishment within the Executive Branch of the US Government on December 22nd, 1987, in the Nuclear Waste Policy Amendments Act of 1987.

Our charge is to evaluate the scientific and technical validity of the US Department of Energy's site characterization work at the Yucca Mountain Site in Nevada and activities related to the packaging or transportation of high-level radioactive waste or spent nuclear fuel.

We are to conduct our evaluation of such activities since the enactment of the Nuclear Waste Policy Amendments Act of 1987, and report our findings, conclusions and recommendations to the US

Congress and the Secretary of the Department of Energy not less than two times a year.

The Technical Review Board is comprised of 11 members, eight of whom have been appointed by the President to date. Term of appointment for the initial 11 members will range from two to four years. I am honored to have been selected by the President to serve as chairman. A list of all current board members can be found at the registration table.

I would like to take this opportunity to introduce the other board members present today. They are Dr. Dennis L. Price, Professor of Industrial Engineering and Operations Research and Director, Safety Projects Office, Virginia Polytechnical Institute and State University, Blacksburg, Virginia; Dr. Melvin W. Carter, Professor Emeritus, Georgia Institute of Technology, and an international radiation protection consultant; Dr. D. Warner North, principal, Decision Focus, Incorporated, Los Altos, California, consulting professor, Stanford University, Palo Alto, California, and associate director of Stanford Center for Risk Assessment; and Dr. Ellis D. Verink, distinguished service professor of metallurgy and former chairman, Materials Science and Engineering Department, University of Florida, Gainesville, Florida.

The day-to-day activities of the TRB will be managed by our Executive Director, Mr. William Coons. Mr. Coons is a retired faculty member and former assistant chairman, Civil Engineering Department at the University of Florida in Gainesville. He is also a retired captain, US Navy. In that capacity, he was associated with the Polaris/Poseidon Submarine Program.

If there are questions about the activities of our board or this panel during the meeting, I suggest contacting Bill. At the first full meeting of the board in March, 1989, we established five panels to help us organize our evaluation. A list of the name and current members of each panel, one of which is the Containers and Transportation Panel, can be found at the registration table. If you are interested in receiving notice of the panel meetings or full board meetings, please be sure to include your full address on the sign-in sheet at the registration table.

Today, we will be briefed by the US

Department of Energy, DOE, on its high-level radioactive waste cask development and transportation programs. At this time, the board is gathering information only about transportation and cask development programs as they pertain to the proposed Yucca Mountain Site in Nevada.

In September of this year, however, the board will meet to review its legislative mandate and expand, if necessary, the scope of its work on transportation and packaging of high-level radioactive waste.

I want to thank members of the audience for attending our briefing session. We ask that members of the audience participate as observers only during our briefing sessions, as we are in the information-gathering stage of our existence. At a later date, we intend to provide opportunity for comment on our technical and scientific activities from any interested person or organization. At this point in our proceedings, however, we stipulate that only board members ask questions of the presentors during the course of the briefing.

With these comments, I will now turn the meeting over to the panel chairman, Dr. Dennis Price. Dennis.

DR. PRICE: Without any further comment, I'm going to turn the meeting over to Tom Isaacs for some introductory remarks.

MR. ISAACS: Thank you very much, Dennis and Don. Once again, good morning to all of you, both panel review board members and consultants and also the audience.

It's a pleasure for the department and for me and my colleagues to have the opportunity to once again share with you an important element of our program.

As you're aware, we developed this agenda in close cooperation with you. We're quite hopeful that this will be a worthwhile three-day effort and that we will go into the kinds of activities with regard to transportation and containers that you are searching for.

As with all of our meetings, I think it's useful to not be bashful and if there are some other things that you want to hear about, we'll try and accommodate you as the presentations are made. If we're not prepared for that, we certainly will be happy to accommodate you in the short future.

I think it's important to mention that this is, I believe, the fifth meeting now that we've had with either the board or the panels. I think that we've had a very -- what I consider to be an extremely productive relationship so far. It's a large task from the department's point of view, but one that we continue to feel is paying great dividends to us as well as to the larger community that is interested in the waste program.

As Don mentioned, this will be a three-day meeting full of substance and one that we believe will measurably enhance our ability to get some reactions from you on where we're headed in this very important area, one that will touch not only the repository site and a potential MRS site, but will really touch in total perhaps more than any other part of the program the entire country as we take a look some day at transporting high-level waste and nuclear fuel from the many, many places around the country to its ultimate resting places.

We also have as part of this, and you'll hear more about this from Chris Kouts in a moment, a tour planned to see some key facilities of the cask testing, which I think you ought to find interesting, and we plan on responding to your request to see a demonstration of RADTRAN also as part of that process.

Today, I expect that we will begin the three-day effort to give you a fairly good overview of the entire transportation program that we have, including cask development, which is very timely, as preliminary designs are nearing completion; the actual operation, which is in the planning phase, and also, very importantly, and I think this has been reflected in some interesting comments that we've received from members of the board in other meetings, looking at the systems studies, systems analyses and risk assessments that are required in order to make sure that this system fits together well.

Also, in transportation, no program is complete without a focused look and a great deal of attention paid to the institutional interactions. Here, as I reflected just a moment ago, perhaps even more so than with regard to siting facilities, we have a tremendous challenge ahead of us as we try and interact with perhaps the 48 contiguous states and the enumerable numbers of communities and counties and local governments and jurisdictions as we try and perceive how we're going to handle the transportation problem.

I might add that we're fortunate in that we've had a tremendous background in transportation from the defense program's part of the Department of Energy who has developed, and I believe very successfully implemented, a long-standing program of transportation in that area and is one that we can learn from and build on, and I think that's why it's entirely appropriate that we hold this first meeting of this particular panel here in Albuquerque.

I also will be looking personally and the department will be looking for the kinds of reactions and interactions that we can glean as always from this meeting from the perceptions of the board. Nobody has all the answers as to how we're going to attack all of these very difficult problems on transportation and, in fact, it's very important that we tackle them in a very systematic and timely way.

One of the things that we find is that you can, indeed, prematurely plan for transportation. You want to plan certain aspects of transportation when you have the knowledge that allows you to plan most efficiently and most effectively.

For example, there is still some question about when and where an MRS would be sited. Obviously, that would have significant implications for routing and for the whole structure of the transportation system, as to whether or not an MRS will ultimately be realized, so some of these kinds of questions need to be developed in a very sequential and staged manner. We'll be very interested in your help in addressing those kinds of things.

The last thing I should mention, since we are here in the Land of the Rising Sun, is that it's important to recognize that this panel does not have jurisdiction -- the panel recognizes this, but that the members of the general audience recognize that the panel does not have any jurisdiction for oversight of WIPP, the Waste Isolation Pilot Plant, which is for the ultimate disposal of transuranic waste, as opposed to the repository program, which is for the ultimate disposal, of course, of high-level radioactive waste.

I'm not going to go through and introduce all the people you will be hearing from over the next three days, I think it's more appropriate that they perhaps be introduced as they come to the podium. I just simply want to mention once again and introduce Jim Carlson, who, as you know, is my major -- although he's on my left hand, he's indeed the right-hand man for this interaction with the Technical Review Board and continues to operate in that manner and, of course, we'll do anything we can to continue to respond to you in the most timely and effective way we can.

With those introductory remarks, unless there are any general questions, which I'd be happy to address, I will turn the meeting over to Chris Kouts, who is the chief of the transportation unit and the OCRWM program, who will then proceed with the rest of the agenda.

DR. CARTER: I have a question, if I might, whether you want to address it now -- I'd certainly like to have it addressed fairly early in the program -- but I wonder, for the record, if you or someone would address vis-a-vis DOE responsibilities as far as casks are concerned and also transportation as these relate to DOT and to --

MR. ISAACS: I understand your question and I think it's a very good one and, indeed, it is early on the agenda here to describe that relationship in fairly good detail as we go through the regulatory requirements, like we have done on some of the other elements of the program.

DR. CARTER: I'd just like the context of this very simply so we can relate it to the background of this particular meeting.

MR. ISAACS: The first element on the program is an overview by Chris. If, after the end of that first half-hour overview, we still feel like there are some residual questions, then why don't we raise it again and make sure that it's clear.

MR. KOUTS: Can everybody hear me? First of all, I'd like to extend my own excitement about this meeting. Speaking directly from the transportation program and I think the Office of Radioactive Waste Management, we look forward to this opportunity to interact with the board.

I think the discussions we've had in the preparation --

MR. ISAACS: Chris, they're not hearing you.

MR. KOUTS: As I was saying, we looked at this as an opportunity to refine some of our thinking about the many different topics that the board had interest in.

I would like to go over a little bit about what you have in your briefing books in front of you. You'll find essentially the agenda for the three days that we're planning of briefings. In addition to that, right after the agenda, you will find a listing of the individual speakers and a short background sketch on each of them.

I would like to make a comment that the only change in the agenda today, you might have already noticed it from the previous agenda that we sent to you, but Ralph Stein is not here today, he's the associate director in charge of the Office of Systems Integration Regulations. Ralph was unable to be here. Tom is sitting in for Ralph.

In addition to that, Carl Gertz, who had planned to be here from the Yucca Mountain Program Office to deliver their presentation on their transportation program will not be in attendance today. He was called away on other business and he sends his regrets. Bill Andrews of SAIC Corporation will be giving that presentation for him.

I'd like to talk a little bit about what we're going to cover over the next three days.

There were about 24 subjects identified by the board of interest in the transportation area. Those 24 subjects are summarized on three pages that you have in your book there.

Today, what we're planning on covering are shipping cask procurement, cask qualifying tests and sabotage, terrorism and activist activities. Very briefly, that will be covered in the AM.

In the afternoon, we'll be looking at transport mode or modal mix; basically, the amount of rail and truck transportation we expect in our system. We're going to be looking at the overweight, dedicated trains, special trains, shipment configurations, highway routing, rail routing, motor vehicle standards and also transportation operations planning.

Tomorrow, we'll be looking at risk assessment and risk management, probabilistic risk assessment, route safety and en route highway stoppage. We are going to have a tour of the Sandia facilities tomorrow.

I would like to state that unless names were submitted in advance, people in the audience will not be able to go on that tour. We do have security precautions that we have to go through out at Sandia through the Albuquerque Operations, so if your names are not on the list that has been submitted earlier, you will not be able to attend the tour. We certainly send our regrets for those people who are going to miss it; it should be interesting.

On the final day, we're going to be talking about system safety analysis, human factors engineering, motor vehicle inspection, shipment monitoring, institutional relations, emergency response, looking at our methodology within the transportation program for issues identification and also we'll be having a briefing that's not transportation related on our waste package container corrosion. We'll have individuals from the repository project office here to give you that presentation.

What I'd like to do next is to give you a little orientation similar to what the board received back, I believe, in January when you initially had a briefing on various elements of the program. It will hopefully orient you as to where the transportation program is and also what the various activities within the program are.

You have identified 24 subjects, they are not the only subjects that we're working on, so in order to just give you an overview of what the overall transportation program is doing, I'm going to briefly go through a summary of where our program is today.

DR. DEERE: Chris, the first meeting was March.

MR. KOUTS: March, I'm sorry. Time flies, doesn't it?

First of all, a question was raised earlier as to what responsibilities DOE has in relation to the transportation of spent fuel and high-level waste within the waste management system.

By the Nuclear Waste Policy Act, we are responsible for the transportation of that fuel. We will take title to the fuel at the reactor sites and we are directed to use the private sector to the fullest extent practicable and the costs of transportation are to be covered by the waste fund.

That was in the original act. When the Amendments Act was passed in 1987, there were three additional provisions that were identified in there.

I want to mention that Section 180 (A) was something that we were planning on doing anyway, was to have all our casks certified by the Nuclear Regulatory Commission.

Section 180 (B) was something we were also planning on, but nonetheless Congress reaffirmed our planning; that was to prenotify states and local governments under NRC regulations.

Section 180 (C) is something you'll be hearing about on Wednesday, which is the requirement for the department to provide technical assistance and funding to train local governments and tribes on routine transportation and emergency response related to radioactive materials.

DR. PRICE: Chris, can I ask, is there any funding for equipment as part of that training or is it just strictly training activities?

MR. KOUTS: Our perspective is that equipment is not encompassed in that -- in that assistance.

Moving on, the four major goals of transportation activities that we have within the department are, number one, to make sure that we properly protect the public health and safety; that we have public participation in our activities; that we use the private sector, as I mentioned earlier, to the fullest extent that we can and that we are efficient and effective from a cost standpoint in implementing the system.

I'd like to talk a little bit about safety, it's a primary objective of this program. There is about a 40-year history of safe transport of radioactive materials throughout this country. The cask designs that we're presently developing will be certified by the NRC and they've had an historically excellent record in terms of safety.

In answer to an earlier question, transport will be conducted under DOT regulations. So we will have our casks certified by the NRC and we will transport under DOT regulations.

DR. PRICE: Is it true, also, that when you say you have the casks certified, it's the design of the cask that's certified, not the cask itself?

MR. KOUTS: There are also requirements associated with the operations of the casks that we have to follow through NRC provisions, also, so it's not just the designs, but it's also making sure that the casks are manufactured according to the designs that have been certified by the NRC.

DR. PRICE: So the manufacture is to be in accordance with the design, and there is some kind of check?

MR. KOUTS: Yes, there is.

DR. CARTER: Chris, one other thing, the implication is that all the casks are going to be new -- newly designed; is that true? Are you going to be using some that have been used for the transportation of used fuel elements for a number of years?

MR. KOUTS: The --

DR. CARTER: You talk about the history of it for 40 years and yet it looks like you're going to redesign.

MR. KOUTS: We're going to redesign casks, and I'll get to the reason why we're designing casks in a minute, but there is a possibility we will use existing casks if, indeed, we ship at a time prior to when our casks will be available.

For instance, if we have no MRS site or something like that and we need a transport capability, we are looking at the potential of using existing casks, but our plans for the operation of the system would be to use the casks that we're developing now for from-reactor transport, which we'll talk about in a minute.

I would hasten to add that we would be certifying under the same regulations that the other casks have been certified under, and our basic reason for wanting to develop new cask designs is because we feel because of the age of the fuel that will be in the pools, in the reactor pools, that we feel this is an opportunity for us to maximize our capacities far greater than what existing casks capacities are now. I'll show you a chart on that in a moment.

DR. CARTER: We're also going to see a variety of casks that you're talking about. I presume there are many more than one.

MR. KOUTS: Right now, we have five cask designs under development, yes, and you'll be hearing about that later this morning.

I'd like to move on and show you essentially what we're talking about so there is no confusion. We're talking about casks that are moved either by truck or by rail.

The ones that we're presenting developing for truck transport are 25-ton and for rail transport about 100 tons. You can see that the cutaways there show that there are personnel barriers basically to keep people away from the casks and these are -- this is a general schematic of what they'll look like.

One thing that we're not talking about in the next two-and-a-half days, until Wednesday afternoon, will be the next slide -- no, we are talking about that, that's a schematic.

Let's go to the next one. One thing we're not going to be talking about in the transportation part of this briefing is basically the waste packaging that will be used for ultimate emplacement in a repository.

So in case there is any confusion on anyone's part, we're not talking about the waste package that goes into the repository. We're talking about packages that are being developed solely for the transport of materials between our facilities.

DR. PRICE: Will all casks have personnel barriers?

MR. KOUTS: Yes, they will.

If we can go back to the previous slide, this is a little bit more of detailed representation of what a rail cask looks like. It shows you essentially that the casks are supported by cradles and basically all the casks have trunnions on which they are lifted and moved. They have impact limiters to also help in case there is any potential for a cask to be moved from its trailer or conveyance.

We'll talk a little bit more about the use of those when we get into our general discussions on cask development and cask regulations.

I mentioned earlier about the regulatory environment that we will have to deal with and there are a great deal of regulations that have been developed over a long period of time in the area related to radioactive materials transport.

From Nuclear Regulatory Commission 10 CFR 71,73, cask design and testing, physical protection and prenotification are all regulations that we will follow and have been developed over a long-standing period of time.

The Department of Transportation has a variety of procedures and regulations associated with the actual operational aspects of the transport of these materials in the area of labeling, marking, placarding, routing, driver training and so forth.

I should hasten to add that in the area of radioactive waste transport, the restrictions and the regulations are far more stringent in many cases than the hazardous materials transport.

You're not going to see a lot of

organizational slides over the next several days and this will probably be the only one -- the next several graphs -- that you see of organizational lines of responsibility.

The Office of Civilian Radioactive Waste Management reports directly to the Secretary of Energy. Within that office, there are four associate directorships. We have the Office of Facilities Siting and Development, the Office of Program Administration and Resource Management, the the Office of External Relations and Policy, which Tom Isaacs heads, and the Office of Systems Integration and Regulations, which Ralph Stein is the associate director for. The transportation program resides within that, within that office, within the Systems Integration and Transportation Division.

Under the transportation branch, we have two field offices that report directly to headquarters; the Chicago Operations and Idaho Operations. In addition to that, we work very closely with the Yucca Mountain Office Project and with the development of transportation activities within the State of Nevada.

Briefly, Chicago Operations has the lead in implementation of our institutional program, the economic and system studies and our operational program. DOE Idaho has essentially responsibilities for our cask systems development effort.

You'll be seeing a lot of faces over the next several days and a variety of contractors and this slide will help orient you as to which operations office that they report.

Under the Nevada office, the main contractor is SAIC; under Chicago, we have Battelle, Oak Ridge National Laboratories and Argonne National Laboratories; and under DOE Idaho, we have EG&G, Sandia and the cask contractors, which you'll be hearing about in a moment.

I'm going to run briefly through the four major elements of the transportation program. You can see cask systems development, economic and system studies, operations and institutional.

Let's talk for a moment about cask systems development. That's also broken into three components: cask design, cask system technology and testing.

The business plan that was published by the Department of Transportation several years ago identified four major cask development initiatives under which we will develop casks for the waste management system: from-reactor casks; from-MRS-to-repository casks; specialty cask development, which will be what we call cats and dogs. The from is intended for 75 to 85 percent of all fuel that we would move from the reactors. The specialty casks would cover everything else.

Besides the MRS casks, we'd also be developing defense high-level waste casks. Now, why are we developing new casks? As was mentioned earlier, there are a variety of existing casks out there -- not that many -- but the basic reason, as I mentioned earlier, why we're doing that is we want to increase cask capacity.

When we increase cask capacity, we decrease the number of shipments, we lower the overall transport risk and we also lower the total operating costs.

The opportunity we have to do this is essentially because the fuel, as I mentioned earlier, that we'll be picking up will be aged significantly beyond what casks are moving around today. Most of the time, the casks that are used today are used for five-year cooled fuel. We'll be moving at least 10- to 15-year cooled fuel.

When that occurs, you have decreases in the amount of heat generation from the casks and also the amount of radioactivity, which allows you again the opportunity to redesign and provide higher cask capacities within the same regulations.

DR. CARTER: Chris, when you're talking about increasing cask capacity, what are you talking about as a rule of thumb? Are you talking about 10 percent or 20 percent?

MR. KOUTS: Let's go to the next slide because that's what the next slide is going to cover.

If you look at some of the existing casks -- note the NLI 1 and 2, that means one PWR cask and --

MR. ISAACS: Assemblies.

MR. KOUTS: Assemblies, I should say, excuse me. Thank you, Tom. One PWR assembly or two BWR assemblies -- pressurized water reactor or boiler water reactor assemblies. What we're developing now within our casks is, for instance, the GA-4 or GA-9, which you'll be hearing about later, are four and nine. So we're talking about an increase of fourfold, and that means decreasing the amount of truck shipments that you would have to make by four, by a factor of four, which is fairly substantial.

The rail casks, you can see there is almost up to a fourfold increase in cask capacity there, also.

DR. CARTER: And the rail is going to be what percentage in general of the total?

MR. KOUTS: Right now, the modal split that we're looking at within the system is about 55 to 45 rail to truck by weight, which means we'll move 55 percent of the fuel right now by rail and 45 percent by truck, and we're refining that as we move closer.

We've just initiated an infrastructure study that's going to look at the transportation infrastructure outside the reactor sites, so we'll determine whether or not rail access is still viable from the reactor sites. Right now, our estimates are that 55 percent can be moved by rail. That may increase or decrease depending on, again, additional information.

DR. CARTER: I presume that's looking at the total system and those figures will vary considerably from site to site.

MR. KOUTS: That is correct.

MR. ISAACS: Rail is the transport of choice, but some reactors, it doesn't look like it's going to be practical.

DR. BARNARD: Chris, are there any differences in your assumptions about the age of the spent fuel between existing casks and the new casks?

MR. KOUTS: Well, typically, they are -- the casks' baskets, what go into these casks, will only allow a certain amount, anyway, so it doesn't make any difference what the burnup is.

Now, I will mention that for very high burnups that we're looking potentially in the system at the reactors and that we're beginning to use those cask capacities and that right now may be decreased. We're looking at that issue, but we expect still to get substantial increases in cask capacity, again, due to the fact that our fuel will -- that the fuel we'll be picking up will be substantially aged.

MR. ISAACS: It may be a useful

perspective to just mention that in the early days people thought we'd be reprocessing and the fuel would be shipped when it was quite new, right fresh out of the reactor and rather high in radioactivity and designed to accommodate that.

We're now looking at the first fuel perhaps being decades old. It's very possible. There is already fuel that's decades old in this country, so we want to take advantage of that.

DR. PRICE: Is there sufficient, reliable data on spent fuel configurations at this time in order to optimize cask design?

MR. KOUTS: We feel there is. We're getting more information all the time. You were at the RTCG meeting last month and you heard that the utilities essentially were concerned about that issue. Again, they provided some data and we're getting some more data from other sources that give us confidence that we can optimize for the cask designs that we're developing now.

Moving right along, if we can, going to the next slide, besides our cask development effort, basically through Sandia National Laboratories, we are looking at technical issues that can provide common benefits for our cask design program.

A variety of these are identified on the slide here. Take credit for reduced reactivity of spent fuel or the burnup that occurs within a reactor when we're looking at criticality calculations.

The next point is essentially to establish leakage rates using source term analysis and what we would expect within our casks. This can have a substantial impact on the leakage rates associated with the regulatory requirements that NRC is imposing on us.

We're looking at improving our structural and thermal analytical capabilities and we're also looking at a variety of cask materials that can be hopefully coded and used in cask designs in the future.

DR. PRICE: Chris, one issue, the cask weeping issue, sort of heard a lot of things about it; is it sufficiently resolved at this time?

Do we understand what is causing cask weeping in order to proceed and so forth? I heard things from a lot of different ideas about why, and is this resolved?

MR. KOUTS: It's not resolved as of yet. This is a concern that the Nuclear Regulatory

Commission has raised, but we have expectation that
it will be resolved. We're looking at that from a
basic research standpoint as to what the mechanism
is that causes cask weeping.

Maybe I should go over quickly what we're talking about when we say "cask weeping." After a cask is ready for transport, it's been fully loaded and a radiation survey has been done around the cask, and it leaves the facility, for some reason, when it arrives at the next facility, we've found that there is an additional amount of radioactivity that's found on the cask and emits from the cask.

The expectation here is that there is some kind of weeping phenomena associated either within the materials of the outside of the cask or some mechanism which causes that amount of radioactivity to increase. It's not a great deal, but it's still a concern. Transport is going on all the time and this is a technical issue that we feel can be dealt with and we are looking into it and we're looking at potential coatings or different types of materials that we could use in the casks to reduce this.

Again, we're trying to understand the mechanism, and then once we find out the mechanism, we'll try to find out the best way to deal with it.

It's something -- I don't consider it a major technical issue; I consider it really a minor one. It's something we are looking at along with the other technical issues that I mentioned up here.

DR. PRICE: But the new cask designs are not addressing that at this time because it's not ready to be addressed?

MR. KOUTS: Well, what we've tried to do in the cask program, within our cross-cutting issues, is instead of having five different contractors look at this issue, what we'll do is we'll turn Sandia National Laboratories on to it and let them look at it from a generic standpoint and the information they develop there can be applied to the rest of our cask designs. We feel that's a more efficient way of doing it than having five different organizations look at it. I think we're making progress in that area.

That was not one of the items that you identified as of interest to hear about, neither were any of these, but we could spend easily a day on all of these issues, but, again, these are other things that we're looking at within the program.

DR. PRICE: Is Sandia looking at cask

weeping, then?

MR. KOUTS: Yes, they are.

If we can move away from casks for a moment, which you'll be hearing a lot more about this morning, we do have an economic and systems analysis program, and that's basically our analytical arm of the program. That has to do with the development of our technical models, our systems analysis and also the support we provide to other areas of the program from a systems analysis standpoint.

Some of the things that we've done are to develop data bases and develop models to do our analyses. We've been collecting accident rates for rail and road type. We've looked at unit costs and risk factors and we're continually refining these as we move forward. We have a variety of models that we also use and we're always looking to upgrade those.

Some of the things we're doing right now, we're looking at analyses on dedicated trains and truck convoys. We're also looking at something that Dr. Price mentioned earlier, the effect of varying spent fuel characteristics and their impacts on cask capacity, and we're doing that in conjunction with our cask development program. So we're getting instantaneous feedback into our cask designs, if you will.

We've also completed a variety of special studies. In the most recent past, we completed a human factors analysis of our operational system, which we'll be talking about this afternoon a little bit. Also, as I mentioned earlier, we've initiated a near-site infrastructure study, which we've looking at the infrastructure around reactor sites.

Also, for the MRS analysis that was done by the department in support of some of the work that the MRS Review Commission is doing, we did do an analysis of looking at a variety of scenarios of an MRS within a system and the transportation impacts associated with that. That is a published report. It was a Task F Analysis of A through J study effort that was recently completed by the department. We also provided some input to a recent report on infrastructures within the State of Nevada.

One of the areas that we do have a great interest in is operational planning, to look at how we're going to go into the future and how we're going to move. The great amounts of spent fuel that we'll have -- I'd like to give you some perspective of the ramp-up that we're looking at.

Presently, probably less -- considerably less than 100 tons of spent fuel are moved within any one year. I think this year we have very little movement; in fact, in this country. We're talking specifically in this country.

When we're ready to move within the waste management system a maximum capacity, which could be to a repository, of 3,000 tons, you're looking at a ramp-up of 30 to 60 times the capability, and we feel that this is going to take a lot of planning and a lot of resource application to make sure that we do this effectively and efficient. So operational planning is definitely an important component of our program.

I should mention that not just 3,000 tons per year can be moved, but up to 6,000. If we're shipping 3,000 to an MRS and at the same time we're shipping 3,000 from an MRS to a repository, you're talking about moving 6,000 tons of fuel, and that's far in advance of what's been done in this country today.

To give you an idea of the amount of shipments that will have to be moved within the waste management system, we're looking probably over a 25-year period of about 25,000 shipments. The vast majority of those will be truck shipments; probably close to 23,000. So that's another reason why we want to try to optimize and increase our cask capacities, especially in the truck area, because that could have a substantial impact on the amount of shipments that we use.

If we were using existing casks, then you'd be looking at probably twice that number, twice the 23,000 and 25,000 figure. That's our present estimate for shipments and for movement of all fuel to the repository with the new cask capacities that we're developing.

If you're looking at the older cask capacities, then you could be looking at double that amount, which is another reason why we want to develop new and higher-capacity casks.

DR. VERINK: Is that consistent with your remark, Tom, that the preferred method is by rail?

MR. KOUTS: Yes, it is. We're only talking about 45 percent, again, of the fuel being moved by truck, but the truck casks are very efficient. The main problem you get into is if the reactor can only handle truck, you don't have much choice.

MR. ISAACS: My point was if you could do it by rail, you would do it by rail. In some cases, you don't have rail access.

MR. KOUTS: What we're doing right now in our planning -- in our systems planning and operational planning is we're trying to identify the functional analysis of all the different things we're going to have to do within the system.

We're analyzing the management structure that we're going to need. We're looking at the existing fleet to see whether or not we can use that to supplement what we are going to be using and we're, as I mentioned earlier, evaluating reactor site handling and loading capability.

We're also looking at carriage design, servicing and maintenance, field operations. Our operational input into our cask designs, we feel, is very important. We're also spending a lot of our time looking at what's going on out there right now, and we're certainly going to have a lot of interest in looking at how the WIPP facility progresses and the success that they have and potentially feeding off their success.

I'm not going to talk very much about our institutional programs because we plan to give you an overview of that on Wednesday. I should say that our plans for the institutional programs at this time are to try to deal with regional groups within the country as opposed to a state-by-state interaction. We feel that's more efficient and effective. We do most of our interactions with our regional groups which we have cooperative agreements with.

The slide that you're looking at now -- leave that up there for a second, Susan -- just identifies the many different ways that we use to try to communicate with the public and with representative groups of the public.

The next viewgraph will show you some of the cooperative agreements that we have with a variety of groups: the Southern States' Energy Board, the Western Interstate Energy Board, the Mid-West Office of the Council of State Governments. Those are three regional groups that make up three-quarters of the country.

We're looking to identify a northeastern group so we can have regional coverage and so we can bring those people in and educate them as to what we are doing.

There is also the National Congress of the American Indians, the National Conference of State Legislatures, the Commercial Vehicle Safety

Alliance, which you'll be hearing about on Wednesday, the CRCPD, the Council of Radiation Control Program Directors, and the American Association of State Highway and Transportation Officials. You'll be hearing more about this on Wednesday.

I'd like to close by giving you a general schedule for what our transportation activities are going to be over the next 15 years or so.

This year, we hope to complete our preliminary designs on from-reactor casks; we're going to continue to study the technical issues that I've identified earlier; we're going to be issuing a transportation plan, which we'll be talking about on Wednesday; we're doing systems studies and review modifications to risk methodologies, and you'll be hearing about that tomorrow morning.

In 1990, we'll be making a decision as to whether we will use overweight trucks or initiate the development of an overweight truck. We'll talk about that a little later this afternoon. We'll be hopefully completing the final decision of our from-reactor casks and we'll be developing and releasing the strategy for our requirements that I mentioned earlier. We'll be talking about that in more detail on Wednesday.

For '91 to '97, we'll support whatever EISs are done for waste management; we'll be submitting safety analysis reports to the NRC for our cask designs. There is a safety analysis over there on the table in case you're interested as to what they look like. We'll be making a determination as to what initiatives we need in our cask development plan. We'll finalize plans for our training assistance programs and initiate equipment acquisitions.

As we move to the '98 to 2002 time frame, we'll be finalizing our operational procedures, developing a limited shipping capability, if necessary, to deal with an early employment of the facility; identify a modal mix; we'll begin providing our training assistance to emergency response and we'll have our cask fleet fabricated.

In the year 2003, hopefully, we'll begin operations.

I would like to draw your attention to the tables around the room where you will see a variety of technical exhibits for your inspection during the breaks. Also, I'd like to draw your attention to a certificate of compliance that we recently received from the NRC on one of our casks. It's over on this table directly behind the board on my right. I think that might be of interest to you to show you what the NRC does when they focus in on the different elements of the cask designs.

Again, we'll be talking about some of these exhibits a little later, but I would encourage you to look at them during the break, and if you have any questions, we'll be happy to answer them.

I'd also like to mention that we'll be covering a very large amount of topics over the next three days. If you find the presentations too general, I'd like to apologize for that, but we do have the technical experts here to answer any probing questions that you may have. I feel we have a good program for you and what I'd like to do now is move right along with it.

MR. ISAACS: One message, do you have the details on this no-host reception so people are made aware?

MR. KOUTS: We do have a no-host reception
at 6:00 this evening. Susan, it's in what room?
Susan doesn't know.
MS. ARMSTRONG: Just down the hall. I'll

let you know later.

MR. KOUTS: We'll know later, but it will be from 6:00 to 7:00 and everyone is cordially invited to that.

I believe that's all I have to cover.

DR. CARTER: Let me ask you several questions. I'd like to come back to my original question now.

At one time DOE, for a number of years, not just at one time, but spread over a period of time, basically had its own standards and requirements, criteria and so forth for not only its casks but also transportation and went through a period where it was going to have things that would be equivalent to NRC, DOT and so forth, and now Congress has specifically said, "You shall do this and you shall do that."

Now, the question is, are there any inherent or important requirements that are not covered by 10 CFR 71,73 or 49 CFR 106-399 that DOE has, or can you say that we essentially will comply

with these NRC and DOE requirements or DOT
requirements?

MR. KOUTS: The historical perspective of the department is that although we've had our own

DOE Orders, if you will, which we followed, they very closely paralleled what the NRC and DOT have done, so there aren't really any substantial differences in the certification process.

DR. CARTER: But the perception of these is quite different.

MR. KOUTS: I understand. I think what we're moving to within the department -- again, our program is a little different from the rest of the department because we've been directed by Congress to comply with all applicable regulations, but the department in other programs is moving that way, anyway.

DR. CARTER: All right. Did you really mean that? You've been directed to comply with all applicable regulations, and that takes care of it, you don't have any of your own -- don't fit in, in other words?

MR. KOUTS: That's correct.

DR. CARTER: Okay. The other couple of questions I have -- one, what's the position now --

we talk like we're going to use rail in the future to a considerable extent.

Now, the past activities of the American railroads has been a stormy one as far as nuclear activities and nuclear transportation is concerned, involving, I guess, the management of the railroads, union issues and a number of other things.

Now, is there an agreement between DOE and the American railroads that they are going to, indeed, be involved in this, or is this just an assumption DOE is making that they will be involved, because in the past, like I say, it's been a very stormy relationship.

MR. KOUTS: I would agree with your characterization of the relationship. I think what you're looking at and what we've provided you are planning assumptions and they may change, and certainly when we get down to the point of shipment, if we're unable to negotiate with a specific railroad, that can provide us a problem.

We have every expectation, given the amount of time we have, that we can work out amicable arrangements with the variety of railroads which we'll have to use in the system.

DR. CARTER: These don't exist at the

moment? The assumption is made that you'll be successful in negotiation?

MR. KOUTS: That is correct.

DR. CARTER: Let me ask you another

question. Now, is there an association, like the American Railroad Association, that you deal with or do you have to deal specifically with each individual railroad?

MR. KOUTS: There are associations, but generally what happens is --

DR. CARTER: But they can act on behalf of the other railroads or their membership?

MR. KOUTS: Not really. You have to generally negotiate with the individual railroad that you want to use for the specific shipments that you want to use. There are certain railroads that are more obliging than others, and that's something that's been a historical perspective in this area.

We feel that we have awhile to work with the railroads on this subject and we're optimistic that we will be able to come to amicable agreements, but your characterization is correct, there has been somewhat of a disconnect there. The railroads have had concerns about the shipments, but they have been worked out.

Certainly, in the area of -- we are making TMI shipments and that was worked out. That wasn't the most amicable arrangement, but, again, it was something that was eventually worked out.

DR. CARTER: You've characterize this as you're going to eventually have to deal with a variety of railroads or a number of them. The expectation is that it can be done and it will be successful?

MR. KOUTS: That's correct.

DR. CARTER: So the climate, for some reason, is going to completely change from what it has been to what you envision it in the future?

MR. KOUTS: We're optimistic, working with them over a period of years, that we'll be able to work out agreements that would be useful. Again, there is no guarantee.

DR. CARTER: The other question I had, I know DOE keeps in contact with technical activities in other countries, and I was wondering if you could characterize at the moment what's been gleaned from either European and/or Japanese experience on the transportation/container side of used fuels and so forth?

MR. KOUTS: There is a great deal -- much more shipment of spent fuel internationally than there is within this country. One of the reasons for that is that they are still reprocessing abroad and that spent fuel is moved from reactors to reprocessing sites.

The experience there has been very good. I should mention that the NRC regulations are really patterned after IAEA regulations, so that the general environment on an international basis is very collegial as to how to move these materials around.

We'll be talking about that in a little bit. Marilyn Warrant, who will be up in a little while, will be talking about the relationship between the IAEA regulations and the NRC regulations.

Generally, the international experience has been very good with spent fuel.

DR. CARTER: I think that's real fortuitous. I think in the transportation, you've got a ready-made situation for international cooperation and the fact that there is commonality in the regulations.

DR. BARNARD: Chris, I have one question.

In your general schedule, you have different bullets that address the cask designs for from-reactor casks. In one of your previous slides, you mentioned from-MRS casks. Are the from-MRS casks different from the from-reactor casks?

MR. KOUTS: Yes, they are. First of all, we're developing rail and truck from-reactor casks. The rail casks that we'll be developing, we're developing right now from the from-reactor casks are about 100 tons in weight, but at an MRS, which would be one of our facilities, what we would look to is to have much heavier casks, potentially up to 150-ton casks. We want to maximize the capacity of those casks and do probably dedicated rail shipments from an MRS to the repository.

So the from-MRS cask would probably be a cousin, if you will, of our from-reactor rail casks, but a much larger version -- potentially a much larger version.

DR. BARNARD: Larger version and you'd probably be able to consolidate some of the -- you'd be able to put more spent fuel in them, is that right?

MR. KOUTS: Yes. The expectation is that they would have higher capacities.

DR. BARNARD: Simply because it was cooler, is that --

MR. KOUTS: It would be a larger cask, which would allow us have a larger diameter and so forth, which would have a larger cavity to put in the spent fuel.

DR. BARNARD: Okay.

DR. PRICE: Chris, what percentage or portion of sites presently, reactor sites, are presently served with rail service?

MR. KOUTS: I can't give you an exact answer on that. In fact, that's what our infrastructure study is attempting to do, and we only started that, I believe, last month.

Again, the general figure to be used at this time, I think it's 56 percent that we feel by weight can be moved by rail. I don't have the amount of reactor sites. We can give you our estimate at this time, but I don't have that figure at my fingertips. We can get that for you, though.

MR. CARLSON: Chris, that's based on utility reports.

MR. KOUTS: Right. Thank you, Jim. There is a report that we -- a survey, if you will -- that we do every year, and it's called an RW-859 Survey, that all the reactor sites give us information on. We base what we know right now on what the reactors provide us.

What we're doing with the infrastructure study is actually going out to the sites and seeing whether or not that rail spur is still there, whether or not it's serviceable and also looking at the potential for rail abandonments in the future for that area.

DR. PRICE: That was going to be a question I wanted to ask. Have you had experience with rail abandonments to reactor sites at this time?

MR. KOUTS: We have, and that's why we've initiated this study, so we can get a better handle on that.

The following question to that is, what do we do about it? That's an issue, I think, that we'll reach after we've gathered all the data and find out what the universe says.

Are there any other questions that you'd like to ask at this time?

DR. RAJ: My question is, are we concerned with intermodal shipments at all?

MR. KOUTS: Yes, we are, but only from the standpoint that our rail casks are also rail-barge casks. So if, indeed, a reactor -- and I can think of the Virginia Slurry Station as one where you could heavy haul to a local barge site, put it there, take it to the Port Hampton yards and then put it on a railcar.

We're also looking at -- we've done some studies at taking truck casks and putting them on flat cars at a nearby rail spur. We are looking at that and that's some of the systems analyses that we're doing right now.

Right now, we're waiting for more data and this infrastructure study will provide a lot more so we can hone in a little bit more.

I'd like to move on to the next point of the program which would be to talk about our cask development effort. I'm going to give you a brief overview and give you some of the different objectives that we have: safety, higher efficiency, greater payload and public acceptance. This is something that's very important to our program.

I've already mentioned the fact that we have four initiatives that you're going to be hearing about. I've already mentioned that we're going to have our casks certified.

Other overall philosophy within the cask development program is to utilize, as you heard earlier, private industry to the maximum extent practicable. We've gone out and we've got five contracts underway with some of the best cask designers in the business in this country.

What we've told them to do is go forth and design casks, but we've not tried to tell them how to do it. We have given them general guidelines; for instance, the amount of fuel that we want and the different types of fuel that we want covered within this procurement. We've also asked them if they can provide some innovation, new innovation, to cask development. I think you'll hear some of that today.

The players that we have in this are EG&G, who is the main support contractor to DOE Idaho; Sandia National Labs and the cask contractors.

Our general plan is to have these available by 1998 to support any shipments that we may have in that time frame. I mentioned that we're also developing technology that's generic to all of them. Also, we're also very closely interacting with our operational and our institutional programs on getting public acceptance and also getting operational input to these designs.

I'd like to talk for a moment about one of, I think, the unique features associated with our cask program, is that we do have a technical review group of about 47 to 50 people -- is that correct, about -- Ira, about --

MR. HALL: Yes.

MR. KOUTS: -- of experts from around the country who are teamed to essentially evaluate the contracts at every stage of development.

We're coming up at the end of preliminary design, there are teams identified, and they will be providing additional review of these cask designs.

The various disciplines that are associated in this area are structural, criticality evaluation, shielding, ALARA -- that's a buzz word for as low as reasonably achievable, to get it down to as low as we can possibly get; certainly a lot of input to cask handling, materials, thermal analysis, operational input, quality and, of course, safety.

DR. PRICE: May I ask, out of the membership in these 47 to 50 people, is systems safety, as such, represented? Safety in general being a rather broad general term, but is systems safety represented and are there people on this technical review group who are human factors people by profession?

MR. KOUTS: Not by profession. We
feel we have -- we have some human factors input
from our operational program, but we do not have
dedicated human factors individuals on that
group.

DR. PRICE: Are these people independent
people in the groups or are these employees of DOE
or how --

MR. KOUTS: No, they are independent.

Ira, would you like to comment on that,
Ira Hall?

MR. HALL: They are not DOE folks; they
are subcontractors to DOE. Most of them are prime
contractors who do not have outside consultants, if
that's the question you're asking. They are
comprised of subcontractors to the Department of
Energy.

DR. PRICE: But these are contractors
other than the contractor being looked at?

MR. KOUTS: That's correct.

MR. HALL: There are no cask contractor

personnel and they are not directly involved in the
day-to-day operations or the design aspects of the
casks. They are independent of that effort.
          MR. KOUTS: One of the things you'll be

hearing me say over the next three days is that we're a little bit behind schedule and we'd like to move right along.

I'd like to now introduce Mr. Mark Pellechi from our Idaho Operations, who will give us a status report on where we are on our cask procurement.

He'll be identifying and introducing other people associated with the presentation this morning.

MR. PELLECHI: Thank you, Chris. Good morning.

This morning what we'd like to do is discuss a number of items related to the cask systems development program. I will be covering the status of the program and giving a very brief overview of that.

I will then be followed by Dr. Marilyn Warrant of Sandia, who will be discussing the regulations, codes and standards by which the implementation program is operating. Dr. Darrough will also be discussing the cask testing program that the cask contractors will be initiating and provide an overview of that process.

Her talk will then be followed by Ira

Hall; and Ira Hall, as Chris introduced, is the manager of the Spent Fuel Technologies at EG&G and will be discussing cask development and fabrication and also the transporter status.

To give you some perspective, I wanted to go back and just mention that back in 1986, the Department of Energy had issued the request for proposals and it outlined the criteria by which these new casks should be developed. Chris had mentioned that we did not tell them how to build it, but we gave them design criteria to which to build.

The contracts themselves were awarded in 1988, from the February through July time period. Five cask contractors were selected. Two designs were essentially selected to be pursued. One is termed the legal weight truck, and Ira Hall will be discussing what the implications of the term legal weight truck means.

The contractors are General Atomics in California and Westinghouse in Pennsylvania. The rail-barge cask designs are being pursued by three other cask contractors, as you noted and can see on the screen, and that is B&W in Virginia, the Nuclear Assurance Corporation in Atlanta, Georgia, and also

Nuclear Packaging in Seattle.

The time frame for the development of these contractors are very similar, whether it's rail, barge or the legal weight truck. It takes approximately one year to perform the preliminary design phase. This would include the development of the project management development phase. In the design phase, there is a review period and the period that we're coming into now. We then proceed with final design, which also takes about one year.

Once the cask contractors have completed final design and approval has been given by the department, they begin the development of what's termed the safety analysis report. This report essentially covers all aspects of cask design and is submitted along with an application to the NRC for certification of that design. The certification process is estimated to take approximately two years.

Currently, all the cask contractors have NRC- and DOE-approved QA programs. They have, in fact, completed this prerequisite documentation that I mentioned. We wanted to get the cask contractors on board as to how they were going to run their program and before the beginning of preliminary design.

DR. PRICE: Mark, could I ask, has anyone ever been turned down for their application for a QA program?

MR. PELLECHI: The answer to the question being have they been turned down, to the best of my knowledge, the answer is no. They all have had programs submitted, comments resolved with the NRC, but turned down, the answer I believe is no.

DR. CARTER: Are there any significant differences between NRC and DOE-ID QA requirements?

MR. PELLECHI: When you say the term "significant," do we place any additional criteria on the cask contractors, and this is an area where we have looked at the NRC requirements for QA, the NQA-1, if you're familiar with that, we have developed our program as to how that will be implemented and have discussed that with the NRC, so I think to directly answer the question, I understand it does not go beyond the NRC requirements. It reflects our understanding of how to implement those requirements.

DR. CARTER: So you've accepted those essentially and that's what's involved, so it's not two separate things, in essence?

MR. PELLECHI: The answer is true. That's correct.

As I mentioned, all are currently in preliminary design. In fact, we're coming to the end of preliminary design, and in the next two months, we'll have all preliminary design packages into DOE Idaho, at which time the review process will begin. It is our expectation that following the review, we can begin the final decision in fiscal year 1990.

The schedule that is now being shown on the screen here is to give you a time frame and a reference by which we're doing this. We mentioned it takes about a year for preliminary design; we're at the end of that. We can also see then the process by which we will have the testing and fabrication done in the calendar year of '96 through '98.

Dr. Warrant will be talking more about that phase later on. I'd like to introduce her now and remind the audience that she'll be discussing first the regulations, codes and standards for cask design.

DR. PRICE: Could I ask you about your cask certification period, the two years? Is that based on your experience in trying to obtain certification or where does that two-year figure come from?

MR. KOUTS: Essentially, in answer to your question, it comes from experience. Sometimes the period can be shorter, sometimes longer, depending on what technical issues the NRC identifies. Our expectation is that it should be about a two-year period.

We're working directly with the NRC right now. We do have meetings with the NRC. All the cask contractors are keeping the NRC apprised of our designs and we're trying to identify technical issues as the NRC raises them. So we feel still that even with that effort, because many of the designs that we're developing are somewhat innovative, that a two-year period is probably a reasonable estimate.

DR. PRICE: What is the longest it has ever taken?

MR. KOUTS: One estimate that I've seen,

it's taken over three years. In some, it's taken a few months. For instance, the TN-BRP cask, that there is a certificate of compliance over there for, I believe that took about four months, but again that was a cask that had been certified prior and there were some modifications being made.

So it all depends again on the nature of the design, whether the NRC gets technical with it and if any technical issues are raised during the certification process.

DR. WARRANT: If I may add a comment to that, through the question process, the NRC can always ask more and more questions if they are not satisfied, and I believe there have been some cask designs that have gone in for certification and have been withdrawn because they felt they couldn't satisfactorily answer the questions they were asked. So it certainly isn't a given that if you apply, you will get a certificate.

DR. PRICE: I see.

DR. WARRANT: We're adjusting the lights to make this a little easier to see. The regulations, codes and standards that I will be focusing on in this presentation have to do with cask design and analysis. There will be other

presentations later that will get into the
applications of regulations, codes and standards to
other aspects, such as fabrication or actual
transport of the casks.

Throughout this presentation, as well as the next one, which focuses on cask testing, I'll be using this viewgraph as kind of a road map to take you through the general process for developing a spent fuel cask.

Chris already introduced the concept of transportation regulations and some of how they fit together. The International Atomic Energy Agency develops model regulations for transport of radioactive materials. The Department of Transportation is the US agency that has primary responsibility for all hazardous materials transport.

Through a Memorandum of Understanding, the NRC, the Nuclear Regulatory Commission, develops or evaluates and certifies designs for shipping casks, and the Department of Transportation, as Chris said, does regulations and implements requirements for vehicles and their drivers.

The regulations have quite a long history. The first regulations for radioactive materials were published as early as 1947 and the first version of 10 CFR 71, which deals with fissile materials, was published in 1958.

DR. CARTER: Let me ask you before you

move that slide, are the arrows -- arrowheads left off in some cases on purpose? For example, I presume there is a close interrelationship between NRC and DOT, but your arrow only goes one way. I just wondered if there was a reason.

DR. WARRANT: Well, the arrow goes that way because the Department of Energy -- excuse me, the Department of Transportation is what's called the competent authority for the United States for transporting radioactive materials. It's a competent authority, as are other competent authorities designated in other countries.

So as far as the international community is concerned, the Department of Transportation is the governing agency in the United States.

The arrows go both ways between the International Atomic Energy Agency, the IAEA, and the NRC because -- and also between the Department of Transportation because in the development of these model regulations, there is also US participation, so we're a member nation like many other member nations.

DR. CARTER: So there is a basic difference between the lines, in essence?

DR. WARRANT: Yes.

DR. PRICE: But is there any interaction between the Department of Energy and DOT, for example, in the area of special studies, because radioactive materials only is a small part of the hazardous materials transportation topic, and perhaps because some of the studies that DOT might be doing might be of benefit to DOE, does DOE have any kind of interaction or input to DOT?

MR. KOUTS: We do interact with DOT on a variety of levels. I think what the diagram shows here to the DOE and also to the NRC is that the regulatory authority for packaging is essentially ceded by the DOT to the NRC. In the area of other shipments and defense shipments and so forth, the Department of Transportation cedes some of that to the defense area of the Department of Energy.

DR. PRICE: So this is strictly a regulatory cycling at this point?

MR. KOUTS: Right. That's correct.

DR. WARRANT: The basic regulatory philosophy of transportation regulations is that the packaging provides the primary protection. The form and structure of the fuel, in the case of spent fuel, also provides secondary protection.

The goal of the regulations is to maintain low risk from transport regardless of what the contents are. The regulations specify performance requirements for the packaging; packaging being in this case a spent fuel cask.

Engineering criteria are developed that simulate the damage of transportation accidents or the normal conditions of transport, and these engineering criteria are used in the analyses to demonstrate safety. Excuse me, package testing can also be used along with analysis in the safety demonstration.

The performance requirements are primarily based on the radiation hazards of the material, and they include containment of the radioactive material, control of the radiation emitted by the contents, and another objective, of course, is to maintain subcriticality.

DR. CARTER: Let me ask you about the first one there. You say packaging requirements are proportional to risk, and I presume that's risk to external exposure of personnel --

DR. WARRANT: It's --

DR. CARTER: -- either public nearby or individuals, and not necessarily the risk involved with the loss of integrity, or are you talking about both?

DR. WARRANT: I'm talking about all of those, yes. The risk involved from the radiation emitted from the package, the risk that would happen if you released any of the contents.

DR. CARTER: Normally, I would think if these are designed and fabricated to take care of the risks from an external standpoint, they might be sufficient for loss of integrity. That's not true?

DR. WARRANT: The loss of integrity gets into different design requirements than does shielding, so they end up being different things.

DR. CARTER: Okay. So you could have two entirely different risks here?

MR. ISAACS: Through normal transport and during accident conditions.

DR. WARRANT: We'll be talking a lot more about risks later. I'm certainly not an expert.

DR. CARTER: I'm talking about the

external sides versus the release of materials.

DR. WARRANT: There certainly would be different health effects from those different kinds of radiation sources.

DR. CARTER: Yes, I understand.

DR. WARRANT: The next few viewgraphs will go through in a schematic sense what the performance requirements are.

Containment requirement is based on containing the radioactive material -- in this case, the spent fuel -- inside the cask containment boundary. The cask containment boundary is typically a metal shell and includes the cask lid and seals and any other penetrations that allow access to the interior of the cask.

This diagram shows the impact limiters which protect the cask body and the containment boundary from impacts that have to be considered as part of a hypothetical accident condition.

Now, the performance requirement is that there can be no release of radioactive material under normal transport conditions measured to a stated sensitivity. Now, the stated sensitivity has to do with what's called an A2 value, which is defined in terms of the relative hazard of a given isotope. The basis for these A2 values is contained in a publication of the IAEA called, "Safety Series 7." For accident conditions, there is a limit on the release that could occur.

The shielding performance requirement deals with the radiation that can be emitted from the spent fuel -- the alpha, beta, gamma radiation. Typically, there are two different kinds of shields because you're shielding against different types of radiation.

By the way, there are also neutrons emitted by this. So the gamma shield takes care of the alpha, beta and gamma emissions; the neutron shield takes care of the neutron emissions emitted by the spent fuel, or at least reduces their amount or their dose rate to acceptable levels.

DR. CARTER: Two things about that. Obviously, if you've got a gamma shield there, I don't think you need to concern yourself about alpha and beta.

DR. WARRANT: You're correct.

DR. CARTER: Why doesn't your neutron shielding include coverage of the whole container? In fact, the way your thing is drawn, from the gamma shield standpoint, it would look like to me that you need neutron shielding more to the left than you do the top and bottom.

DR. WARRANT: Each cask designer has to do an analysis of his design. This is merely a schematic, but the --

DR. CARTER: That looks misleading to me.

DR. WARRANT: Well, like I said, each cask designer will have to do an analysis of his shielding to demonstrate that the shielding he has is adequate for the object's content's transport. You're right, that may be a little misleading.

The performance requirements that must be met -- the whole idea of shielding is to limit the external exposure to people that can be around the cask. The limit for normal transport is 200 millirem per hour at the surface of the cask, and that includes both gamma and neutron.

DR. CARTER: Does that include the impact limiters? Is it measured external to those, at the surface of those?

DR. WARRANT: This is the surface anywhere around the cask.

DR. CARTER: But is it with the impact limiter on? Because I presume these have a substantial thickness to them, so you're measuring at the surface of the cask, per se, or are you measuring at the surface of the limiter?

DR. WARRANT: This is a transport

requirement, so it's measured with however the cask is assembled for transports, usually with impact limiters.

DR. CARTER: Whatever surface you can monitor, in essence?

DR. WARRANT: That's right, but you have to go all the way around the cask in determining whether it meets this limit.

There is another limit that is measured at two meters from the cask that gets out some of the more penetrating radiations, and the limit there is 10 millirem per hour.

There is a separate limit for accident conditions, and that is one rem per hour at one meter from the surface.

There are also DOT requirements that have to be met involving the dose rate to a person in the occupied location, say, of the truck.

DR. CARTER: In essence, you've got a time limit on the latter?

MR. KOUTS: That's correct.

DR. CARTER: That implies they could sit there for a long time, but I don't think that's the intent or would be allowed.

DR. WARRANT: Well, this is just the way

the dose rate is expressed.

DR. CARTER: But there must be a limit to what people can receive.

DR. WARRANT: Right.

DR. CARTER: That's the proof of the pudding.

DR. WARRANT: There are occupational exposure limits set for the people involved, yes.

Then the third major performance requirement has to do with criticality. There are different ways of maintaining a subcritical configuration in spent fuel casks.

One of them is to use acceptable geometry of the spent fuel in the basket. Another is to use what are called poisons in the basket that act as neutron absorbers. Then a third option is to exclude moderator materials, such as water, from the cask cavity and, of course, various combinations of these can also be used.

The performance requirement, rather

graphically, is that there can be no criticality event.

In your package as an additional viewgraph -- there is an additional viewgraph in your package that lists these performance requirements. An additional one has to do with heat dissipation, but that is typically not a major design problem, at least not in the same sense as the performance requirements having to do with radiation.

There are a series of test conditions that have to be satisfied. By "test conditions," I don't mean physical testing necessarily, but conditions that have to be analyzed or tested for. There are separate ones for normal conditions of transport and for accident conditions.

The normal conditions of transport are defined for reasonably expected ranges in temperature, pressure and vibration that could be encountered during transport over the road or by rail and various rough-handling considerations.

For accident conditions, there are a series of three events that have to be considered in sequence: an impact test, a puncture test and a fire test.

The impact test is from a drop of from 30 feet onto an unyielding surface at an orientation that would cause maximum damage. The puncture test is a drop of 40 inches onto a six-inch diameter, mild steel, puncture bar; once again, at the worst orientation. Then the third test in sequence is an exposure to a fully engulfing thermal environment of 1,475 degrees Fahrenheit for 30 minutes, and this is a transient thermal event.

So in the fire environment, the cask is at some of initial condition, the fire environment starts impacting it and then the effect on the cask has to be evaluated after 30 minutes of exposure to that environment.

There is a separate immersion test conducted on either the same package that was used here or a separate, undamaged one, and that is immersion under 50 feet equivalent of water for eight hours. This is usually taken care of by analysis of the pressure that would be induced by that 50 feet of water.

DR. PRICE: Could you comment on the rationale for that particular sequence of events and those three tests? For example, why is it that the fire is before the puncture?

DR. WARRANT: Well, actually, it usually

goes the other way around in that the puncture test, it doesn't show in this particular example, but one puncture test that's usually conducted is on one of the impact limiters, or very close to the seal of, say, the front impact limiter, and that damage of the impact limiter close to the seal makes the cask more vulnerable in the fire test.

DR. PRICE: Has it been done the other way around, or do you know what the results would be if you did the fire test first as far as the vulnerability of the puncture test?

DR. WARRANT: My personal opinion, and I don't know whether it's been done, but my personal opinion is that this is the most damaging sequence because the impact limiters, which not only protect the cask on impact but also insulate closure, are damaged through the impact and puncture test and leave the cask more vulnerable to seal failure in a fire. If someone else would care to respond that, feel free.

MR. ISAACS: It's my understanding, also -- I'm not quite sure about this -- that it also translates into the sequence in which one might expect an actual accident to occur; an impact which could have with it a puncture event, followed by a fire. It's less likely that you have a fire and then the thing would somehow be impacted.

DR. PRICE: I guess you could argue that a fire might cause a release which could result in a puncture, a release of the cask from its tiedowns.

MR. ISAACS: It's possible.

DR. PRICE: Yes.

DR. CARTER: Let me ask you two questions; one on the immersion test. It seemed to me at one time the immersion depth was a lot less than 50 feet, is that correct?

DR. WARRANT: There is a separate test that can be analyzed for following the fire, but if the criticality analysis considers ingress of water, that test does not have to be considered, and that's usually the approach that cask designers use when they are analyzing for transport of fissile material.

DR. CARTER: So there is some flexibility in this?

DR. WARRANT: Well, I believe the regulators felt that if the criticality analysis included ingress of water, that the last test was superfluous and that would be added on after the fire test.

DR. CARTER: Okay. The other question is, why aren't these things designed for crushing?

DR. WARRANT: There is a crush test that is being added or is included in the proposed changes to the NRC regulations, but the crush test tends to be only more -- a crush test would tend to be more damaging than the series of impact and puncture tests only for very light-weight packages, and that's not the case for the spent fuel.

DR. PRICE: Well, would you not have a more severe -- maybe I don't understand something here -- a more severe crush test, say, if you had, say, a train with more than a 100-ton cask on it and, for some reason, one of those sheared and impacted the other?

Wouldn't you be talking about a crush of greater force simply because it's heavy?

DR. WARRANT: I think we're talking about two different things. The crush test, as proposed in the regulations, deals with, say, a number of things being -- or ways in which there is external pressure applied to the package that would crush it.

In the case that you're talking about of a package running into it or a spent fuel cask running into something, this 30-foot drop onto an unyielding surface is considered to be a bounding accident condition, even when you consider impacts of various casks onto each other.

MR. KOUTS: Recently, the NRC was asked the same question and their perspective was that in an accident with these casks, which were very substantial, that they generally end up as the crusher as opposed to the crushee in an accident since they are so substantial.

DR. PRICE: But if you had more than one cask per train, then the crusher would also -- there would be a receiver which would become the crushee.

MR. KOUTS: There is a potential for that. There is a potential for that. The NRC, from their perspective, doesn't think that it's worth an additional regulatory requirement for these types of packages.

We're talking about an environment again where we're essentially complying with the regulations. The NRC essentially sets them, and it might be more useful to the board if you have these types of questions to perhaps have a session with the NRC and ask them their regulatory philosophy in these areas.

We can give you our perspective of what their philosophy is, but we can't speak for them.

DR. CARTER: I realized when I asked the

question that this is not your bailiwick, but I'm just curious.

I would assume that if you were transporting these by rail, there certainly is a possibility that one of these could fall on another one, for example, or some distance, whether it's five feet or ten feet, and I just was curious why they had never considered that, or if they had considered it and assumed that it was no problem and that these were essentially -- if it could pass these, then you were home free, and I presume that's what occurred, but I don't know.

MR. KOUTS: I think it would be useful reading for the board -- there is a report which we are going to mention called, "The NRC Modal Study," where the NRC did an analysis of their regulations in relation to the historical perspective of transportation accidents and how they view the different accidents that potentially can occur out in the real world, and I think that report would be very useful to you and perhaps a session with the

NRC would also be useful.

DR. RAJ: This brings up an interesting
question. Are the regulations the same as those of
the International Atomic Energy Agency model

regulations? If not, what are the principal differences? Are these from the IAEA?

DR. WARRANT: The requirements shown here are consistent with the IAEA requirements. There are minor differences in the requirements, but not these.

DR. RAJ: The US conditions could be quite different from what's in Europe, especially regarding rail transport, and if it's an adoption of IAEA, there is a considerable difference in the transportation of this. Why were they not considered?

For example, the sizes of flammable materials carried on US railroads are much larger than in Europe, so the fire situation could be considerably different.

MR. KOUTS: In many cases, it goes the other way, that IAEA adopts what we do in this country, and the historical perspective I think around the world is that our regulations are very, very stringent. So in many cases, you may be asking yourself why IAEA isn't adopting NRC regulations as opposed to why NRC isn't adopting IAEA.

DR. WARRANT: I might add that in the next presentation on testing, I'll be describing this unyielding target and it may become more graphic to you when you see how massive it is as required by the regulations.

In analyses, of course, you can build into the analysis the effect of the impact and a yielding target.

As I mentioned, the tests have to be conducted or analyzed for various orientations and one has to evaluate the worst-case orientation or event. The examples shown here are typical orientations considered for the 30-foot drop test, end drop, side drop, center of gravity over a corner or slap down, which is an initial impact onto a shallow angle and a secondary impact then onto the closure in the cask.

We've gone through some discussion with the board on some of the questions concerning current regulatory performance tests. These have been raised from time to time throughout the years. The questions usually deal with whether the regulatory conditions are really connected to actual accident conditions or are they bounding for actual real-world conditions.

The NRC has made their own assessments of the safety provided by the transport regulations, and these have been documented in a number of reports and also in 10 CFR 51.

The conclusions of these reports have been that transport of radioactive materials in compliance with the regulations is a safe process.

The latest report that Chris just mentioned that is collegially called, "The Modal Study," concluded that the risk calculated in earlier studies was -- they calculated the risk of transport, which was only about one-third the value reported in some of these earlier studies.

So the general consensus of opinion here is that radioactive materials transport, when it's controlled by the regulations, is safe.

DOE's view of the safety provided by the regulations is generally the same; that the NRC regulations, which are based on international regulations, have the consensus of the whole international community behind them with their experience and technical abilities.

The regulations are an integral part of

OCRWM's efforts to develop safe casks. In addition, as Chris mentioned, DOE/OCRWM performs independent technical assessments of cask safety through the technical review, and Ira will be talking perhaps a little more about that later, but Chris gave you a good general review of what's involved in that process.

DR. PRICE: Does DOE have an expressed opinion about things we hear about, blow torch conditions and the direction of the flame, whether it's concentrated in one small place versus distributed over the whole cask as, I think, the 1,475 degree Fahrenheit tests are done? Do you have any comments on that?

MR. KOUTS: This is something that's come up recently. There is a certain perspective that if a very specific thermal environment was provided to one of the casks, that there is a great deal of heat transfer that goes -- that this is a large heat, so it would be distributed very rapidly. That is something that hasn't been analyzed at length. I don't think we have a formal position on that yet.

Again, you're getting into a regulatory question here and it's really more appropriate to ask the NRC as to what their view will be in terms of a blow torch being provided to a cask and how they view that vis-a-vis their regulations.

At this point, we haven't done any analysis to really have an opinion. There is some speculation. Again, you have to ask yourself how long it was there and where on the cask it was and so forth, but we don't have a formal position on that as of yet.

DR. PRICE: Is this being investigated by NRC? How long could be a long time if you had an LP rupture right beside a cask or something like that, that could provide a blow torch over a long period of time.

MR. KOUTS: I don't have any idea as to what NRC is doing in this area. Again, that might be a good question to ask in a meeting with the NRC, ask them what their perspective is on this issue.

MR. COONS: Is there any rationale for the 1,475 degrees? Higher? Lower?

MR. KOUTS: Well, the 1,475 degrees -- and there is some confusion about this -- the thermal environment is 1,475 F, but you have to understand that in order to attain that, the actual flame temperature would have to be substantially higher, probably around the 1,800 degree area, to have a totally engulfing thermal environment. The perspective as to how you get that generally is that, obviously, there is some kind of tanker car rupture and the cask is somehow caught up in that.

MR. COONS: So you're indicating that the surface of the container itself would be at 1,475 throughout? Is that what you're saying?

DR. WARRANT: That's the thermal environment applied to the cask.

MR. KOUTS: Right.

DR. RAJ: Just for the record, I would like to say that the time limit is much more severe than the NRC requirements. It calls for 1,600 degrees for 100-minute exposure for a tank car, which is not as well protected as the casks, of course.

The second thing is I don't think I agree with you on this issue of the flame is 1,800, but only the thermal environment is 1,475. I couldn't understand how that is possible when you expose it.

Finally, there is a recent report by the DOT which has looked at all past accidents involving flammable material releases and finds that there are instances where the durations of fires have been as long as two hours at 1,600 F or more, actually.

MR. KOUTS: Again, you have to ask yourself the question whether or not the cask would be in the middle of that for a two-hour period or whether or not the fire would move to the various portions.

I think the perspective of the regulations is that the fire is not necessarily in one area, but there will be movement on it from place to place. So whether or not there would be a -- whether the cask would be in the middle of that is another issue, I think, that has to be looked at again by the regulators.

DR. RAJ: That depends on the contents and so on and so forth, but from a safety perspective, there is a possibility of something happening that one should consider that in the design stage.

MR. KOUTS: I think, again, that you're asking questions of the regulator and we are not the regulator. I think that the perspective we have is that if there are regulatory issues associated with regulations, that they need to be raised with the NRC and the NRC needs to dispose of them. If the NRC chooses at that point to modify the regulation, then our cask would be modified.

DR. PRICE: I want to comment that I think the questions are appropriate since your slide is on your view of the safety regulations, so we're asking what your view is.

DR. WARRANT: I might add that one purpose of the modal study that we just talked about was an assessment by the NRC and their contractor whether separate regulations were needed for a rail transport versus highway transport, and their conclusion was that no, they weren't.

Regulatory practice of the transport regulations is established by a number of different ways: regulations themselves, of course; regulatory guides that are published by the NRC; NUREG documents, which are reports that may be generated by contractors to the NRC; there are precedents of previous cask designs and certification actions; standards, which are developed by a number of different organizations, the primary ones being American Society for Testing and Materials, ASTM, or the umbrella organization, ANSI, American National Standards Institute, and under ANSI are other standards organizations such as ASME, American Nuclear Society and many others.

DR. CARTER: By the way, NUREG documents can also be prepared by NRC itself, they don't have to be contractor documents.

DR. WARRANT: Correct. They are usually

designated NUREG reports or NUREG/CR if they are developed by contractors.

DR. BARNARD: Marilyn, how about past accidents? Have there been any past accidents? We do ship 100 tons a year, I guess that's what Chris said.

MR. KOUTS: We are going to be talking about the accident history when we get through the operational aspects, but there have been past accidents and there is some history on it.

DR. BARNARD: Okay.

DR. WARRANT: Analyses appear in the design process in two generally different ways. Analyses are used at the beginning of the process and preliminary design to determine basic cask parameters, such as wall thickness, impact limiter strength or bolt size. Then as the design progresses, detailed confirmatory analyses are conducted that simulate cask response to normal and hypothetical accident conditions.

During the design process, the regulations and codes and standards are implemented in cask design by use of design guidelines, analyses of the design by validated computer codes and then verification of design analyses with test data where deemed appropriate.

ASTM specifications are used in selecting materials and they provide assurance of a stated level of material quality. They include fabrication guidelines, minimum physical and mechanical properties of materials and require testing to demonstrate that the minimum properties are met.

The ASME boiler and pressure vessel code, Section III, is an integral part of cask design. It provides general design guidelines for containment vessels, specifies maximum allowable stresses for materials according to how they are used in the design and, once again, defines qualification tests of fabricated materials.

Another set of standards that are also typically used in cask design have been developed by a committee called ANSI N 14, which has a number of different standards that they've developed for equipment, testing or environmental conditions.

Probably the most common ones used in cask design are the ones for leakage testing and the shock and vibration environment, as used in fatigue analysis.

DR. CARTER: Does DOE directly have membership on a number of these committees, or is it primarily contractor organizations?

DR. WARRANT: I can't answer for DOE, but I do know that we at Sandia participate on a number of these committees. The ASME pressure vessel codes, some of their subcommittees, I'm a member of ANSI N 14, and there are a number of other people that participate on this.

General standards organizations are for everyone that sets the standards within the technical community. DOE also has membership on ANSI N 14, probably many other standards organizations.

The analysis -- say, a structural analysis -- will create a mathematical model that gives a geometric representation of what happens to a cask design under, say, the 30-foot drop test.

Before a code like this is used in an analysis, it's validated through a benchmarking process. Benchmarking involves or can involve a number of different processes. One way to benchmark a code is to compare the results of the code with an analytical solution for where the answer is known. Another way is to compare the code results with experimental data. On occasion, where neither of the first two avenues are available, the results of the code are compared with results of other codes that themselves have been benchmarked and it's a consensus of different numerical solutions.

The benchmarking process not only validates the code, but also tests the user of the code, which can be a very important aspect in design. The NRC has gotten kind of nervous sometimes about certain codes because they are not convinced that the users of the codes use them correctly and so the benchmarking exercise can relieve some of that concern.

DR. PRICE: Do any of the new cask designs require additional benchmarking of the codes?

DR. WARRANT: I don't know the answer to that. Ira?

MR. HALL: There are some codes that the cask contractors will be using in application to the casks which they have not done before, and those will be part of benchmarking. There are a couple of instances where they have developed scoping structural analyses codes which will have to be benchmarked.

There is a program in place where the verification, validation of these codes is required in the quality assurance program.

DR. WARRANT: All of these analyses, plus any testing that's performed, are put together into the safety analysis report for packaging that Chris mentioned.

The safety analysis report includes sections on description of the transport package, of all the analyses and test data for the structural, thermal, containment, shielding and criticality control aspects of the cask. There are sections on acceptance tests and maintenance programs for ensuring that the casks will continue to meet the performance requirements, and then the quality assurance apply both to the cask design and to its fabrication.

The safety analysis report is submitted to the NRC for review and approval and, if approved, a certificate of compliance is issued that authorizes use of the cask designed for transport.

That concludes this part of my discussion and I think it's time for a break.

MR. KOUTS: If there are no other

questions, we are running behind, so I'd like to take about a ten-minute break and pick up after that, so if you could get back in ten minutes.

(Recess held.)

DR. DEERE: If I may take time while we're finishing our coffee and getting seated here, I'd like to ask Bill Coons to introduce some of our staff and consultants, as they are participating in some of the questioning and you'd like to know who they are.

MR. COONS: I apologize for not doing this earlier to those members of the panel, my colleagues and those in the audience, but from my left down here, the last gentleman is Dr. Bill Barnard. He is from the Office of Technology Assessment, Congress of the United States. Under the terms of our, I guess, establishment by law, we are able to request assistance from OTA, and Bill is 50 percent helping us out and a marvelous asset.

The next gentleman down here is Dr. Russ McFarland. Russ has been with the Underground Technology Development, a consulting firm, and has been a geotechnical engineer and consultant, and as of last Friday, is now going to be one of our permanent, professional staff in our Washington office.

Seated immediately adjacent to me is Dr. Phani Raj, who is president of Technology and Management Systems, Incorporated, and has been heavily involved in transportation issues, safety analysis, thermal effects and so forth.

So these are the gentleman that are assisting the board in its deliberations today.

MR. KOUTS: We'd like to move on with the program at this time. I would like to comment about your earlier question associated with blow torches turned on casks. I was reminded by some of our staff that there have been analyses that have been done on this.

Sandia has been working with the Federal Railroad Administration on this issue. There are some reports that are issued, it is not a big technical concern, and we can certainly make that information available to you.

What I'd like to do now is reintroduce Dr. Warrant, who will be talking about the subject of cask testing.

DR. WARRANT: Before I get into this one, I should add that in the -- one question dealt with differences between the US regulations and international regulations. Current international regulations also include a 200 meter, or about 650 foot, immersion test for spent fuel casks, with the performance requirements being that there would be no rupture of the cask, which is a different requirement than the stringent leakage rates for release of radioactive material that we discussed earlier.

The proposed NRC regulations for the next revision also include that test, so, occasionally, the NRC regulations do not include regulations of the international community, but there is always the effort to get in consensus with them.

In this presentation -- I've been asked by Chris to move along here, so I'll move along as well as I can -- I'll be talking about how testing fits into the process for developing a spent fuel cask in this part of the presentation.

The first category is engineering tests. Engineering tests yield data on behavior of materials and components. Examples of engineering tests are the temperature performance of the seal, energy absorption of an impact limiter or material properties of various cask materials used in the body, impact limiters or the shielding material.

Engineering testing is typically conducted and usually emphasized in the initial phases of the design, but can continue through final design.

The next kind of testing that we'll talk about is design verification tests, which are usually conducted on scale models. Testing of scale models integrated with analysis allows more for your money, in essence, because testing can verify analytical assumptions in material models or boundary conditions.

The analytical models can then be fine-tuned using this testing data and then, finally, physical testing can only be conducted on a finite series of orientations, so that the results of the testing you do can then be incorporated in that analysis to analyze for orientations that you didn't physically test.

Detailed scaling relationships have been developed for structural properties, given that the same materials are used for scale models as for the prototypes and the developed distances remain the same. This viewgraph shows what the scaling relationships are. They are pretty self-evident.

Once again, the structural tests we're talking about are the free drop test of 30 feet onto an unyielding, horizontal surface in the worst-case orientation.

I just wanted to show you a schematic of what the target looks like, and believe it or not, this is actually drawn to scale because I checked it last night. If the unit up here is a quarter-scale model of a rail cask, this is what our Sandia target looks like compared to that cask model.

There is a steel plate with a large concrete mass underneath and the mass of this total system is required by the guidance that the IAEA issues to be ten times -- at least ten times the mass of the unit that we're testing. So this is not going to yield compared to that.

Those of you that go on the tour tomorrow will just see the surface, so you won't see all the stuff underneath, but just keep that in mind.

Then the other structural test is the puncture test. We've talked about that before. The types of data that are collected during testing are the bottom lines of what the deformations are and those are determined through mechanical measurements conducted before the tests and after the tests, x-ray examinations of usually how the shielding has shifted, if it has, or any damage to the shielding, or also damage to welds.

Leakage testing is performed primarily to determine gross changes in leakage because leakage itself does not scale. High-speed photography documents just what happened in the test. Then various kinds of instrumentation data are collected, measuring accelerations, strains or temperatures of the test unit, if the temperature is done at other than ambient temperature. Frequently, the drop tests are done at a cold temperature if there is any concern about brittle properties of the materials.

Thermal tests -- and the test, as we described it, is a transient test, don't scale like the structural tests do. In fact, the guidance of the IAEA is to not even consider doing scale model testing on the transient thermal. It's felt that there are sufficient data from engineering analyses of measuring the thermal properties of material and well benchmarked codes that can analyze the temperatures that occur at different locations in the cask body during the thermal event. Also, the test article itself can affect the thermal environment.

The next category of tests is on the

prototype unit when it's fabricated, and those are called acceptance tests. These are assurances that the unit has been fabricated the way it's supposed to have been fabricated. So the things that are measured have to do with that the impact limiters go on when they are supposed to, are there any visual imperfections in the cask that could affect its performance. If it's a pressure vessel, does it meet its pressure requirements? Can it maintain the leakage rate required by the safety analysis report? Is the shielding adequate? Does the cask sufficiently dissipate heat?

DR. CARTER: What are the limits on the pressure test, both negative and positive?

DR. WARRANT: Well, there are several different things. The most stringent pressure test is an overpressure of 50 percent that has to be conducted if the pressure --

DR. CARTER: 50 percent of what?

DR. WARRANT: 50 percent of the design pressure. So depending -- I'll speak in general terms -- depending on the pressure that can be achieved under either normal or accident conditions, if that pressure is above -- the number escapes me right now, but if it's above a stated limit in the regulations, then an overpressure test of 50 percent above the design pressure has to be performed.

DR. CARTER: What about the negative?

DR. WARRANT: The negative side is usually not a concern. If it can take overpressure, it can take underpressure, but there are normal condition underpressures specified. I think 3.5 psi ambient.

DR. VERINK: This is internal pressure or external?

DR. WARRANT: There are both. There is a range of external pressures that have to be addressed in the normal conditions of transport that primarily result from changes in elevation or other things like that.

Then in the design of a cask, especially where you have significant heat input by the contents, you have to analyze the thermal expansion of the gas.

DR. VERINK: That's internal.

DR. WARRANT: That's usually the pressure that you're concerned about.

DR. RAJ: Is recertification or retesting necessary after -- required under the regulations for certain dual cycles for the casks? Another question is, do you anticipate material degradation due to neutron bombardment, especially the last number sealed?

DR. WARRANT: Let's see if I can answer that generically. The safety analysis report has to consider degradation materials under use, so issues addressed in the safety analysis report look at the behavior of the performance of the cask over its expected lifetime, and that lifetime is used in fatigue analyses and so on, so that's a basic thing that has to be stated in the safety analysis report.

So the degradation of all kinds of materials has to be addressed there. There are also tests that are performed on an annual basis looking at leakage. So there are inspections of the casks, the measurements to the design and the leakage rate that are conducted every year. Then, also, not only the cask itself is looked at frequently, but the NRC has a recertification process every five years where they take a fresh look at the cask design and decide whether it should continue to be certified, and when they do that, they'll take into account any operational history that could affect the performance of the cask either in normal transport or in accidents.

DR. CARTER: Could I ask a related question? Do you happen to know if the NRC has ever found any degradation of casks that have been in use for a number of years due either to neutron or gammas or a combination of those and taken them out of the field?

DR. WARRANT: I do know there have been cases where casks have not -- where inspections have shown that the cask has not done what it should have done as far as the safety analysis report describes or perhaps some fabrication step was not carried out correctly, and in that case, yes, they have removed casks from service.

DR. CARTER: But you don't know if it's been due to degradation, due to radiation, neutrons and gammas?

DR. WARRANT: I don't know the answer. Does someone else know that?

MR. KOUTS: I don't think we have the answer and we'll try to get that to you.

DR. PRICE: What proportion of casks have been removed from service that were certified by either NRC or DOE for safety reasons?

MR. KOUTS: That's another question I think we're going to have to get back to you on.

DR. WARRANT: The process that's described here is the acceptance testing upon fabrication. The other issues that you're raising have to do with the degradation of the cask during service.

Several other kinds of tests are planned in this program that are not normally conducted, and one of those is called performance evaluation testing. Performance evaluation testing will be conducted at one or perhaps a few other facilities.

The objective of this testing is to determine if the prototype cask performed as it was intended to perform in transport; intermodal transfer, that we talked about a little bit earlier; loading and unloading from the transporter, the trailer or the railcar; loading of actual or simulated fuel; leakage testing, and that could be not only -- that would be after the acceptance testing, so this would be leakage testing under operational conditions; decontamination of the cask, and Dr. Price already mentioned that or brought up that the cask could get contaminated when you loaded it in the fuel pool. So the process of decontamination will be exercised in the performance evaluation testing. Also, this testing can demonstrate how well the cask can be handled by manual or automated methods.

Some data will be obtained in shipping and handling areas for life-cycle cost evaluations. Then, finally, any potential improvements will be identified and the design modified, if necessary, before operational testing occurs, which is the next category.

Operational testing is like performance evaluation testing, but it's after the design has received the stamp of approval from performance evaluation testing.

Operational testing will be conducted at numerous facilities. The objective here is to integrate each cask system into the transportation system, the generic transportation system.

Operational characteristics of each cask will be determined, the equipment evaluated and detailed procedures tested out at different facilities; personnel trained and find out how well they have learned the procedures; interchangeable components, such as impact limiters that can fit on either end, or other tools that can be used on more than one cask design will be demonstrated; and site-specific interface requirements, procedures and training programs will be defined.

Then, once again, we'll probably find out that some improvements can be made and the design modified, if necessary, before the entire fleet is procured.

DR. CARTER: Is this going to be statistical and random testing, or do you plan to test every cask?

DR. WARRANT: This would be, say, one prototype of each cask design or maybe more, but not many, many, many. This would be before the fleet itself is procured.

DR. CARTER: Okay. It's operational testing of a prototype, in essence?

DR. WARRANT: Yes.

DR. NORTH: Could you comment further on the human factors aspect, what the potential is in both the operational testing and the performance evaluation of catching the potential for somebody making a mistake, failure to secure a seal or bolts or something of that sort?

Is there to be monitoring such that that would automatically be caught and it would be realized that somebody hasn't done their job?

MR. KOUTS: I'd like to answer that question. We are going to be covering how we deal with human factors within the cask designs and we'll get into such areas as -- we'll be talking about air or water connections to the casks and we'll make sure that there are different connectors so that you can't use an air connector in a water nozzle. I mean, those types of things we're designing into our casks such that a human being will -- when interacting with it, we're going to limit the amount of mistakes that he could potentially make.

We are going to be addressing this a little bit -- Ira will be talking a little bit about it. Also, I'll be talking a little bit about it on Wednesday.

If you'd like, we could go into that now or we could defer the discussion to that point.

DR. NORTH: I'll leave that to you.

MR. KOUTS: I would prefer -- since we do have so much material to cover, I'll defer it to that point and we can get into a little bit more detail in those areas.

We are going to have a lot of operational input. We have human factors input from our operational input into the designs and, again, we'll be talking about that more.

DR. NORTH: I want to make sure that we do come back to that point because in this presentation the stress, at least as I interpret it, has all been on the equipment and not the human side of the system. I want to make sure that we cover the human side of the system as well.

MR. KOUTS: This afternoon, we'll be talking about what we're doing in the operations area and in the transport phase, and I think also we'll be addressing your concerns in presentations later.

DR. WARRANT: As I see it, an important part of this kind of testing is video taping and very carefully documenting where people run into problems.

DR. NORTH: I think one of the concerns is a prototype with a highly trained crew from a contractor who are very familiar with the equipment versus what you might get out there in the field in actual operations and making sure that you understand what the position is for mistakes and what the requirements need to be for training and monitoring so those mistakes aren't made, or if they are made, they are caught.

MR. KOUTS: You're absolutely right. We're not going to be the ones handling these casks, but the utility personnel, we have to train them so the potential for error is reduced to a minimum. We are looking into that.

I do want to mention that this testing

again is on prototypes. This would be prior to the time that we would begin to procure the fleet. So we'd be taking these out to utility sites and testing them at utility sites with utility personnel so that we can get their input into any final changes we would like to make in the cask.

DR. CARTER: Part of the problem is the title of that slide. If you had prototype on the top, it would -- it looks like it's an operational thing.

MR. KOUTS: These are for prototypes.

DR. BARNARD: Chris, you talk about fleet procurement. What's a fleet look like? Are we talking about hundreds of casks or ten or thousands?

MR. KOUTS: Right now, the total fleet would be under 100 casks; both rail, barge and truck. So we're not talking about a tremendous amount of -- in terms of numbers.

DR. BARNARD: How much money are we going to be spending on casks? A couple million dollars apiece or --

MR. KOUTS: About. A rail cask will obviously cost more than a truck cask.

DR. BARNARD: Yes.

MR. KOUTS: Probably be under a million. I'm guessing at this point, but our rail casks will probably be in the area of 1.5 to 2 million dollars. Again, when you manufacture a lot more, the prices tend to come down.

DR. WARRANT: I'd just like to summarize the objectives of the testing that we've talked about so far which are the planned testing activities.

They are to verify the engineering design analysis, reduce uncertainties in cask design, expedite the certification process, assist in public understanding and the bottom line is to evaluate the cask performance.

There is an additional kind of testing that is being considered and that is testing of a full-size prototype spent fuel cask. The possible reasons for confirmatory cask testing would be if there are statutes or regulations that require this kind of testing or in response to public concerns.

When we talk about confirmatory cask testing, we're talking about not only full-size, but tests that could be conducted for regulatory requirements or potentially for requirements different from the regulatory requirements.

DR. CARTER: How would these public concerns get communicated to DOE? If one person gets up and says, "I've got a concern with this," do you do something about it, or is an organizational thing or 300 people or 3,000 people that have a similar concern?

MR. KOUTS: Basically, we do have an institutional program and we use that as a pulse-taker, if you will, on the environment around the country.

We do have regional groups, as I indicated. We get a lot of feedback from them as to their views. We also have a variety of national meetings that we hold and there are plenty of opportunities for representatives of the public to express their views in this area, and we have received comments on this subject in the past, but we use our institutional program essentially as a mechanism for getting public input into the program on issues such as --

DR. CARTER: This would be a sense by DOE that there is a public concern, and that process, I imagine, is fairly complicated. It's not a single individual saying, "I'm concerned about this," or is it?

MR. KOUTS: It's single individuals and it's representatives of states, representatives of regional groups that encompass a variety of states, it's anyone who wants to tell us what's on their mind. That's what an institutional program is for.

DR. CARTER: Well, I would hope you're not going to respond to every individual that might have a concern.

MR. ISAACS: Actually, we will respond in the following sense that that -- for example, when we put out documents or hold hearings, if we get comments during either of those two processes, we make sure that we have a comment response document, whether it was our mission plan or our environmental assessments, so that everyone can feel that we have at least addressed their concern.

We may say we've already taken care of it or we're not going to consider it for the following kinds of reasons, but at least we have a document trail in those kinds of more formalistic settings.

I think it's more important to recognize that one of the lessons learned in the institutional setting is that it's not important -- not enough for a program to be successful to worry about the things that we think are worth worrying about, it's important in the institutional framework to worry about things that the general public thinks are worth worrying about and, therefore, we do have to find some kind of mechanism as we go down the road here to at least understand people's concerns and try and translate those into sometimes more educational programs and changes in the program structure itself.

DR. CARTER: I understand that, but the thrust of that could have been that you go off on a tangent, everything someone says is a problem, and I'm sure that's not the case.

DR. PRICE: With regard --

DR. CARTER: Excuse me, you certainly have to consider these in the overall and respond to them individually.

MR. ISAACS: That's right.

DR. PRICE: With regard to that last slide, the possible reason for confirmatory cask testing, regulatory and public concerns, do I read into that to mean that you don't anticipate there is going to be any real technical reason for full-scale confirmatory testing?

MR. KOUTS: That's correct. We feel that

the model testing will do the job. In addition to that, the NRC does not have any requirements for full-scale testing of designs prior to certification or even after certification.

DR. VERINK: I note that what we've been talking about now has been largely mechanical kinds of considerations, and I'm assuming that somewhere along the line we're going to talk about evaluations having to do with perhaps chemically related things, corrosion resistance and so on, which will also bear on the matter of cask performance, what is the environment, is there a standard?

DR. WARRANT: The question that you raised, there are requirements in the transport regulations for evaluating any corrosion possibilities of, say, cases where the contents could interact with the cask or different parts of the cask could chemically react, and that's always part of the safety analysis report, to perform those evaluations.

MR. KOUTS: I don't want to mislead you in the sense that we don't have a separate presentation identified for that.

If that is a subject of interest to you, I think we can provide that at a subsequent briefing, but right now in terms of how we structured the briefing, that's not going to be covered specifically.

DR. VERINK: I certainly think it's a very important aspect of it.

MR. HALL: I might just mention that in the cask contractors' contract, there is a requirement to consider galvanic action between metals and also what they are going to be carrying, and that the cask, when it's loaded, will be loaded with an inert gas as a cover gas that's sealed into the cavity of the cask and around the fuel.

There is also another general requirement for corrosion requirements that the cask contractor has to look at. We don't have a presentation today on those, but those are required.

MR. PELLECHI: If there are no other questions, I'd like to introduce Ira Hall, the current manager of Spent Fuel Technologies at EG&G.

Ira this morning will be discussing cask development and fabrication, as well as the cask carriage development.

MR. HALL: As was indicated, I am with EG&G and we have the responsibility to day-to-day monitor the cask contractors -- the five cask contractors and their designs as they progress. We carry on, generally, about monthly meetings with the cask contractors where we review the progress and work that is going on and other day-to-day concerns that a project manager would have to talk with the cask contractors.

So those are the areas that EG&G monitors. So we will be talking about the casks as they are presently being developed.

I might just mention that the next two slides are out of order. I will use this slide two or three times and it very closely parallels the one that Marilyn Warrant showed you except that I have cut off the top of it where all the regulatory body and requirements have already been addressed and I won't go into those efforts, but you need to understand that there is a large regulatory body which has been developed over the last 30 or 40 years. It's not that we're developing a brand new system that doesn't have a support area for consensus standards and for regulations, those are in place and we're using those as our primary standard for the requirements for the cask program.

So when I say "requirements," I'm really talking about those that are unique to the cask and the definitions that are given to the cask contractors as they develop their casks. I will be covering those in five areas, and I might mention that I've done this just for convenience and there is nothing exclusive about one of these categories. Because there is a large carryover between these various categories, I've done this just for convenience of the presentation here today.

In the safety area, again, the cask contract requires that they consider the safety aspects. The key to this, as has already been discussed, is meeting the requirements of the DOE -- the NRC requirements in 10 CFR 71, and this is met by the safety analysis report which is submitted at the completion of their final decision.

In addition to that, as was mentioned, each of the contractors has had several meetings with the NRC. These are informal meetings where they discuss their design, keep them up to date on their design and get comments from the NRC where there may be particular emphasis or concern that the NRC would have and then they try to discuss those in subsequent meetings, so that when the safety analysis report is submitted to them in a year or so, there will not be any new innovations or new concepts that the NRC has not seen previously.

We think this will allow us to have a little smoother licensing process, as well as get the input to the NRC and their expertise in the areas that they may have concerns in.

DR. CARTER: Ira, that process of being interactive with the NRC and the contractors, doesn't that begin during the preliminary design stages early on?

MR. HALL: Yes. We are in preliminary design now, and as soon as the cask contractors have their -- what we call their documentation in place, where they had their QA program, the program management plan and the NRC- and DOE-approved quality plans, they had an initial meeting with the NRC on their proposed designs and then there have been subsequent meetings, I think there has been as many as four meetings since that in this -- for a single contractor in the succeeding year since the preliminary designs began. So it is an ongoing process.

DR. CARTER: The other question I wanted to ask you, as I recall from seeing the list of contractors for casks, all of them have a substantial track record in the design and fabrication of casks, is that essentially correct or --

MR. HALL: That is essentially correct. Westinghouse has not necessarily built the cask, but, as you know, they've been in the fuel business and in the reactor business for a lot of years and just because they have not built a cask, per se, does not mean that they don't have the expertise.

The other four contractors have all had casks that have been certified by the NRC, with the exception of B&W.

In addition to the NRC requirements, we do have the internal reviews that we carry on at the end of design and final design. These are very formal project review presentations where there will be a report issued from that effort.

The specifics related to the design that are stated in the contract, they -- as they develop their carriage, we've asked them to maintain the lowest center of gravity possible. The safety of that is obvious, I believe. Ease of inspection, once the cask is in place on the carriage, make sure that they don't have any hidden areas that might be critical to the safety of the cask and its carriage.

Then there is a leakage test capability which is carried on subsequent to the licensing cask test -- the leak program that Marilyn mentioned. So this is ongoing as the cask is being operated.

DR. PRICE: Ira, on your preliminary design review, do you have documents and presentation related to things like preliminary hazard analysis and failure modes and effects-type things, job safety analysis, this kind of thing presented at the preliminary design review?

MR. HALL: The safety -- the preliminary design package will pretty much follow the format of the safety analysis report package that the NRC requires, and in the safety area, some of those are addressed, but I can't say that each one of those specifically will be addressed as an individual item.

DR. PRICE: Does DOE or you or anybody at any time in the preliminary design process receive preliminary hazard analysis from the contractors?

MR. HALL: I don't know what you mean -- could you explain "hazard analysis"? I'm not sure I can respond to that.

DR. PRICE: I guess the easiest thing to reference that to would be a mil-standard 8-82 type analysis. The preliminary hazard analysis isn't necessarily confined to mil-standard 8-82 definition, but in general it would include the hazards which exist with that, including the handling hazards of the design, then the response or comments that there may be in the failure mode or job safety analysis may be going down step by step by step and identifying with each step what might be the hazards associated with those steps, and then what are -- what response is taken to ameliorate the situation.

In the area of human factors, you would have functional flow going down finally to task analysis, going into each individual task, looking at the human performance criteria and the adequacy of design for these things, and this is usually done at the preliminary stage.

MR. HALL: I think the answer to that is I don't believe that there will be a specific report prepared by the contractors in that sequence. There is a requirement for him to describe all of the operational steps that are required, and in the review process, we have our operational people who have developed a review of the items that you just alluded to that will be checked off as we go down through the design review process, but the operational mode and then the hazards that are associated with that and then a response to that by the contractor, we have not specifically required.

DR. PRICE: And you would not likely have a fault tree, even a qualitative fault tree analysis at this time?

MR. HALL: Not from the contractor, no.

MR. PELLECHI: Ira, if I may just add to that, the possible exception to that would be the NAC-CTC, their wedge-loc design. We are requiring that they do a fault mode and impact analysis as part of the preliminary design.

MR. HALL: Yes, that is a unique area where it's a unique design that we're requiring with them.

The other operational procedures, right or wrong, we've felt that with the experience that we've had and some of the instructions which I'll get into in just a few moments in the contract, we've covered a lot of those areas, so we've not required them to address each one of the steps in their preliminary design.

DR. PRICE: Do you have a document, then, that would indicate the hazards associated with the steps that are going to be taken in using these particular things that would be generic in the sense that you're saying you've covered them? Is there a document, as such?

MR. HALL: I believe that Ron Pope this afternoon will cover some of the areas in the operational stages. He won't cover all of the details, but we have -- I think it's a 10- or 15-page checklist for operational considerations when they do various moves or they do the bloating or so on.

DR. PRICE: But these are somewhat design specific. For example, if you were taking a yoke and you were attaching it to the portion of the design and say it was kind of a slotted thing and you fit it in and you dropped it down, it would look at that specific operation and seeing if the human operator has the information that assures that he's made that connection manually or remote or however

it's done, and it's related specifically to the
dimensions, the movements. It's not that general?
MR. HALL: We do not have those specifics
at this time. The contractor is required in his

package to -- and not during the preliminary design process, but in his package to provide us with all of the step-by-step procedures that he will go through, but he's not at this time contracted to give us the hazards associated with those movements.

Another area of safety that we will just briefly cover is that called safeguards, and that is where it's a physical protection from theft or sabotage. There are some general requirements in the contract, and these are covered under 10 CFR 73, for physical protection of plants and materials.

There is some classified information and areas of study that are going on in this area, but this is all we'll talk about today as far as safeguards and securities are concerned, and the specific design requirements are ease of safeguards inspections and to avoid areas where there can be concealed explosives or other tampering devices and tamper-indicating seals.

Of course, you have the personnel barrier which will be covered in each one of the casks and so that will also provide for us an opportunity to prevent access to the cask itself specifically.

Cask quality, I'd like to differentiate

between the two areas of quality that we have; the one being quality assurance, the other quality control.

The quality assurance is a philosophy within the program where the line management, those who are responsible for the design and the performance of the cask, are responsible for the quality of the product, and that is a philosophy espoused right from the top of the quality programs that are instituted within the OCRWM system, and these have to be approved by the DOE and NRC, and the implementation plan for the contractors where this philosophy is carried on is approved by DOE before they could actually begin their designs.

The basis for those specifics of the quality plan is, again, NQA-1.

After you have, hopefully and I believe successfully, built the quality into the product, you have the quality control on the tail end that says, "Have I really complied with all the regulations and requirements," but we believe that the quality will be built in before that quality control effort takes place at the end of the design phase.

We also have the graded quality assurance levels which defines the responsibilities that are more stringent for more serious elements of the cask, and I'll go into that a little bit more when I get into the fabrication aspects.

Cask interfaces, we have three interfaces. We have to go to the utilities, we have to load the fuel and then we have to deposit that somewhere. So the DOE initiated what we call a cask facility interface capability assessment where they went to the utilities and surveyed the areas where the casks would have to be handled; the overhead heights, the capacity of the cranes, the depth of the pools, the type of fuel that they had and so on.

The program is just finishing up. It will be completed late this year, in November, but we have a lot of the preliminary data that's already been gathered, and in reviewing that preliminary data, we have only three utilities where we feel that our present generation of casks, from-reactor casks, cannot go in and be handled by that utility.

As was mentioned, also, another initiative within the OCRWM program is a specialty cask, and if we feel we can't handle those from-reactors, that the specialty casks will be developed where we can handle the fuel from those reactors.

Standard fuel contract is called 10 CFR 961. This is a formal contract between the DOE and the utilities and it specifies the fuels that need to be handled.

There is pressurized water reactor fuels, the boiling water reactor fuels and those that are not in that category, such as NS 4 FR and other universal fuels and so on, that will not be handled by our from-reactor casks. They will be in specialty casks or other casks that we don't have. So we will be handling the pressurized water reactor and boiler water reactor fuels.

DR. PRICE: Does that 178- and 179-inch length accommodate like CE System-80-type fuel?

MR. HALL: Yes, it does. It does accommodate that, but it does not accommodate the South Texas fuel, which is about 196 inches long.

DR. PRICE: And the control rods and channels and things like that, are they accommodated with that?

MR. HALL: Some of them can be. Again, these are what the contract requires and then they have a comment down that says if the nonfuel-bearing components are integral or not extend in the envelope, then they can be considered for inclusion in the fuel assembly.

There are some of those that do exceed those and there is a study window right now as to how they'll handle those that are outside that boundary.

MR. KOUTS: I would want to mention that weight is a very critical consideration with these casks. When you begin adding control rods or channels and so forth, you can potentially cause the capacity of the cask assembly to go down because you exceed the loaded weight of the pool of the cask.

So we have to be very careful in terms of what we can put into these casks. We're evaluating that issue right now. It's something that I think we're going to have to come to grips with.

DR. CARTER: Let me ask you a related question. According to my experience, control rods -- use of control rods could be considered low-level waste by definition.

MR. KOUTS: That's another issue associated with this, whether or not it really is high-level waste and whether or not it should be disposed of in a repository.

DR. CARTER: That decision, I presume, has not been made. In the past, they've been disposed of as low-level waste.

MR. KOUTS: That's correct, and I think we have a negotiation process that we're involved in with utilities right now. That's one of the issues that we're going to be working with them on.

MR. HALL: The contract also indicates that we will be handling in these from-reactor casks only unfailed fuel and that that has been cooled at least five years.

DR. PRICE: And burnup, 35,000, is that on it?

MR. HALL: That is part of the contractual regulation. I'll get to that in just a moment.

The tail-end interface, of course, with a DOE facility and MRS repository and those are lagging us, so we are coordinating with those who have the current responsibility to handle the casks that have come to that facility, but there is no -- have been no designs on that area that have come to fruition.

Going to the cask design requirements that are specific to the cask, and this is where I'll get into the -- I guess I took that out. I guess I'll have to address that.

Maximum payload is the thing that we want to have the contractor accomplish within the weight constraints and the safety considerations. As was indicated, the more you can get into a cask, the fewer shipments, the less risk, the better safety, less exposure you'll have to the workers, as well as to the public.

So within the constraints, payload is the maximum consideration that we've asked the contractors to do.

Of course, it has to do with the four items that Marilyn mentioned earlier: subcriticality, shielding, dissipate the fuel heat and maintain the containment of the payload.

DR. CARTER: I presume you factored into this railroad bids and highways and this sort of thing as far as --

MR. HALL: We have.

DR. CARTER: Is this going to be covered specifically?

MR. HALL: Yes, I will cover that in just a moment. The contractors do have the requirement to develop a trailer for the legal weight trucks and the railcar for the rail cask, and we'll get into the limitations on weight and the interchange requirements we have there in just a moment.

We also have a 25-year life and one million miles on the carriage. So that's included in the contract.

I guess this would be a good point to address -- I had it in the slide previously, but I've taken it out -- where the contract also specifies that the base design should require 35,000 megawatt burnup and four-and-a-half percent enrichment of the fuel, that's for the PWR, and 30,000 burnup and four percent enrichment for the boiler water reactor fuel.

There is a trade-off study in the contract that asks the contractors to look at that and see how they can accommodate higher burnup as far as having to download or if they should actually make a design at a higher burnup than we have specified for the nominal conditions in the contract, and those trade-offs, design trade-offs, will be coming in within the next month or so, about the same time the preliminary design comes in. There is a possibility that we would change that nominal design point that's assigned to the contractors.

DR. PRICE: I believe the utilities have a concern about 35 being too low in the very near future.

MR. HALL: That is correct. The recent studies show that the utilities expect to go up to burnups of 45, 50, maybe even a little bit higher than that. So one of the studies that we're doing with the cask contractors is to tell us their capacity; if they design a cask for 35, how much burnup they can handle; if they design it for 50, how much can they handle. Then with that, we will decide which design point we want to continue with.

DR. PRICE: This kind of opens the door, if you have variable-type loads, getting the right load in the right container, is that -- I mean right cask, is that correct?

MR. HALL: There have been some studies about fuel blending -- is that what you're referring to?

DR. PRICE: Yes, that could be part of it.

MR. HALL: There have been some studies

that show that you could reduce -- increase the capacity of the cask if you design it for a blended load, where you had some higher burnups, some lower burnups, some higher -- longer cooling, some shorter cooling and so on.

We've not addressed that at this particular time with the cask contractors. We've talked about a specific load of nominal fuel conditions.

MR. KOUTS: There are a variety of parameters that I think you have to look at. Again, you have to keep in the back of your mind that we're trying to utilize these casks for 75 to 85 percent of the fuel out there, and the parameters that you have to look at are things like spent fuel burnup, the age of the fuel, because if you age a higher burnup fuel for a long period of time, you may not necessarily have to dereg.

So what we're trying to look at is the optimum design as to what our casks should be at, recognizing that there may be instances where we have to ship when we have to dereg for various fuels.

We are doing systems analyses on this right now. We're taking the input from the

utilities, we're getting our own input and we're
running systems analyses to find out what the
optimums would be. Prior to the time we enter the
finals on it, we'll adjust the baseline of the

designs to reflect that optimization.

MR. HALL: As a specific example, one of the rail contractors has said that if they design it for 35 megawatt per day burnup, if they could -- and they have to handle the five-year-old fuel, that if they could have ten-year-old fuel, they could handle up to 45 to 47 burnup. So there is that variation. It becomes quite a parametic study that they have to perform.

MR. KOUTS: The other issue associated with this is whether or not we'll have a great deal of selectivity when we pull up to the utility site and want to load our casks. That's, again, something that's being negotiated right now with the utilities. So we're trying to look at all these issues.

MR. HALL: The next area is operational requirements and this, I guess, would be where we come closest to addressing human factors; that is, the human interaction with the equipment that we're designing.

I will not try to go into each one of these areas, just indicate to you that we have these areas and areas on the next slide that are addressed in the contract with a paragraph -- or two or three paragraphs where we want them to -- the parameters that we want to consider.

I will just take the last two on the next slide and give you some overview or indication of what's addressed in the contract. So let's take lifting devices first and then cask penetrations to show just a very brief overview of what may be covered in the contract for the contractors to consider.

Lifting devices, we specify the trunnions to be circular, and that was one about, you know, should they have square trunnions or so on, and we've asked them to have circular trunnions, and have them replaceable so that they can be easily maintained.

We want four trunnions at the near-closure end, that is the top end where you're loading fuel. That is the closer end and for ease of getting ahold of the trunnions, because you generally use a lifting device that connects only to two trunnions and so you can get it at with an ease of orientation.

Rear trunnion offset on the bottom of the cask. As you tend to uplift it as it's coming off of the carrier, if you have the trunnion directly in the center of gravity, then as you upload it, it could move one way or the other, so you tend to have it stable in the direction you're uplifting it from.

Lifting devices that are self-guided onto the trunnions and are remotely activated. I think that's straightforward.

Operator visibility as the trunnion is being put on and as the cask is being moved is addressed.

Considerations for accident retrieval, if they can't get ahold of the trunnions, are you going to have something else that is readily available for -- particularly for the rail casks that weigh 100 tons -- for the rail people to get ahold of to retrieve the cask if it's off in a conveyance or into a mud puddle or something like that.

Those are the types of things that are addressed in the lifting devices.

DR. PRICE: Are you confident that saying something like near-closure end -- four trunnions near the closure end gives you the design that provide clearance and so forth?

I know the FICA study probably is addressing this, I assume it is, but do you think

that with the designs that are being presented now
that if there is overhead clearance you --

MR. HALL: Yes, in a word, and certainly they will be looked at more in the design and review process.

DR. PRICE: That's a good word.

MR. HALL: Cask penetrations, again, an indication on the types of things. There are four types of penetrations that we anticipate. If they can combine some of those penetrations so the two operations can be performed with one penetration, we're encouraging them to do that.

We will also require that if they have a valve that closes the penetration off, that they'll have a closure plate so that there will be double closures on those penetrations.

One of the concerns is that we minimize the particulate accommodation as the cask is used over and over again, so minimize the shelves or crevices associated with it.

Dissimilar fittings, so if you want to do one operation and you know you want to do that, that you can't connect a line from the facility to the wrong penetration of the cask.

Verify that the cask is empty or full from afar and vacuum drying requirements so that you know that the cavity is dry. Sampling at the top end; we found over the years that people are at the top end and that's where the sampling ought to take place because that's what's generally accessible to them.

No hydraulic locks, and that is if you've got a penetration that's going in that as you've drained the casks, you can have, because of a vacuum in the end of that, a dead or blind hole or something that's going to slowly come out after you think that you've already got the thing dried out.

So these are the sorts of things that in all of the other areas that I showed you on the previous two slides that are addressed in the contract that I will not try to get into today, but we consider those as human factors because of the large amount of information we have over the many years of operating casks in the utilities and in the Department of Energy.

So we feel we're not working in a vacuum here and we'll try to address those and, as I indicated, there is a formal design list, a checklist from the operations people, that we will go through in both the preliminary and the final design phase.

DR. PRICE: Has there been consideration given to whether or not it's necessary to provide an indication on the outside of the container of the temperature within the container, the pressure within the container, radiation within the container, these kinds of things that might be monitored and provided as a state of what's inside the container so that those who are unloading and so forth know what it is?

MR. HALL: When it gets to the off-loading point, there is a requirement that they can cool a cask down. So the temperature consideration is checked and then if it's warmer than they want to handle, there is a requirement that the cask has the capability of being cooled down.

The internal pressure, they will sample it to see what -- not only what the pressure is, but also what the content is. If there are some materials in there, as they vent that, that will be monitored before they actually open up the cask.

DR. PRICE: Is there any value to this en

route as well?
MR. HALL: No. I believe that the only requirements there are to monitor the outside of the cask to make sure it meets the requirements for

radiation effects and then the personnel barrier has the capability of keeping people away from the cask. The requirements for the temperature on the outside of the cask allow for safe transportation.

DR. CARTER: Ira, are there any plans to vent any kind of radioactive gases?

MR. HALL: Any plans to vent those?

DR. CARTER: Like Carbon 14 or tritium.

MR. HALL: Only at the tail end, just prior to the cask being opened up for removal of the fuel.

DR. CARTER: But none during the transportation phase here, say?

MR. HALL: None. The contractor is required to calculate the maximum pressure that could occur inside the cavity because of all the gas releases within all the fuel assemblies and that pressure has to be maintained by the seal, so it's an integral package that is intact until it gets to the off-loading facility.

Cask contractor designs, we've covered the requirements and, as I've indicated to you, we are in the preliminary design process, and I will show you those preliminary designs. I should mention that as we're in the preliminary designs, all of the contractors have done what we call engineering tests. That is, they've taken components of the casks where they may feel that they want verification of their analysis codes and they've done testing on those, and an idea of that is, for instance, the impact limiters that we have over here on this table, one of the tests that General Atomics has used for their testing, and this is for the crushable material, and this is to verify their anaylses, and there are others which they've done which have been going on during the preliminary design phase.

We have pictorials of the two casks. This happens to be the GA cask and this is the square -- the only one that we have that has a square design.

I might mention to you that every cask has common elements. We have the impact limiters on the end, which tend to minimize the effect of impacting on the internals of the cask as well as the sealing surface of the cask.

Internal to the cask we have the cask

basket, which provides for holding the fuel. We have two models of that. We have, over here on the table directly behind you, a complete cask model from Westinghouse and we have just a cask model for a very unique design over here on the table behind you which is the NAC cask design, and I'd be happy to discuss these with you after we get through the presentation.

Then next to the cask, we generally have just a shell material, and outside of that shell material, we have a gamma shield. Outside of the gamma shield, we have the structural seal, and that is the containment boundary, and immediately outside of that would be the neutron shield. Then protecting the neutron shield would be another shell.

That is pretty much common to all of those. The variation is the materials used in those various capacities.

The next slide after the Westinghouse Titan slide -- I'll show this to you. Again, the same items. They have a titanium alloy, which I will address in just a few moments.

DR. PRICE: On the previous slide, the unusual feature of that slide is the rectangular design?

MR. HALL: That is correct. The rest of them are pretty much uniform. Just after the Westinghouse slide, I compare the materials, and so

I'd like to do that after we get to that slide.

DR. PRICE: Does that design affect any benchmarking?

MR. HALL: Not benchmarking so much as the application of already accepted structural codes. It has been a good topic of discussion with the NRC as to how they will handle -- particularly the areas in the corner.

As you know, the NRC does not like to see plastic deformation, so you have to use elastic analyses, and when you have something like this where there is a discontinuity, there tends to be yielding there. So that is an area that has been addressed with the NRC. It's not a new code. It's just application of the well-accepted codes.

DR. CARTER: There is going to be no particular need for heat dissipation?

MR. HALL: In the truck casks, where we only have three or four elements, heat is not really a problem. I'll address that when we get to the rail casks where it is a significant consideration.

The Westinghouse cask is round in configuration and again has the impact limiters on the outside.

MR. KOUTS: Before you leave that slide,

Ira, the slide isn't reflective of the latest Westinghouse design. The toroidal impact limiter that you see here has been abandoned by Westinghouse. They are going to a standard design for the impact limiter, so it's similar to the designs of the other casks, totally circular, just for your information. We just haven't redone the graphic.

MR. HALL: This is -- if you'd seen the other one, it would have been a donut around the outside and would not have been the honeycomb. It would have been a donut that crushes and that would have been the impact limiter.

They found that that was not acceptable and they've been authorized to change to the honeycomb impact limiter.

DR. CARTER: I think that's the honeycomb.

MR. KOUTS: I'll try to look at the slide.

DR. CARTER: Is this one of the few that uses depleted uranium for shielding?

MR. HALL: Can we address that on the next slide, please?

DR. CARTER: Sure.

MR. HALL: That's on the very bottom of

the slide, both the rail casks and one -- excuse me, both of the truck casks and one of the rail casks use the depleted uranium for a gamma shield.

Looking at the payload, the GA has a 4/9. I think that gives you the innovation. Allowing them to go to higher burnup -- excuse me, the higher payload is the shape that they have because they conserve weight and not going to the complete circular. You still have the capacity with the Westinghouse of the three PWRs and seven BWRs.

Structural material is stainless steel, which is quite commonly used in casks, and then the titanium, which is uniquely used as far as we know, in the Westinghouse cask. It's not been presented to the NRC in another design.

DR. CARTER: What kind of weight advantage does that give?

MR. HALL: Well, it's in the structural material, which is the only area that they use the titanium. I can't tell you the pounds, but it allowed them to go from a capacity of 2/5 to 3/7 in their payload. That's the number that I know, not the weight.

DR. CARTER: Well, that's substantial.

MR. HALL: Yes, it is substantial.

Basket material, stainless steel is typical. Honeycomb impact limiter, which we've indicated. Neutron shields, they all, with the exception of one, use the borated polyethylene or silicone. Then the gamma shielding is depleted uranium.

DR. PRICE: The shielding, I presume that each contractor has given you estimates of the two-meter distance, for example?

MR. HALL: Yes. They have done a very detailed calculation and we have those results already.

There is one other area that we're quite concerned about and that is the shielding, so even prior to them submitting their preliminary designs, we have had them submit that package and we've had that done -- and we've had an independent review of those design analyses by three independent people that are even aside from the Technical Review Board.

We have that option, if we have a concern about a particular design condition or parameter, we can get that reviewed independently even prior to the submittal of a formal design package.

DR. PRICE: Does each contractor --

including, I guess, the other contractors -- use the same computational methodology? Is it uniform computational methodology?

MR. HALL: No, it's not completely uniform, but the majority of them go back to the origin and those codes that were developed by Oak Ridge National Labs. They have their basis back there, although they may have some independent routines that are developed unique to a particular contractor.

DR. PRICE: Is a Pathrae T code used?

MR. HALL: Pathrae T?

DR. PRICE: Pathrae T.

MR. HALL: Ray, can you answer that? Pathrae T, is it used as a computational code for shielding?

MR. CHAPMAN: I don't recall seeing that on any of the presentations.

MR. KOUTS: Before we leave this slide, one point I'd like to make is we use the term of dedicated-use and common-use casks in the cask development program. Dedicated-use casks are essentially two separate designs, one for the PWR cask and one for the BWR cask. The GA-4 and GA-9 are two separate casks. Each designs for PWR or

BWR.

The Westinghouse Titan cask is a common-use cask that could specially have an interchangeable basket, so you'd be using the same cask, but you'd be changing baskets.

This is an issue that we're looking at from the life-cycle standpoint, whether or not it makes sense to go to dedicated-use or common-use casks. Right now, Westinghouse has a common-use cask and GA is developing two separate casks.

DR. PRICE: While we're on that kind of topic, I had a question and was wondering, do you have a dual-purpose cask program or something going on in the area of both storage and transportation?

MR. KOUTS: We do not have an initiative underway for the development of a dual-purpose cask; a dual purpose meaning they can be used for storage at a reactor site and for eventual transport from it.

We have been approached to participate in a cooperative agreement by a certain amount of parties, but we've made no decision at this time. We have received comments from utilities in the past that -- and I can provide you the correspondence, it's about a year old right now, where they felt that we were essentially not going to be in a position to develop these soon enough for use by utilities. That was a separate initiative that we were looking at.

Right now, I think our policy is somewhat in a flux. We don't have any firm position on dual-purpose casks as to whether or not we're going to be developing one, but at this moment we're not developing dual-purpose casks.

We have been approached, as I have said, to participate in the cooperative agreement that would cause the development of about a 125-ton dual-purpose cask, which is larger than what you -- than what we're developing from a transport standpoint, but we have no activity underway at this time to work in this area.

MR. HALL: Okay. Going on to the rail casks. The NAC cask is the one that we have the basket over here on the table for and it has a unique design itself.

The NRC is concerned about using aluminum as a structural member, so they have developed a very unique design that has the boron sleeve that goes into each of the square assembly holding channels, so that they get their poison in a channel and does not require further structural strength of the cask -- of the basket itself.

They are the only cask that uses depleted uranium in their shielding material, and they have the largest capacity, which I'll show you in just a minute. They also have an HY-85 structural material for theirs, as compared to stainless steel or titanium. They have uniqueness there.

DR. PRICE: Is this a design that uses NS 4 FR?

MR. HALL: Yes.

DR. PRICE: What in the world is that?

MR. HALL: We have samples of that back there on the table, and we can show them to you. They have one that doesn't have the boron in it and then one that has the boron in it itself.

Well, you can see the material, it's kind of like a bowling-ball material, if you will.

The NUPAC design, we consider this our standard design because it uses stainless steel and lead shielding and polyurethane (sic) for the external neutron shielding.

DR. PRICE: Could I ask you on the previous slide about the wedge-loc cover, to describe it a little bit. It's one of the unique features of that design, is it not?

MR. HALL: Yes. Can I wait until we get to the summary sheet and that has all of those things and then I'll cover the wedge-loc closure because that way I can compare all the various closures and so on.

DR. PRICE: Okay.

DR. RAJ: Excuse me, did I did I hear you say "polyurethane shield"?

MR. HALL: Yes. Not on this one, but on a previous one -- polyethylene, excuse me.

DR. RAJ: I was just going to say, my God, that doesn't go with the slide.

MR. HALL: Excuse me, polyethylene, you're correct.

DR. PRICE: What is the material on the impact limiters?

MR. HALL: Can I cover that again when we get to the comparison slide? That's easier for me to talk about them, because there it's obvious that there are differences.

DR. PRICE: Yes.

MR. HALL: Okay. I might just mention on this last one, although it's common to all three of them, but on the rail cask, they have fins for heat transfer that go from the structural member through the neutron shield to the outside shell so that you can dissipate the heat. These are generally stainless steel or carbon, or some subset thereof, and there are generally 30 to 50 of those around the circumference going through the polyethylene or whatever they are using for the neutron shield.

This is a consideration because we have about 1,500 kilowatts of heat generated by each one of the fuel lines. So there is a considerable amount of heat that has to be dissipated.

DR. PRICE: On this one, you use borated concrete?

MR. HALL: Yes, and I'll get to that in just a moment, also.

DR. RAJ: You said 1,500 kilowatts of heat. Per rod, is it, or for the whole assembly?

MR. HALL: Per assembly. We do have an assembly -- section of assembly, a GE, it would be a boiler water reactor assembly over here that's provided to you. That's what I'm talking about when I say "an assembly." It's an array of 7x7 or 11x11 or 17x17. The plan for those that we've come up with is about 1,500 kilowatts after they have five-year cooling coming out of the reactor.

DR. RAJ: In your design analysis, have you taken into consideration what would happen -- within what time would you have some critical problems? When I say "critical," I don't mean criticality, but --

MR. HALL: Well, the heat has to be dissipated, and that's one of the things that they do during the design, get enough fins in there so they can dissipate at steady state. Then they also have to consider what build-up of heat there is in this if they are surrounded by this 1,475-degree fire. Those are considerations in the analysis.

Okay. I'll try to answer your questions. First of all, look at the payloads, and these are all what we call a common-use cask where they take and use different baskets for PWR and BWR. We go from 26 PWR to 21 and from 52 to 48 BWR in the designs.

There is the HY-85, which is a structural material which is unique to NAC; the other two use

stainless steel. There are aluminum baskets and
stainless steel. There is the honeycomb impact
limiter and foam impact limiter, which is unique to
NUPAC. We have a sample of the foam over here on

this board that shows the impact limiter. They've used this previously, I believe, on the 125-B that's used to transport the TMI debris at the present time on a rail cask. Balsa wood and kevlar reinforced is unique to B&W, and that was -- that's used on the TN cask which is being -- which was just certified, the BRP cask, which is over here. The safety analysis report used this same material, so it's not unique to them if you look at the whole fabrication capability out there.

On the next slide, I need to make a correction. This is -- it is correct on here. On your handout, it shows depleted uranium-- or it may show depleted uranium, but it really is lead. The neutron shield, the Bisco NAC, which is over here on this table where you can see a sample of that, the borated silicone and then the borated concrete, and I don't believe we got our sample from B&W here. We expected to have it, but what it is is as it just states, a high-density concrete which has boron distributed throughout it for the neutron shield.

It's not unique to them, it's being used in Europe
in their transportation casks, and they actually
have as a subcontractor, a company called Robatel,
which is a French company, that has used that on

casks in Europe. They will be providing the material to B&W in their cask design.

DR. PRICE: Is the distribution of the material reliable for fabrication purposes?

MR. HALL: That's one of the tests that -- one of the engineering tests that I mentioned. They'll be doing one of those to see how the distribution of the boron occurs in the concrete.

DR. PRICE: But the question would be in the manufacture or the fabrication process, it may pass an engineering test, but will distribution -- is the process a reliable process, or do you know?

MR. HALL: Well, again, I just have to say that they have to satisfy us and the NRC that their fabrication process does have uniformity of the boron, and it's not just a consideration, but it's also for any other material where you have the boron distribution and there is considerable discussion with the NRC on that particular topic.

MR. HALL: The other comment here was the wedge-loc closure where NUPAC has a design -- excuse me, where NAC has designed, instead of having the bolted closure as you're probably used to and can be seen demonstrated over on this cask model, they have a wedge -- they have wedges that are contained in the lid and they are driven out to a groove in the outside flange and they are driven out.

They are hydraulic. Once they are in place, they are actually locked mechanically so that you don't have hydraulic pressure that is holding the device in place. It's unique. They are developing an operating model of this to answer questions by the NRC, but we believe that it will have the opportunity of minimizing a lot of the exposure because a lot of the exposure in handling a cask is when you're putting on and taking off the lid, the workers having to do that are working over a fairly high radiation area, and if we can do that remotely, we think that has some significant advantage to the program.

DR. PRICE: There is a large number of these hydraulic cylinders in the cover?

MR. HALL: Yes, on the order of 10 or 12.

DR. PRICE: And is there visual feedback that you can determine that each is in place?

MR. HALL: Yes. The locking device has to be in place before an indicator will show that the thing is locked in place. They all have to be in place before this indicator is tripped.

DR. PRICE: It's a single indicator and all of the cylinders have to be made in order for it --

MR. HALL: For that lock to go around and that lock makes the indicator come on.

Just to give you an idea of where we are on weights, and then I'll get into the GVWs a little later, but you have about a 54,000-pound cask for the overweight -- for the legal weight truck.

We have a requirement in the contract that they will meet 200,000 pounds with fuel and water in the pool. That is what we call a hook weight. That is what the hook has to lift out of the pool. It has to be less than 100 tons or 200,000 pounds.

In preliminary design, we're exceeding that just a little bit where we have done significant weight savings at this time than we have -- well, if they can't meet it, then they have to reduce their capacity so they can meet it, because it is a requirement of the contract.

This comes out of the FICA study and the

crane capacities of a lot of the utilities. So
there is that strong, firm requirement to maintain
100-ton hook weight.

DR. PRICE: Are all of these handled by a single lift device or can some take two lift devices and are the utilities -- do they have to have uniformity in their capabilities to lift?

MR. HALL: They do not have uniformity and they have requirements -- there is a regulation, an NRC regulation, that says that if you have just a single lifting device that you have to have safety factors of two, three and five, and that's on operating, yield and ultimate.

If you don't have that, then you have to have twice that safety -- you have to have four -- those aren't quite the numbers. At least, it's a factor of ten on ultimate strength and then you can lift and have the equivalency of a redundant lift if you use only one device.

In talking with the utilities, they are in favor of this, I think, and we're getting confirmation of having only one device because there is a diversity of designs within utilities, so we will design to the higher elements -- higher safety margins, so we can meet the requirements of redundancy with a single lifting device.

DR. PRICE: And do the yokes for lifting go with the casks or are they kept on site? Are they part of this weight here?

MR. HALL: The lifting device is part of this weight and each contractor will provide a lifting device and whether we require more than one of those is an operational consideration that's being studied right now. We're leaving it with the utilities. There is a campaign going on where there will be cask loads coming out of that utility. It may be left at the utility; if not, it may go with the cask.

I think I've covered all of the innovative design features that we considered in our previous discussions.

DR. PRICE: Is there any concern about balsa wood because it burns?

MR. HALL: Yes, and they have to consider that in their thermal analyses.

I'd like to go into cask fabrication now. We've covered the preliminary designs, and as we've talked about several times that we'll have a review of that.

A review of the preliminary design package will result in a report which then will define the basis of which they will go into the final design. At the end of the final design, we'll have another review.

While they are doing the final design, they are building models that will perform the tests that Marilyn indicated; the drop test, the pressure test, the puncture test. Those sorts of things are done by a model which is done in final design and based on the outcome of the review of the preliminary design.

After these designs are complete and it's been accepted by the DOE, they will provide a design package with specifications, and that's what they will build their prototype with. That's what I'd like to talk about now is just that fabrication process, and I won't bother you with going through all of the codes and standards, but we have, again, accepted the uniform and widely accepted practices that are out there from the many years of fabrication and also the regulatory bodies, and it facilitates our approval of this or the NRC approval of this, the Code of Federal Regulations, various codes there.

The Department of Energy has ones that

relate specifically to packaging and transport, and they've included one typo to see if people are awake. There are safety requirements in DOE Orders.

Nongovernment codes and standards, again, that we use that are consensus standards and on down the line. Association of American Railroads has requirements that we will be meeting, particularly in the recommended practices for new cars, and we will actually meet those requirements and I'll indicate that in a few moments.

Quality assurance with our codes and standards, not just in the design but in their quality assurance plan. They have to indicate to us the types of quality assurance controls that they will have during the fabrication. These, again, are DOE Orders; NQA-1 being the primary one that we address now. In 10 CFR 71, Part H addresses the quality assurance for packaging and regulatory guidance.

DR. PRICE: Is there someplace sometime that a cask is fully inspected by Inspector 16 or something and certified to have been built by the design in accordance with the certification of that design?

MR. HALL: Yes, there is.

DR. PRICE: There is some point in time when that one cask -- it itself is certified?

MR. HALL: The quality inspectors, if you will, the quality control people that show conformance or compliance are living with this cask as it's going through the fabrication process, so it's not just a one-time thing, but each process it goes through, if there is an x-ray, they read those x-rays and make sure that there are no voids or inclusions. Then, of those, those are all put together for a package that says that this is certified as being built according to the standards of the package that was presented to us in the final end process.

DR. PRICE: So it's a series of steps, and there is not a final inspection and a final sign-off as such?

MR. HALL: There is acceptance testing where if there are dimensional things on the outside -- you know, you can't inspect the internals at that point, but there are dimensional inspections and there are also shielding inspections that are done after the cask is put together. That will be an inspection package that goes with that cask.

DR. PRICE: I raise the question because I've read that there have been incidents of the casks not being built in accordance with the spec and in accordance with the design itself.

MR. HALL: Yes, I appreciate your concern there. I do believe that we do have a quality assurance/quality control program that will assure us that the casks are built according to the design that has been certified by the NRC. We have a large effort in that area and we're very concerned about the same thing that you raise.

I mentioned graded quality approach to quality assurance, and this means that the cask contractor, before he started design, specify to us a quality level -- one, two or three -- for each one of his components to be addressed; quality one being the highest level of quality assurance.

There are very stringent requirements for analyses, for testing and so on and that he performs under; quality three being the least significant of the requirements that does not require or is not involved in the safety aspects of the cask itself.

We have those listings from each of the contractors prior to the beginning of their design and we'll be reviewing them to make sure that their quality plan is carried out in the design of those quality level one's, two's and three's.

In addition to this, the cask contractors have internal personnel that are knowledgeable on fabrication, but I believe all of the contractors -- if not all, a majority of them -- have gone to fabrication houses; that they have subcontractors where they expect to go for the fabrication, have already submitted their preliminary designs to them and asked for their input as to the fabricability, the difficulties that might be involved and changes that may be made in the design so that they can be fabricated and inspected appropriately to make sure that the manufacturer is performing according to the requirements.

In addition to that, we have manufacturing engineers on the Technical Review Board, and that would be a consideration of the formal design. Then, as I mentioned, we have the quality assurance personnel at the tail end of the fabrication which will ensure confirmation.

Cask carriage developments. By the carriage, we mean the trailer -- in this case, the trailer and the railcar.

We'll cover the legal weight truck first, and I'll show you where the limits for the GVW occur and the other requirements show where there aren't some regulations or specifications. The 80,000 GVW is also broken down into requirements for steering, single and tandem access. The overall weight cannot exceed 80,000 GVW. The length varies according to the states, and we should not have any problem there because we have a very concentrated load and we don't have a need for long length except to meet bridge formulas and it's well within the requirements of the various states. There is a federal standard for 102-inch width and we will comply with that.

As I indicated, there is no consensus standard for design. The N14.30 Committee is in -- N14 Committee is in review of an N14 performance standard which would have acceptance criteria for trailers, and we have not waited for that, as I'll show you on the next slide, but there is also a requirement for -- not a requirement for recommended practices for guidelines for construction, but we didn't feel that these were appropriate or defined enough and so we have asked GA and Westinghouse to provide for us a design specification for the trailer that they will be developing.

They are then in the process of doing that now. They both expect to cooperate on this. We have had a workshop with those two contractors, told them what we feel is required there and we've had their draft of the design specification reviewed by the Oak Ridge folks, who are in the operational area of our program.

MR. COONS: Can I ask you a question on your trailer design? Are you going to have the QA procedures in effect as well?

MR. HALL: Yes. Yes, we will.

Right now, what we've done is we've allocated weights to get down to the 80,000 GVW, and we have 9,000 or 10,000 pounds for the trailer and the tractor is 16,000 pounds. As you'll see in this afternoon's presentation, we may need another thousand pounds there, but as I also indicated to you, we're under just a little bit on the cask weight, so we may be able to make this up.

This is about the way the breakdown is now and we think we're well within getting an acceptable tractor, a good trailer and, of course, allowing us for the maximum capacity we can get on the legal weight truck.

MR. KOUTS: I think that was a very

important slide for you folks because we call our program the cask systems development program and it is a systems analysis within itself as to how you create this vehicle to move across the road.

Weight is a very important consideration. You have to trade off cask weights sometimes to trailer weight, to vehicle weight and so forth, so, again, this is a delicate balance that you're always playing with throughout the design process.

DR. PRICE: As part of that, are these all lowboy trailers? Is the trunnion height with the limiters and the CG height all figured in that?

MR. HALL: Both of the contractors are looking at lowboys. I can't tell you they are going to come up with a lowboy finally, but that is certainly a consideration.

On the tractors, I would just defer you to this afternoon's presentation where they'll get into a significant discussion of tractors and weights and the requirements there.

The railcar requirements, we want to have a free interchange car -- that is, there are no restrictions on the car because of the design or the weight of the car -- and that is written in the contract. To do that, we have to have a 263,000 GVW and any axle cannot exceed a quarter of that weight. The maximum length is 48 feet; maximum CG above the rails, 98 inches, and we hope we can be underneath that.

As I indicated, the railroads -- Association of American Railroads has a design and testing regulation, and we've imposed that on the contractors, so they'll have to be passing that design, and of the new car committee, the Association of American Railroads, and the testing that is required by them.

Operator safety is by the Federal Railroad Administration, and those are also imposed on the cask contractors.

DR. PRICE: What's free interchange mean? Four axle?

MR. HALL: It does not necessarily mean four axle, but we're certainly getting that message from the Association of Railroads that that's what they'd prefer.

The railcar developments, the DOE has a contract with the Association of American Railroads where they give us input, and although they are not directly involved in the design of the casks themselves, they'll certainly be involved in the design of the railcar itself.

I mentioned that 100-ton hook limit, so if we've got 200,000 pounds here, it leaves about 63,000 pounds for the railcar, the tiedowns and the personnel barrier. In discussion with the railroad people, we think that is sufficient to get a very sturdy railcar. The contractors have all employed specialists, either retired AAR or railroad people or those who are railcar manufacturers, and they are at the present time developing conceptual designs for the railcars.

That concludes my presentation.

DR. RAJ: You alluded before to the European and Japanese experience. How do these casks differ from those that are in operation? What have you learned from their operation scenarios, both human and technical problems?

MR. KOUTS: That's one thing that we're looking at right now and trying to get input from the international community on, on what their experience is.

We have some actions underway to look at international experience in the area of radioactive waste transport right now. We don't think we have a lot of international input into what we're doing.

We have certainly a lot of interest in the recent conference and many people were interested in the designs and so forth.

In answer to your question, I don't think we have a lot of input from European and Asian experiences in this area, and that's something that we're looking to add, especially in the area of operational procedures and so forth.

DR. RAJ: Let me rephrase it. What's the significant difference between those casks and the casks that you're developing? Is it the weight? Is it in size? Both of them have to meet the same kind of regulations; i.e., if IAEA and NRC are the same as you said before, why are we developing a new cask design?

MR. KOUTS: Again, going back to the comments I made earlier, that we're looking at very aged fuel to move and, as a result, we're trying to increase capacity and, as a result, we're looking to new designs to develop casks that have higher capacities. There aren't any capacity casks out there right now that are approaching these cask capacities, so our basic input for this initiative again was to increase cask capacity, taking advantage of the opportunity we have with the aged fuel that we expect within the system.

DR. RAJ: Okay.

MR. KOUTS: We're almost right on time, believe it or not. If you look at your agenda, I think it's a little confusing, we've allowed you from 12:15 to 1:15 for lunch, and there is no description as to what you're supposed to be doing between 1:15 and 1:30, but we'd like to start again at 1:30 sharp.

We've covered a lot of material this morning and we have at lot more to cover this afternoon. We certainly thank you for your attention and we'll see you at 1:30.

MR. HALL: The cask exhibits here will probably go away this evening, so if you have any questions on those, please seek out one of us and we'll try to describe it for you.

(Recess held.)

AFTERNOON SESSION - August 21, 1989

MR. KOUTS: If we can all begin to take our seats for our afternoon session, please. The afternoon session you're going to be listening to today will deal a lot with our operational planning and a lot of operational considerations associated with the transport of the casks that we heard about this morning.

What I'd like to do now is introduce Dr. Elizabeth Darrough, who is on my staff at DOE Headquarters, and she'll be more or less giving you an overview of our operational planning area and also introducing the subsequent speakers.

So I'd like to introduce Dr. Darrough.

DR. DARROUGH: Can you hear me okay?

I'm Beth Darrough and I'm going to give you a very brief overview of the operational planning that we have set up. I'll be discussing our goals and objectives and our general strategy that we've used in developing the planning part of our operations program. I'll show you how we structured the operational planning and basically where we are.

I will introduce Mike Klimas, who will show how we used the systems engineering approach in structuring a very complex program where we have more than a hundred waste sites. We have multiple transport modes, we have different cask types and waste characteristics, and all of this we've tried to put into a coherent, meaningful system and by using a systems engineering approach.

He and Ron Pope will be describing in some detail the subsystems that we've developed and with an interesting part of how we're using the shipping experiences of others in our planning.

As a subpart of that, Rob Rothman will be talking about a preliminary analysis that's been done on human factors and accidents. The human factor study has limited applicability to our program, but it still is useful as we are planning our training.

Our general philosophy -- and this reinforces things that have been said earlier this morning -- is that our operational system must be developed in a way that is safe, efficient, cost effective, accepted by the public and utilizing the private sector to the maximum extent possible.

Our overall goal, of course, is to provide a smooth transition from the existing system in which about 100 MTUs per year are shipped to our full-fledged operation where we'll be shipping 3,000 and ultimately 6,000 TRSs per year.

We see three primary goals of our operational system as to develop -- first of all, to develop the operations support system, to deploy a limited operational capability by the year 1998 and then to initiate the transportation of spent fuel to an MRS or other repository when they are available.

Keeping this slide on for a second, the objectives for each of these, in developing the operational support system, we first need to look at the functions and to define and describe them and to allocate them; then look at who will be working the functions, what kind of management structure will we be considering.

Then we also need to define and describe the support facilities and finally to provide technical demonstration and implementation of these facilities and the vehicles.

In looking at the second goal, the limited capability by 1998, we would be moving from an

existing infrastructure, which is using the existing
casks and cask maintenance either at the utilities
or at the cask vendors, and from there moving
gradually to using our own casks and developing a

cask maintenance facility.

To initiate full operations, we would be initiating the transportation sections of the standard contracts with the utilities, the 10 CFR 961; we'll be supporting the overall OCRWM work with the utilities under that standard contract and moving on to fully implementing transportation operations.

Our strategy in planning a transportation operation system is described with this waterfall. In looking at the first -- at the top row, first of all, we have to identify what the functions were. Our three main functions were to accept the waste, transport it and support the transportation operations.

From there, we allocated the requirements to subsystems, and I'll go into some detail in a little bit about the subsystems that we have defined, one of which is maintenance and servicing. I'll take that as an example for this what we call a waterfall effect.

Then once we have a subsystem defined, we need to look at the technical requirements for those. In the case of the maintenance, we figured we needed a maintenance facility for doing such things as basket changing, cleaning and decontamination of the cask.

From there, you look at trade-off studies, and one of the trade-off studies that we looked at in developing our cask maintenance facility was, should it be a wet facility or dry facility? It's at this level that we are now.

Now, the bottom tier is something that we'll have to be doing over the next several years, developing a design criteria, title one and title two design, and the actual procurement or acquisition of facilities, the testing and operating.

Generally where we are, our status now in terms of structuring the operational planning, we see the transportation operational system as having five subsystems. Now, these are not necessarily in any kind of hierarchy or order, but I'll go through these briefly, and Mike and Ron will go into them in some detail.

The planning and control subsystem,

obviously, is your long-range planning, administration, regulatory compliance, quality assurance, ultimately campaign planning and site service plans.

The servicing and maintenance subsystem, from this, we will have the main cask test maintenance facility and vehicle maintenance. Ron will be talking more about that later.

The field operations subsystem will cover things like cask handling procedures and training, as was mentioned this morning, as to how the workers at the utilities would be trained in terms of handling the casks.

The casks subsystem, we've already mentioned a little bit this morning and Mike will go into that in some detail.

We've had the operational review of the cask and operational testing. The carriage subsystem, again, we'll have some detail about this this afternoon.

Ira had mentioned the weight limits, and we'll be looking at the weight limits of the cask and the trailer, as well as the requirements of the tractor, and see how they all add up.

So now I would like to introduce to you

Mike Klimas, who will give us some details about our systems engineering approach and about the cask subsystem.

MR. KLIMAS: As Beth mentioned, I'll be

talking a little bit more about the systems engineering approach we're doing and some long-range planning we're doing for the system and also discussing a little bit more from the operational perspective the operational input into the cask designs.

I believe on the transportation operational planning, we have two activities going on. We have, as Beth mentioned, systems engineering and we're also doing some long-range planning on the planning and control subsystem.

Additional efforts and activities I'll be talking about is our interface with cask design development, and this is on two levels. One is our review of the cask designs and also what we're doing in trying to look at the carriage system in terms of the tractor and what's required equipment from a tractor standpoint.

I put this slide together to kind to illustrate some of the issues and logistic problems that the operating system must contend with.

Really, on the operating side, it's not so much of a technical issue as it is an organizational issue.

As you can see, we really have to interface a number of different organizations. Of course, we have to deliver fuel to the repository, but before that, we have to take fuel from the utilities.

These utilities are very different. There are about 80 different utilities and 125 different reactors, and many of those reactor sites are very different from each other. They have different infrastructures and different modal accesses. We're trying to identify what problems are associated from operating systems and from taking fuel from these different reactors.

The other issues we're faced with, we have to work with different regulations. The operating system -- in the end, we have to contend with verifying that the casks are still in compliance with the certificate of compliance and we also have to deal with DOT regulations in terms of shipping and driving requirements.

Finally, we have to work with state and Indian tribes in making sure that our transportation system is in compliance with various regulations they might have.

The way we're trying to pull all this together is using a systems engineering approach. Right now, we're really at the top level of the tier in which we're looking at reviewing the functional requirements for the system, the allocation process and technical requirements.

Last year, we were focusing a lot of attention on the functional requirements.

What we have done is assembled a team of eight transportation engineers and specialists to kind of ferret out and identify all those kind of activities that the transportation system must perform to do its job properly.

The reason we have a team of eight is we wanted to get input from a wide variety of perspectives. This team includes not only DOE specialists, but also staff that had experience in shipping from private utilities.

Within this group, we've identified three major functions that Beth mentioned -- the accept, transport and support -- but also 80 subfunctions, and we've identified how these functions are related to each other.

In this process, too, we've also had a

peer group that consists of ten experts that have a wide variety of experience that look over our work and to kind of give us input on where they felt we might make some modifications to the functional development that we've done so far.

This slide sort of summarizes, I guess, the effort that we've achieved so far. As I've mentioned, we've identified a top level of three functions: the accept, transport, support functions.

The accept function includes all those activities that DOE would have to do to accept waste from the utility and accept title for that. That will include such things as observing any preparatory activities that the utility could be doing, verifying classification of the fuel, making sure the fuel meets requirements for the casks, observing the loading of the fuel, making sure it's consistent with the cask certificate of compliance.

DR. CARTER: Who is responsible for the -- I wonder if you could go through the interface at the reactor itself.

MR. KLIMAS: As far as --

DR. CARTER: Who loads it and what are the responsibilities.

MR. KLIMAS: At the accept level, the fuel is owned by the utility. DOE takes title to the fuel after it's loaded on a cask, put on a truck and it's ready for shipment. Up until that time, the fuel is owned by the utility.

If DOE wants to accept the fuel, it has to meet all the requirements that it's ready for shipment, it's been loaded properly and things of that nature.

At that point, when DOE takes title, we transport the fuel to an MRS or to a repository, and we've identified those subactivities that go along with that.

Then we've identified the various support functions that would support both the accept and transport. That would include traffic planning, maintenance and emergency response activities that may be required, training of the utilities in terms of training for the loading of fuel, helping the utilities develop procedures for the loading of the fuel into the cask and also a QA program that would be over all this to just make sure we've met all our requirements.

As I've mentioned, we define a number of

lower-level functions that are a part of this.
We've also put these in sequence so we know which activities are in parallel and which precede each other, how one activity depends on another

activity.

As Beth mentioned, out of all of this we've also identified a number of subsystems in which all these various functions would be incorporated under.

Final activity involved or underway now is identifying issues involved that come out of this work. One issue could be, for example, what is DOE's role in observing any preparatory activities that a utility might do in preparing fuel for shipment?

That's an issue we have to look at, understand more fully, and that's an example of an issue that's coming out of this activity.

As I mentioned and as Beth mentioned, we have five subsystems, and I'll be talking now a little bit about the planning and control subsystem and later on about the transportation casks subsystem.

One key requirement in long-term planning is that we're trying to understand just what is it that requires the operating system in terms of what utilities will ship when, how much of it we'll be shipping and how long will it take to really ship the fuel.

The understanding of this comes out of the DOE standard utility contract, which is a contractual relationship that DOE has with the utilities. This specifies responsibilities of DOE and the utility.

One of the requirements out of this contract is that it establishes that utilities that have first rights to deliver fuel to DOE are those who have the oldest fuel. The contract establishes that those utilities that have first rights to this system have the oldest fuel. The utilities have the option, if the utility has more than one plant or reactor under it, they can allocate this to the site that originally resulted in the oldest fuel or distribute that among other sites in its organization.

What we're trying to do is determine just what kind of distribution could occur and what that means in terms of operating requirements.

DR. PRICE: Maybe I don't understand the oldest fuel first idea. Does that mean that regardless of the utility, wherever that oldest fuel is, that it goes first?

MR. KLIMAS: Right, that utility has the option. That's the first fuel that has to be delivered to the system.

MR. KOUTS: In terms of setting up the queue -- in terms of setting up the actual queue as to how we'd service the utilities, the oldest fuel first is the priority, if you will.

There are some differences of opinion associated with whether or not we would actually pick up the oldest fuel, and the utility perspective is that -- their perspective has been, in similar negotiations we've had with the utilities, that as long as they meet the requirements, which is five-year cooled fuel, that that would suffice and that they don't necessarily have to provide us with the oldest assembly that they have in their pool.

So this is something that, I think, will be worked out in some years as to exactly what we will be picking up at the time we're ready to pick up fuel from any reactor facility.

DR. PRICE: Will each facility be uniformly serviced in delivery from the reactor or will certain ones, because they have older fuel, receive more attention earlier and so forth?

MR. KOUTS: The actual queueing again is set up by the age of the assemblies in the pools, so if it requires us to go to a reactor one year and then the next year go back to that same reactor, we would do that according to the queue.

There have been some discussions associated with whether or not the utilities will exercise trading rights and trade their rights to other utilities, but this is something that is still in the theoretical stage at this point.

I think when we actually have a delivery commitment schedule and so forth, and as we move closer to the point of shipment, we'll get a little better idea as to what we'll be picking up.

DR. PRICE: Storage capacity of an individual site, does that enter into it?

MR. KOUTS: No, it does not.

MR. ISAACS: No, but it's a very relevant question to the MRS Commission who has been wrestling with the same question.

If you look at strictly the oldest fuel first concept and the kind of situation you'll run into over the next 10, 20, 30 years, what you find is that the amount of additional storage that's required is quite a bit greater than if we went to pick up the fuel based upon the needs of the individual reactors with regard to the queue.

In other words, with those that have storage, one might say, "Well, why don't you go to them later in life, they can handle their fuels"; whereas, others might have to go to some other kind of concept.

So our utility contracts call for us going by the oldest fuel first rule, as the Q requires. As Chris mentioned to you, trading rights might help alleviate some of that situation; in other words, utilities that have excess capacity might trade their rights to other utilities that are running into difficulties.

These are some of the issues that the MRS Commission is wrestling with right now and may, indeed, make some suggestions when they make their report in November.

MR. KOUTS: Just to add a technical point, I think that to get some utility perspective on this, most of the utilities that are going to dry storage, for instance, will be placing their oldest and coolest out in the field.

As a result, if we pull up to a reactor site, the oldest and coolest will be in metal or concrete storage. Their perspective is that what we should first do is take what's in the pool and then worry about the other material later. Again, this is something that will be worked out with the utilities in years to come.

DR. CARTER: How do you maximize the amount of fuel that you have? I presume what's available in any given age in burnup and so forth may not match what you can carry, for example. You take partial loads or --

MR. KOUTS: Well, we hope that --

DR. CARTER: -- some older and some newer? Are you going to fill up the casks in every case?

MR. KOUTS: You're raising very good questions. It's not only the amount of fuel we pick up and what its age and burnup would be, but how many truck reactors we're servicing in one year, how many rail. The ones we have to service in one year, that certainly adds complexity of the amount of transport.

These are issues again that have to be negotiated out with the utilities. It's difficult to get a handle on it from an operational standpoint, there are so many analyses that you can do, but what we're trying to do is to do the best we can and to try to get our arms around it and find out what the bounding limits are and then, hopefully, as we move closer to shipment, we'll be able to negotiate some of these issues.

DR. CARTER: I presume all the data are available or will be, and I presume, also, it's up to the reactors to certify the burnup, this sort of thing.

MR. KOUTS: They will have to certify burnup. There is also a question as to whether or not the NRC would be interested in some kind of measurement associated to confirm what the burnup would be for that individual assembly. Administrative records are not necessarily what the NRC would like to see. This has implications also in emplacement underground and so forth.

These are all very good issues and they are ones that we are aware of. Again, they'll be hopefully resolved as we move closer to shipment and we get a better idea as to what the shipping schedules will be and the trading rights will have occurred and we'll have a little better

understanding of whatever it will be in any one
year.
DR. PRICE: With the oldest fuel first and
dry storage on site, does that not mean that there

has to be some kind of transfer capability in vehicle, like a transfer bell or something to go from the dry cask to the pool and then loading it into the -- from the pool into the cask?

MR. KOUTS: Essentially what would have to occur, assuming that the device that they have out for dry storage is not transportable, is that some mechanism would have to be developed to transfer that fuel to a transportation cask.

In most instances, I would expect that they would have to move it back into their pool to open up the container that they used for storage and then we would take the fuel out of there and then place it into a transport cask.

DR. PRICE: Is this strictly the utility problem? Does DOE get into this part of the transfer issue?

MR. KOUTS: I think that it's a collective problem, but the NRC is very interested in this issue. They call it ACARA, as compatible as reasonably achievable.

One of their concerns is -- there already is proliferation of reactor designs out there and the NRC is concerned also about proliferation of dry cask storage designs, so you're talking about more and more designs and adding complexity to the ultimate operations of the movement of the fuel from the reactors to the storage or disposal site.

DR. CARTER: Why are they concerned about it? They control that, don't they? They have to regulate those.

MR. KOUTS: They have to regulate, but as long as the -- as the technology that the utilities are utilizing is certifiable under 10 CFR 72, which is the dry storage requirements, there are a variety of ways you can meet that. You can meet that with metal storage, you can meet it with concrete storage, you can meet it with storage transportation casks, if you want.

So there is still flexibility within the regulations for the utilities to make their own decision as to how they are going to best deal with their dry storage needs, if they need them.

DR. CARTER: There is also flexibility on the regulatory side.

MR. KOUTS: There is -- and I think there is agreement between the NRC and the utilities and the Department of Energy that we ought to work towards some type of minimization of designs and ease of integration. I don't think we're there yet.

I think that there are a variety of discussions that still have to go on, but I think it's certainly an issue that the industry and NRC and the department is certainly aware of and working on.

DR. PRICE: But the tendency now not to have a dual cask kind of a program is taking us in a direction away from having a dual cask, dry storage/transportation type cask?

MR. KOUTS: I don't think necessarily that dual-purpose casks are the total answer to this compatibility question. I think they may be part of it, but I think there are other ways to look at it.

Minimization of the amount of designs for a metal storage or potentially a metal storage container that could be dry transferred into an outer shell transportation container; there are, again, different ways to look at it.

I don't think anyone has stepped forward and said that they have an answer. I think that both the industry, the NRC and the DOE are searching for an answer, but I don't think we've found one.

MR. KLIMAS: Okay. Continuing on. The

other considerations or requirementss of the contract is it requires a cask and support equipment suitable for use.

There has been a lot of discussion on the cask requirements, but also utilities have done some of the rating of the training requirements. We'll be looking at that and the old design to see how they are compatible. We're looking at the requirements of 10 CFR in terms of training to utilities.

The next slide is of some of the discussion we just had. We're trying to define what the oldest fuel first means in terms of the operational requirements for this system, in terms of what will be shipped when, how much fuel, what does this mean in terms of rail casks or truck casks.

There are many different ways utilities may allocate their oldest fuel first requirements in trying to reiterate the process and understand how much can be shipped from different utilities given the oldest fuel first allocation process and by doing that get a better understanding what the operational system must do.

The issues that emerge from this are kind of what we talked about before. As I mentioned, we have 80 different customers or utilities that contract with DOE, with a total of 125 different facilities. Each of these facilities are different in terms of your infrastructures.

We have a modal split that has been identified with studies ongoing now to get a better handle on what this modal split is. There are reactors access/handling capabilities. Several may have derated their cranes and shipping using rail, if they have a rail capability, and using rail may require an increase in capability of the train to handle that if it's been derated.

We also in this country don't have any experience in long-term continuous shipments. As Chris mentioned earlier, in this country the average shipments of spent fuel have been on the order of almost 100 MTU per year. The program would eventually require us to ship 3,000 MTUs.

We'd have to kind of gain a better understanding of how many shipments this will

require, how many sites we'll be shipping from and
how is the best way to organize these shipments from
one region for a period of time or from one region
to the other, what's the best way to handle this

problem.

DR. NORTH: What stages are you at in working out these scenarios with some degree of detail? Do you have a base case with and without MRS for what this ramp-up is going to look like in terms of number of vehicles, number of people, time to train the people and so forth?

MR. KLIMAS: Right now, we're working and trying to develop this. Probably at the end of October, we'll have some idea what it will look like. Right now, we're just identifying --

DR. NORTH: Right now, there is no base case you can show us, essentially?

MR. KLIMAS: Right.

MR. KOUTS: We are basically planning assumptions with how much we'll ship in the first seven years to an MRS and how that would ramp-up to a 3,000-ton-per-year capacity.

I think what Mike is referring to is that within the parametric analysis of that base case, there are a lot of different calculations that you can go through, and I think what we're looking at is trying to look at bounding cases associated with the base case, because the base case, although it's defined simplistically, it can have a lot of variation with it and that's what he's referring to, but we do have planning estimates as to how much we'll move to the MRS in its early years and how the repositories would ramp-up and so forth.

Those are well defined in the mission plan and the mission plan amendments that have come out and so forth, so we have basic assumptions related to the planning of the program.

MR. KLIMAS: From the operation's side, we want to go down to the site-specific level and determine what does a shipment of 3,000 MTU per year, for example, mean in the next year for each site.

One site will say -- one plant might be 200 MTU from for a three-month period and by integrating into other sites, we can get an understanding at a very detailed level as to what needs to be done from the operational side.

Right now we have a very global understanding. We're trying to get down to a nitty-gritty understanding as to what the shipments might be.

DR. NORTH: I guess my concern is the lack of seeing something in the middle and with the very, very fine level of detailed planning such as we talked about this morning on the casks and thinking about it in terms of a ramp-up of tons per year and at the level of how many people do you need and how many activities do you need for maintenance and what your modal split is going to be and what you tell the governor of a state or a mayor of a town that's concerned about how it's going to affect them.

It would seem to me it would be very important for you to get maybe not one base case but a small spectrum of scenarios where you can really lay it out in detail as to what's going to happen and when.

MR. KOUTS: I agree with you and, again, we're also dealing with a lot of variables; variables in terms of not only who we're going to pick up fuel from, but what that fuel will be and whether or not that utility will trade it to another utility so we won't be going to that site, anyway.

One of the areas we're looking at is just how much -- for instance, what's the maximum amount of casks that we would need to service -- given our acceptance schedules, to service the amount of truck transport we'd have to have. Again, we can't move that much with trucks, so we're very sensitive to that.

I think what we're telling you is that we're trying to get a handle on this and that there are a variety of variables and we're nowhere near the point where we can state with assurance that this is what it's going to look like.

I think only after a variety of iterations with utilities and on a variety of assurances that we'll have a better schedule in our facilities and we'll be able to do the type of detailed planning that you're suggesting.

DR. CARTER: Well, don't you know -- you know the age of the fuel, you know the burnup at the utilities. Now, you certainly know whether these things have got a rail spur or whether you've got to pick it up by truck.

MR. KOUTS: You've stated some things that we don't really know, because I think --

DR. CARTER: I think you could get somebody on the phone and in a couple hours you could find out whether you've got a railroad spur in each of these.

MR. KOUTS: Will it be there at the time that we're ready to ship? Will there be rail abandonments that occur that will cause that rail spur to be no longer serviced by main line?

So even if that spur is there, we have no way of getting it to a main line and getting it to its ultimate destination. It's those types of issues that we have to feel comfortable with.

DR. CARTER: Some of those may be unanswerable at the moment, but there must be some bounds on that in terms of current information.

The other thing that would appear to me that you don't know the most, if that's the correct terminology, is the trades between the utilities as far as what they may do.

When are you going to have a handle on that?

MR. KOUTS: That's a good question.

DR. CARTER: I think some of these other things you could tie down reasonably close.

MR. KOUTS: We're required to have input from the utilities. I believe we're supposed to have it six months before we're ready to pick up, and that's the minimum amount of time that we have that the utilities have to tell us exactly what we're going to be picking up in terms of the age and the requirements of the fuel.

So even though we're talking about 10 to

15 years in the future, it's not until six months prior to the time we're actually ready to go to that facility that we'll actually know what we're going to be picking up. So there is a lot of variability associated with that.

We're trying to portray to you again some of the complexities associated with this. We're trying to plan for the system because, again, there are many, many variables.

In terms of the age of the burnup of the fuel, I would agree with you, we can make projections on that, but, again, it's not just what we see at that reactor site, it's what the utility will actually give us when we come to pick it up.

DR. CARTER: I understand that. Like I say, the age of the fuel and the burnup, I would think that would be, you know, available information.

MR. ISAACS: Things that are out of reactors now, for example, I think we're not giving a full picture of what we know here. In an effort to try to explain to you how complex it is, we know far more than you might suppose from what you've heard so far.

DR. CARTER: I'm pleased to hear that.

MR. ISAACS: We certainly know by assembly how old that assembly is, we know what its burnup is within reasonabe calculation limits. We know by reactors the projections that are out there for spent fuel. If you look at the annual capacity report, which is a document that comes out --

DR. CARTER: No matter how you slice it, some of that is going to be the oldest stuff.

MR. ISAACS: One of the things that I think we're trying to portray, and it was part of my introductory remarks, is that you have to make certain decisions at the time when you have enough information to make smart decisions.

With some of these things, you have to put together a capability that has flexibility associated with it to allow you to operate the system in an efficient way, given a certain uncertain future world.

The fact is that there is no way today that we will know what will be occurring when we start to pick this fuel up; can't do it. So we're trying to develop bounding conditions, we're trying to develop trade-offs, we're trying to develop insights, we're trying to develop the building blocks here.

I think Warner's point is probably a good one. We have done of some of that kind of thing. The law requires by 1991 that we actually come out with a firm schedule to show the utilities how we plan on approaching the pick-up of it, but there will be a number of decisions that will have to be made sequentially, and we'll have to make sure that we have those resources in place to do it in a smart way then.

DR. NORTH: One of the ones I think you may find to be a problem -- at least I'd be very interested in given the little I know about the railroad problem -- is, how do you inventory cars? How long is it going to take to load these casks? How long are they going to do the equivalent of setting on a site while operations go on regarding them that are outside of your control?

MR. ISAACS: Those kinds of things, hopefully, will be part of the presentation here, how we plan on handling some of those logistical considerations.

MR. KLIMAS: Part of the planning is issue resolution activities. We have on the top line data acquisition/analysis.

As I mentioned before, we have the FICA study, the infrastructure study going on, and that's information to put a handle on it. Additional work going on is defining what actually is an alternative operations scenario, what are the factors involved in that, how do you integrate a multi-site campaign activity.

Those are things that are ongoing in the future, where we have to really try to understand a problem in a very general sense and kind of working our way down lower, to a lower level of detail, and in doing that, we hope to develop some scenarios.

We have a general basis, the number of equipment in terms of casks that are needed, what should be the configuration of the cask maintenance facility, acquire the services and personnel to operate the system.

Later on, after we get more detailed information, we'll be able to develop the site specific reactor plan and later on doing some campaign planning. These are things that we're working towards.

The point that should be made is that we -- DOE has developed some global operational base cases and we're trying to work down to a more nitty-gritty level.

We are looking at different assumptions based on that utilities will make trade-offs on the delivery rights. We're looking at maintenance assumptions on turnaround times. We're going to refine those assumptions as we get down closer and closer to shipment.

We realize -- I guess this discussion illustrates that we have a complex system and moving of fuel will not be easy. There are a number of issues that we're not totally aware of right now or we don't have answers for, and what we're trying to do is find those answers.

We think that by going through the systems engineering approach to define the system and going to the integral process of planning, we hope to get a better handle on it. We just really started this activity, and I think in a year or so, we'll have much better, more detailed information to get back to you on those issues, but we recognize those are problems.

The next subsystem is the transportation cask subsystem, and I'll be talking a little bit about our operation system, how we're planning to interface with the designing of the cask.

As I already mentioned, we have developed from this process a checklist for operational review of cask designs. On this checklist that we've developed, in a hierarchy fashion, it covers four areas.

Cask design is for its handling and loading and unloading. We're looking at ancillary equipment in terms of what DOE needs to provide in terms of special tooling and things of that nature. We're looking at -- later on at a transporter design, a trailer, and the intermodal transfer equipment.

We have this checklist, and right now when the cask -- when the preliminary designs are available, a team of transportation specialists review the cask designs with this checklist to provide systems feedback to the cask designers and what we feel should be considered from an operational standpoint.

We also are doing some preliminary efforts at looking at what operational testing should involve, what number of sites we should be visiting through operational testing, what should be involved in operational testing.

The other aspect of coordination with the tractor program is kind of a simple issue, but it turns out to be much more complex than we'd like it to be. As Ira mentioned, we have a target weight for the cask and the trailer of 54,000 pounds and 9,000 pounds, and that leaves us about 16,000 pounds for the tractor.

Right now on the road, a tractor that would, in essence, carry a load of 80,000 pounds weighs in the range of 17,000, 18,000 pounds. We're going back and looking at the tractor specifications to determine where is the weight involved in designing a tractor and what savings can we make to get a tractor down to the 16,000-pound level.

We've identified a number of issues and later on next year we're looking at doing some trade-off studies. We hope to be involved in some demonstration programs. When a trailer is developed, we'd like to be involved in putting together a tractor -- the 16,000-pound configuration to haul the trailer around.

This is a quick review of the specs that we see for a tractor. This is a dry weight, meaning it does include the weight of the fuel and the driver and things of that nature. We've gone through and identified what we thought would be a --

what we feel is a basic tractor, and the weight comes out to 14,500 pounds.

The next slide kind of gives a bottom-line estimate. We feel that a tractor should also -- we'd like to have an additional fuel tank which would give us longer driving time without stopping for fueling, but that would add other weight. We also -- the fuel would add 700 pounds. Each gallon of fuel weighs seven pounds. Either way, the drivers and gear is another 1,000. If we ship in the wintertime and we had some snow and ice, that gives us 17,300 pounds.

We've then gone back and identified where we think we might be able to reduce some of the weight. New technology in engines may allow us to go to a smaller block engine, get the same horsepower, a 400 pound, it might say 500 pounds there, but reduce the sleeper and there's also a possibility of getting some weight reductions there.

This slide indicates that to get to a

16,000-pound tractor, we will have to look at a variety of options and work with the program to see what can be done.

So that completes my part of the

presentation.

DR. DARROUGH: I'd like to introduce Ron Pope from Oak Ridge National Labs who will be discussing the field operations subsystem and servicing and maintenance subsystem.

MR. POPE: I'll begin by discussing facilities in general with a focus on the surface and maintenance subsystem and then move on to a discussion of the field operations subsystem.

We actually envision, as the system developments develops, that we will have facilities in three of our subsystem areas. We will have facilities in the cask -- in the servicing and maintenance subsystem in the area of cask maintenance and vehicle maintenance.

Currently, we envision the need for a cask system maintenance facility, and that's what I'll be discussing here in a moment and is the focus of the next two viewgraphs.

Relative to vehicle maintenance, we would envision that any contamination that might end up on the transport vehicle will be removed at the cask system maintenance facility and any significant vehicle maintenance will be performed at off-site, commercially available vehicle maintenance facilities.

DR. PRICE: Does this, in essence, mean that these facilities will be qualified as safe havens for this kind of a thing?

MR. POPE: No, no. In other words, we would ship the vehicle without the cask to those types of facilities for whatever maintenance you're requiring.

DR. PRICE: What do you do if you have a maintenance failure on the road and a cask is on board and you've got to handle it?

MR. POPE: I'll get to that in just a few moments, if you'll bear with me.

DR. PRICE: Okay.

MR. POPE: The other three facilities that we envision, we have not addressed to date. In the field operations subsystem, we envision the need for an operational control center, and the need for that I will discuss in a bit. We also see a need for a training facility to train those people that will be working within the federal waste management systems transportation system and actually operating the system so that they are properly trained.

Finally, in the carriage subsystem, if we have intermodal transfers, there may be a need for intermodal transfer facilities at those locations.

We felt that of those five facilities that I've just mentioned that the cask maintenance facility would be the one that had the longest lead time and, therefore, we addressed that first.

We've performed and are completing now a feasibility study of the cask maintenance facility. We started that activity in the last fiscal year and are aiming to complete that this fiscal year.

The major purpose of a feasibility study of a facility like this is to determine its cost and schedule so that we can then lay out in the program when we have to do the various other steps to complete that facility.

In order to do such a feasibility study, however, we had to develop a first cut, if you will, of the facility systems requirements. We have completed that. We view this as a living document. As we proceed into the design and development of the cask maintenance facility, this will be updated to satisfy the requirements of the system in general.

Again, as I mentioned, we view this as being a long lead item and, in fact, the information that's posted on the wall over here to my right, the blue pictures there, is a summary of the cask maintenance feasibility study which gives you an overview of the concept, the schedule and our projected costs.

In the study, we assume that the cask maintenance facility would become operational when the fleet itself becomes operational; that it would be a stand-alone facility, what we call a green field facility.

After we've completed that aspect of the study, we then blacked off and said, "What cost savings or penalties would we incur and what regulatory savings or penalties would be incurred if it was located within one of the other facilities, such as a repository or the MRS?"

DR. CARTER: Is there only to be one cask maintenance facility?

MR. POPE: As we envisioned it, there would only be one facility. We assumed, for purposes of trying to establish how we would construct and then operate this, that it would be a government-owned, contractor-operated facility.

There are certainly alternate management structures that can be used here and we are studying those alternatives and the impact that that would have on the scheduling costs.

For a moment, let me just mention the functions, and then if any of you have questions after looking at that, feel free to contact me and I'll describe it or discuss it with you in more detail during the breaks.

We view the functions of this cask maintenance facility to be many, and we've tried to summarize these on this one viewgraph. Basically, it is to schedule and perform whatever cask inspection, testing, preventive servicing and maintenance and damage repair are required of the cask and the ancillary equipment.

Now, Mike Klimas has mentioned the utility contract. In that contract, it defines that incidental maintenance will be performed by the utilities or the purchasers, as it's called in the contract; whereas, routine maintenance will be the responsibility of DOE.

We are striving now to try to define where the cutoff is between incidental and routine maintenance. If you have some maintenance activity that has to be performed on each use, we would certainly view that as being an incidental maintenance activity. Also, incidental maintenance would, of course, require replacement of seals if they become damaged, and at a reactor being loaded, you'd certainly have to replace the seal before being shipped.

DR. PRICE: Who owns the cask?

MR. POPE: We have assumed that the DOE would be the owner of the casks. Maybe Chris would like to address that.

MR. KOUTS: As with the rest of the program, there are a variety of options available to us. We could operate and own our own casks. We could also have private industry operate them for us and we could also lease them from private industry for the use, so we haven't -- we plan to do a full business structure evaluation.

I think in our business plan that we published several years ago and an updated transportation plan will be coming out later, you'll see some of the options that we'll be looking at, but at this point in time, we're not ready to commit to any management structure as to how we'll operate the system.

MR. POPE: The second primary function that's listed there in a sense addresses the question that Dr. Price raised a few moments ago about how do we handle a situation where we have a transport vehicle break down while it's in transit with the loaded cask.

The requirements that we established were that the cask maintenance facility would have the capability to perform unplanned cask repair and, if needed, vehicle repair and inspection at locations other than the cask maintenance facility itself.

Now, certainly, if you had a truck that had broken a fan belt, that would not require interaction with the cask maintenance facility. If you had a major breakdown, a failure of the trailer where recovery action is required, then the cask maintenance facility would need to become involved in that activity.

We also might have unplanned repairs that will be required at one of the other facilities in the system or the utilities and, there again, the people at the cask maintenance facility would be your base of experts to draw upon for that.

We also envision the cask maintenance facility would be that place which would be responsible primarily for what we call a reconfiguration of the casks, the change of the BWR basket for a PWR basket within the cask body and the storage of those cask baskets that are not being used.

Another important function is for both the internal and external cleaning and decontamination of the casks. We are expecting that we will have some form of weeping problem, which was mentioned earlier, unless we're very successful, and the world hasn't been to date in terms of totally solving the weeping problem.

We will periodically have to clean up the external surfaces of the cask. Also, the shipment of spent fuel will generally lead to build-up of contamination within the cask basket and the cask cavity and periodically we envision having to clean that out to reduce the exposure of personnel during the loading and unloading operations.

Finally, the major function of the cask maintenance facility will be the support of cask recertification. What we're talking about here is any testing or inspection that will be required on a periodic basis and also the maintenance of documentation to support the recertification of that cask with the NRC.

DR. CARTER: How frequently is that at the moment?

MR. POPE: Pardon?

DR. CARTER: How frequent is recertification?

MR. POPE: The recertification in the US right now is five years and generally the inspections to support that occur annually.

In the rest of the world, generally, in France and England, they have gone to almost like the 50,000-mile, five-year warranties you get on cars where they are performing service depending on the number of uses or at a maximum once every two or once every three years.

We will be investigating alternatives that might be available to us to enhance our system there.

DR. PRICE: Will there, in essence, then be a certified cask repair person who will have authority and power -- similar to, say, the person making repairs on an aircraft -- to pull it off line, if necessary, regardless of whether it's

certified, this kind of person envisioned who has
some special training?

MR. POPE: My personal view is that that
will definitely be required, that we will have to

have people who are trained, qualified and certified to do this work and, of course, the concomitant QA program goes with that to track all of the inspection, maintenance and repair activities that go with that.

DR. PRICE: Having gone on an airplane that was declared as unairworthy by such a person, is this what we're seeing here, the possibility of a cask being declared untransportationworthy by such a person at this facility until the repairs are made and to his satisfaction?

MR. POPE: Again, in my personal view, yes.

MR. ISAACS: I think it has to be.

MR. KOUTS: In our collective view, yes.

DR. PRICE: I was a little concerned about personal views.

MR. KOUTS: That's a DOE view.

MR. POPE: I might indicate that all of this is in a very formative stage in our minds. Let me get into that as I talk about the field operations subsystem here.

I'd like to introduce this topic by recalling the discussion we've had in the last 20 or 30 minutes relative to Mike's presentation on the standard contract and the implications that that has relative to oldest fuel first and everything else.

DR. CARTER: Excuse me, Ron, could I ask you a question before you get there? I think the descriptive material on the board said that these things would essentially be looked at twice a year; is that correct?

MR. POPE: That's the assumptions we made in our feasibility study.

DR. CARTER: Then the other thing I wanted to ask you about, I think it also indicated that the fleet would be around 75 versus the 100 we were talking about earlier.

MR. POPE: Okay. Both of those questions -- in order to scope out the facility and come up with a design that we used to scope out the costs and such, we had to assume the size of the fleet. We made some calculations and estimated that the fleet would be on the order of about 75 casks under an optimum condition.

We then assumed that they would visit the facility twice a year for either maintenance inspection or reconfiguration and that we would have to have a fairly efficient operating system to manage our campaigns in order to minimize the reconfiguration and minimize the visits to two -- twice a year.

If the fleet were to become bigger, if we have to reconfigure more frequently, then the size and the scope of the facility will have to change accordingly.

Relative to the field operations subsystem and the discussions we've just had in the past few minutes, I'd like to draw an analogy for you, if I may, and that is what we will have when we're in the fully operational state is something equivalent to a fairly large airline.

If you'll envision that the airline that we'll be operating is the transportation people and the people that move in the airline basically are the spent fuel assemblies and high-level waste that we'll be moving, the airlines have a lot of customers and some of these customers buy tickets pretty far in advance and others buy within just a few days or a few hours of being transported.

We will be faced with a similar problem partly because of the flexibility that the utility contract allows the purchasers to select or designate the fuel that they want shipped or even to request an exchange with another utility or another purchaser.

So we are striving to understand the concerns that you have just voiced in the past few minutes in terms of the impact that it will have on a very complex operational system. One way of looking at that is to look at the oldest fuel first concept and assume that not only are the shipments allocated on that basis, but the actual fuel owners are selected and shipped on that basis. That provides one bound.

Another bound, for example, as Chris mentioned, would be to allocate oldest fuel first, but select the youngest fuel that's available from that utility that is at least five years old. That establishes another bound.

Then we have to start looking at what happens if they start exchanging rights. We are starting to try to understand that and what that would do to our campaign strategy, fleet make-up, management of the fleet, and then eventually get into understanding or trying to understand what impacts it would have -- how we would be impacted by such things as weather and the other concerns that were voiced here, what happens when an unplanned shipment sets on a site for two days or whatever.

DR. CARTER: You've got to be careful with that analogy. We've got some airlines that are well managed and some that are less than that.

MR. POPE: Yes. The field operations subsystem will eventually be that subsystem that deals with the services, the data, procedures and equipment pertaining to a number of items.

The first one will be the interface between the facilities and the transportation system, and here we're talking about all the facilities, the reactors, the receiving sites and MRSs, if there is one, and the intermodal transfer facilities.

We have to be sure that we have the proper equipment and personnel interfaces at all these facilities. We specifically will need to eventually address detailed procedures so that we address all of the concerns that we've heard so far today about the human factors and assuring that we minimize the potential for human error.

We also envision having to provide technical support to the facilities. One way of looking at this is that we will ship the casks to them at the beginning of a campaign and we'll also probably ship what you might call a campaign kit which might include the yoke, other vacuum equipment, spare seals, spare parts and so on, and this might be a fairly large shipment, but we'll have to make up that shipment and it might have to be adapted on a site-by-site basis depending on what their facility looks like.

We also will need to provide support to them in terms of training their personnel so they can properly handle and load the casks, because, as Mike mentioned, we take delivery after that cask is loaded. The loading of that cask is their responsibility.

We will be trying to address the waste acceptance operations relative to the utility contract and the requirements that are specified there.

I've already mentioned the facility interface equipment that we might have to deal with. Also, we envision that we'll have to have at least a minimal capability in terms of emergency

response to support the actual emergency response
teams that might be called upon and to lend our
expertise to that specific situation.
So our first step in this is trying to

understand the problem and to ultimately obtain, assess and integrate past and ongoing experience, build on that as we develop the system.

To do that, we have started a number of activities -- or are thinking of starting a number of activities. First of all, when targets of opportunity make themselves available to us, we're striving to observe and document various transportation activities that are occurring in the United States, and I'll mention a couple of these later.

We're thinking about in the near future, as we've already discussed, starting to try to obtain foreign technology information. To give you a feel, we've already had some numbers talked about, but in the United States in the last 25 years, we have moved about 2,300 shipments or about 1,500 metric tons of fuel. It's equivalent to roughly the first year of shipment. In the last six years, we've had 840 shipments of spent fuel, amounting to 670 metric tons, and on an average, that's about 112 metric tons a year.

So relative to what we've done in the past few years, we're going to have to scale up significantly over what we're doing right now.

There is a lot of information available out there. Significant shipments are occurring to France, United Kingdom and Sweden, and I have gone through about 12 different reports trying to assess the total amount of shipments that occurred overseas. It's hard to do because you're not sure if you're duplicating numbers when you go to different sources like this. You go to a source from Cogema, the processing facility, they report what they receive. You go to the shipper and part of the shipment is going there, so there may be some duplication of numbers.

The best I can estimate is that today within Europe, generally, they are receiving at the three sites in those three countries somewhere between 1,000 and 1,500 metric tons a year. So the rest of the world is shipping roughly what we expect to ship the first year we start operation, and we're going to have to scale up by a factor of three or more beyond that.

So there is a lot of information to be

gained from the international community. As we identify the needs, we will perform research and development and demonstration programs in the operational area.

Our goal is to apply the experience that is available to us, rather than reinventing wheels, so that we can develop a proper transportation operations plan and from that then develop the detailed operational procedures that will allow us to interface with the equipment and facilities.

What we're after here is dealing with the real systems, the real crews. We want to have good type procedures to minimize the possibility of error, and I think we'll accomplish this through proper training and good quality assurance.

Part of this, as Mike has already mentioned, is bringing the operational perspective into this. We plan to review all of the preliminary designs of the casks and come back to them with input that can be used in the next stage of the cask design process, bringing in the operational aspects of that. Again, the ultimate goal is to provide cost-effective, fully integrated and safe transportation operations systems.

DR. CARTER: Ron, in your US statistics, you were talking essentially about commercial experience not government.

MR. POPE: That was both commercial and

DOE shipments combined.

DR. CARTER: But not things like navy fuels?

MR. POPE: Not the navy fuel, but that includes the research reactor fuel and the shipments from TMI.

Relative to cask operations studies, we have recently performed a couple of studies, again, trying to collect the data, that the experience that is out there and we have gone to the owners of legal and overweight truck systems and had them document for us what their experience has been and make recommendations on what improvements could be made from their perspective.

That information has been provided to the cask systems design program for their benefit. In the coming years, we plan to do the same thing with the IF-300 rail cask, which is the only rail cask system currently in operation in the United States.

I will leave the next viewgraph for your review at your leisure, but these are just a few of the items that have been identified in the legal weight and overweight operations studies. A lot of this focuses on the interface of the equipment with the facility or the equipment and the facility with the operating crews and, again, all of this information has been fed to the cask design people at this time.

We are trying to utilize this documentation and other documentation that's out there. There has been a lot of work done in the past years and we're trying not to lose that. As I mentioned, we're also observing and documenting current experience, and I just mentioned one here.

There has been spent fuel transfers between unit one and unit two and unit three pools at San Onofre, California, using the IF-300 cask. We sent a crew out and have observed this and have documented it and this will be used as a training tool to our people to make sure that we address all the issues that come up from such an operation.

Again, in summary, we're trying to start developing and obtaining the information that's available overseas.

DR. DARROUGH: I'd like to --

DR. PRICE: Will you have in your operational plan a plan for the development of a data base that will track each cask and what happens to each cask and that will track fuel assemblies, make sure that the myriad of fuel assemblies to the cask is appropriate and so forth that will be available?

MR. POPE: I think if we're going to have a well-run system, we'll have to have such a data base.

DR. PRICE: Is it fair to say that your operational planning right at this point is at infancy?

MR. POPE: Yes.

DR. PRICE: How long have you been going?

MR. POPE: About two years. Yes, within the latest element of when the OCRWM program got started.

DR. DARROUGH: I would like to introduce Rob Rothman from DOE Chicago. Building on our discussion of integrated human factors experiences into our planning, Rob will be speaking about a preliminary study that we've had done on human factors in accidents.

The study has limited applicability to our program, primarily because it focuses on all hazardous material shipments rather than just spent fuel. Spent fuel shipments are a small piece of hazardous material shipments and are much more stringently regulated and the operators are more stringently trained than other hazardous material shipments.

Nevertheless, with those caveats in mind, we can find the data useful as we put them into our operational planning and reinforce our already-existing training programs.

MR. ROTHMAN: Thank you, Beth. You just identified and presented the caveat I was going to present.

In April of this year, we published a document entitled "Analysis of Human Factors Effects on the Safety of Transporting Radioactive Waste Materials." I should point out that this study was based primarily on a generic data base, on commercial transportation data, and it did not focus on the radioactive nuclear waste transportation data base because there simply isn't enough; the data is just too sparse.

DR. PRICE: Is this the Abkowitz study that you're referring to?

MR. ROTHMAN: Yes, Mark Abkowitz.

So the objectives of this effort were essentially to identify human factors in relation to commercial transportation accidents and, in addition, the analysts attempted to identify areas where DOE might take more formal effort in studying human factors, and if indeed such a need exists, where those efforts should be directed.

The scope of this work -- it was a preliminary analysis, it was a scoping effort and it was based or directed to truck, rail and barge modes. It was limited essentially to transportation. To some extent, handling, loading and transfer operations were addressed, but, again, the scope really focused on transportation.

Importantly, the data base was so dominated by the truck industry that that, in fact, is where the study itself focused on.

DR. NORTH: Did it get into maintenance reliability issues at all?

MR. ROTHMAN: No, the study was limited to the transport segment of transportation itself and very limited analysis was done to the actual handling of materials.

DR. NORTH: So if there was an accident

that was caused by failure to maintain the truck, that didn't show up?

MR. ROTHMAN: Correct. However, there was in the study -- and I think we do have copies of it here -- it did address some of the key factors related to truck reliability that were responsible for accidents. So it did touch on that, but, again, the emphasis was on human error.

The approach used in this study was primarily based on a data-base assessment. There are a number of data bases available, but three in particular were most useful, and those included the HMIS data base, that's the Hazardous Material Information System, and that's produced by DOT; the NASS data base, which is the National Accident Sampling System, that's produced or sponsored by the Highway Administration; and the FARS data base, F-A-R-S, that's Fatal Accident Reporting System, and that's also produced by the Highway Administration. Naturally, appropriate pertinent literature was consulted.

Another thing I want to point out is the study was essentially divided into two components. One focused on the HMIS data base, where it took the hazardous material data and attempted to disaggregate it into hazardous materials shipments that reflected to some extent that the shipment configuration of hazardous -- I mean of nuclear waste. I think there was an attempt to get more applicability to this analysis.

The remainder of the study then focused on the NASS and FARS data base, which more explicitly went into human error categories, such as fatigue, alcohol use and that sort of thing.

General findings in this study include that human error is a leading cause of accidents involving the transport of hazardous materials. Roughly 40 percent -- based on the HMIS data base, roughly 40 percent of accidents were attributed to human error or are attributed to human error.

The severity of human-factor-related accidents is considerably lower than for accidents caused by other factors. The accidents resulting from human error just on a statistical basis did not tend to be as serious in terms of fatalities.

DR. NORTH: Could you comment further on that?

MR. ROTHMAN: From a fatality standpoint or from a damage, cost standpoint, the report did not go into much detail or provide a great deal of insight on that subject other than statistically the HMIS data base again was used for this finding.

It did show that the significance from those two standpoints, from the cost and fatality standpoints, just were not as significant from a human-error standpoint. They just tend to be less severe.

DR. CARTER: Did this study distinguish at all between primary contributions and contributory?

MR. ROTHMAN: Slightly. It didn't get -- again, it didn't get into that much detail.

The secondary cause is human factors, and that's one of the problems with the data base is the data bases are not necessarily designed to illuminate that kind of finding necessarily. They are not a human error or human study data base, so there are real limitations there. The reporting approach in those -- in collecting that data for the data base doesn't necessarily allow you to make that distinction. To some extent, though, there was an attempt in the study to say, yes, these are secondary causes versus primary.

DR. CARTER: It was sort of fortuitous.

MR. ROTHMAN: I get into that a little bit later on my next slide.

Truck, rail and barge transport appear to share many common human factor problems. That's an apparent finding in the study. The data available on rail and barge is limited. Nevertheless, human factors was again a significant contributor to accidents, however, not as much so when compared to truck accidents.

Human factors effects on radioactive waste transport operations are important and should require further investigation.

The asterisk on this overhead again indicates the point that Beth made, that these analyses and data bases and literature sources used for the study are based on a much greater population than the commercial transport population and that what we're actually concerned with and the analyses or the findings may be somewhat conservative given the more stringent regulatory control for nuclear materials.

DR. PRICE: Is there any more stringent regulatory control over who is allowed to be an engineer on a train carrying radioactive materials or a driver of a truck carrying radioactive materials?

MR. ROTHMAN: Is there more stringent control over the --

DR. PRICE: The skills and capabilities of --

MR. ROTHMAN: Good question. I don't believe so. I think that the controls are primarily geared to the truck industry, but I cannot address that explicitly.

DR. PRICE: Is there any reason to think that the transportation of radioactive materials should have a different experience than the transportation of nonradioactive hazardous materials?

MR. ROTHMAN: I think -- well, first of all, the nonradioactive -- I mean, the nuclear material shipment history is limited and sparse. Nevertheless, the data to date does indicate that they have an excellent driving record.

DR. PRICE: That's my understanding.

DR. DARROUGH: Ron, you might mention that it's the training, the very vigorous training requirements of nuclear material, radioactive materials, compared to the various mom-and-pop operations of other trucking companies.

MR. ROTHMAN: I think that's true and

for --

DR. PRICE: But do the training requirements, for example, in truck deal with the skills and ability of the driver to handle his rig?

MR. ROTHMAN: I think from a --

DR. PRICE: Is he a more skillful driver than the person who is not driving?

MR. ROTHMAN: Well, again, on the next page, some of the findings indicate that people without training, in fact, have a less favorable record in accident rates than do people with training.

So training does contribute to, obviously, the safety aspect of a campaign, but the fact that DOE has an opportunity to mitigate or control or design a training program, I think, is a consideration as well.

I'm sorry, am I getting --

DR. PRICE: Well, I think in general the assumption has been made in the transportation of hazardous materials -- I'm talking about hazardous materials in general -- that there is no reason to think that the accident experience in the transportation, let's say in highway transportation of hazardous materials, should be regarded by planners to be any different from the accident experience of those who are not carrying hazardous materials.

I would wonder, unless you, for example, have a training program specifically teaching the truck driver, as an example on highway, to be more skillful in emergency maneuvers and things like that that there still is not any reason to expect that person to have just because they are carrying radioactive materials.

Isn't the reason for a better accident record, per se, that there needs to be something substantial in contribution to his experience or her experience that makes them better and, therefore, you would say the rest of this is more conservative?

MR. ROTHMAN: From a training standpoint, that may be true, but from a driver selection standpoint, there are opportunities to be very selective in terms of --

DR. PRICE: Do you have selection criteria for your drivers?

MR. ROTHMAN: No, we don't. The study does.

DR. PRICE: You said that no, you do not?

MR. ROTHMAN: I don't believe DOE does at this time. I don't want to get too far out of line on that.

MR. KOUTS: We haven't developed them yet. The study, as Rob indicated, does make some recommendations to us as to what we might look for in our driver selection.

I think that's on the next slide, isn't it, Rob?

MR. ROTHMAN: In the last slide of this presentation, there are nine or ten categories that are clear indicators where if we choose to have a policy for selecting drivers, it would improve -- it should improve their performance.

DR. RAJ: Are you implying that they are going to impose this on the railroad engineer also; 50 percent of your shipments are going to be by railroads, 50 percent by tonnage?

MR. KOUTS: The data that we have right now is predominantly truck. I think we'll look at this from a truck perspective, and if new data became available for rail, we'd consider it.

We tried to caveat this as well as we

did. This was a very limited study. It did focus basically on the truck because there isn't a lot of experience from the rail or barge that you can draw upon.

DR. PRICE: There are human factor studies on rail handling on car handling and so forth.

MR. ROTHMAN: Yes, and we acknowledge that this is one study. In fact, it's the initial study from our office that we did in the area of specifically human factors. Basically, we're getting our feet wet.

Later, in Dave's presentation, I think Chris will be talking a little bit more about human factors from a problematic standpoint.

MR. KOUTS: Do you want to go to the next slide?

MR. ROTHMAN: I just want to quickly cover that the driver is -- specific findings, the driver is most frequently the key factor in vehicular accidents occurring under difficult driving conditions. This is indicated through the HMIS data base where, again, 40 percent of the accidents have been contributed to human error.

A large number of heavy truck -- I should say drivers of heavy trucks have poor driving records. 30 percent of the drivers have had speeding convictions from the data-base analysis.

Correlation between drivers under the influence of alcohol and increased accidents is a major safety concern. One of the studies that we've referenced in this analysis pointed out 33 percent of the fatal accidents have been by drivers with a positive blood alcohol content.

A major portion of heavy truck driver population has not received any driver training, and this refers to the fact that in the accident data base, 50 -- close to 60 percent of the drivers had not had before any kind of training.

Drivers of large trucks have shown significant fatigue-related driving errors well within the current hours of service limit. Approximately 30 percent of the accidents have been attributed to fatigue. The hours of service limit refers to the 10-hour driving limit per day for a driver or 15 hours on duty.

Vehicle design and operating characteristics have a significant impact on safe performance. This is a portion of the study that addresses some of the vehicle considerations and, of course, it points out that brakes and tires are two of the key considerations for a safe vehicle, but, importantly, from a human factors standpoint or from a fatigue standpoint, noise and vibration in the cab is a real key consideration.

The final slide here points out areas that the DOE can consider for further consideration or for policy-making. Quite simply, they include employee selection and hiring practices, drug and alcohol use, fatigue, speeding and other moving violations, operator training, vehicle design and environmental factors and enforcement.

Those are policy operation options available to us for consideration.

DR. CARTER: Isn't fatigue sort of a catchall? If they can't think of any other reason, they are liable to lump it under fatigue in terms of accidents?

MR. ROTHMAN: It is kind of a catchall; however, it is distinguished in the NASS and the FARS data base. They do distinguish between fatigue.

Quite a bit of literature and research has been devoted to fatigue itself, so it has kind of surfaced as a -- in fact, fatigue, alcohol use and it skips my mind at the moment, but there are three particular areas that have received considerable attention in the research in this area. Fatigue is a --

DR. CARTER: But some of those you can

quantitate. I mean, you can quantitate alcohol level, for example.

MR. ROTHMAN: That's right.

DR. CARTER: I don't believe you can quantitate fatigue.

MR. ROTHMAN: That's right. Fatigue is a hard thing to quantify and it's largely due to their findings are subjective. I mean, the data bases it's reflecting are very subjective.

DR. PRICE: Well, there is a large amount of literature in the area of fatigue, and it's very poorly operationally defined.

DR. NORTH: It would seem to me that you want to make sure, as you present this list, that this is a starting point rather than the eight key factors or whatever --

MR. KOUTS: You're absolutely right.

DR. NORTH: -- the total is here. The fact that you didn't have data on the relationship to inspection and maintenance certainly ought to be factored in there. That, to me, is a really key issue in terms of brakes, tires and a lot of other things; what might be done to avoid those kinds of problems which frequently occur with heavy trucks.

Then you've got the aspect of the weather, and I would expect the data will show that a lot of accidents occur in weather where a prudent driver might have pulled off the road. You have Yucca Mountain not too far away from the Sierra Nevada, and it's very frequently the case that in mountain driving in bad weather, you get accidents and procedures to deal with those so that if the weather is difficult or there is a potential even for difficult weather going across a pass that you don't go that day.

MR. ROTHMAN: I --

DR. NORTH: I mean, I'm mentally putting on the thoughts of making a presentation like this to some of the highway officials and some of the states, certainly starting with Nevada, and what are they going to be concerned about.

I would hope by the time you give this presentation to them that there will be a lot more thought in terms of the issues that they will be concerned about.

MR. KOUTS: I think we have

representatives here from the City of Las Vegas, State of Nevada, so they are hearing it with you.

I would want to mention that our perspective related to weather is that we want the carrier to have the flexibility to select driving routes at the time of shipment, and that's one thing that we feel is very key and that if, indeed, there are weather concerns along a certain route that we have the flexibility to use a different route where that wouldn't be a big concern.

We feel that the existing federal rules associated with this -- especially a highway area -- give us the flexibility to do that, and you'll be hearing about that more this afternoon.

DR. PRICE: But this study addresses one little segment and with a certain fragmented amount of data and there are many more segments to the transportation problem than is addressed in this particular study and the handling problems that are there, the design problems that resulted maybe in loose bolts and other kinds of human factors, things that have cropped up throughout the system from the loading through the complete unloading process doesn't begin to be reflected by this.

MR. KOUTS: I couldn't agree with you

more. We recognize the limitation to the study. This was the starting point. We felt it was timely for us to begin this effort, and what you're seeing is initially an initial scoping study looking at limited data bases in this area, but giving us some recommendations as to things we might look at in the future.

We certainly don't look at this as a definitive study in any way. I don't want to leave that impression with you.

DR. PRICE: But the scope of things that needs to be done is much agreed.

MR. KOUTS: Absolutely.

MR. ROTHMAN: I think the scope of this -- this really indicates areas very consistent with the limited scope of the study itself. Now, from a human factor standpoint, overall, there is a much larger area of consideration.

Perhaps one of the things I didn't point out sufficiently in this presentation is the fact that loading and handling was addressed to some extent, but limited in this study, and it did indicate that human error again is a key contributor to problems when accidents occur, but it was very lightly touched upon.

MR. KOUTS: We're running a little late. What I'd like to do is take about a ten-minute break and continue with the rest of the program this afternoon.

(Recess held.)

MR. KOUTS: If we could take our seats and start the remainder of this afternoon's session.

I would like to perhaps correct an impression that we've left you with in terms of how we view the implementation of the transportation system. We do have baseline assumptions and we do control those assumptions and use those on transportation systems analyses.

I think the issues that we've talked about this afternoon are associated with the variability that can occur depending on a variety of things that could happen prior to the time we go to shipment, but we do have standard assumptions for the system and we do do our analyses with those.

Again, the variability and the assumptions are something that we're concerned about and something we're looking into and affects how we would procure the system, how many casks we would have and so forth.

So I just wanted to again correct the

impression that we might have left. We do have a definite baseline for the system and we do operate under it.

I'd like to turn this back over to Beth

Darrough, who is going to be introducing someone I think you've just seen for a little while.

DR. DARROUGH: Rob Rothman is going to continue our discussion of how the studies that we're doing will feed into our operational planning. He will be speaking about the modal mix and about specialty studies that we have performed.

Then we will have Dave Joy from Oak Ridge National Lab discuss our routing.

MR. ROTHMAN: I'm going to talk first about the modal split. The modal split is something that we've talked a little bit about this afternoon already and it is a key -- it's a key question that faces us and it's got a big impact on much of what we do.

It's a principal planning consideration. It's a principal consideration in our interactions with the utilities and it's something that we have been working for some time now to get a better handle on.

The three areas that are helping us in addressing this question or this issue include the -- we're doing three studies: one includes the Facility Interface Capability Assessment, called the

FICA study; the next is the Near-Site Transportation Infrastructure study, which is the NSTI study, and the third is the Modal Options study. These are three specific activities that are giving us some insights. I'll cover each briefly.

The FICA study is a study that was started about two years ago and is near completion. Its principal objective or purpose was or is to identify inside the facility, inside the reactor site, the capability for handling casks, including crane capacity for picking up and lifting casks to pool size and depth and, in general, the overall infrastructure within the site and its ability to maneuver a cask.

In addition, the assessment includes the identification of areas where we can improve the capability. In other words, if you can increase crane capacity to pick up heavier casks, we're looking into that to see what exactly is possible.

Finally, the FICA study advances and completes the RW-859 exercise, and that's a principal source of information to date for the DOE to understand what the capabilities are at their reactor sites. It is essentially a questionnaire that the utilities and reactor people have been responding to over the years, so the FICA study more or less confirms that information or illuminates that information that had been previously requested by mail.

The general scope has 76 site visits and 122 facilities where spent nuclear fuel will be shipped from. The Near-Site Transportation Intrastructure study is a study that's just getting underway. Its purpose is to assess the capability of the local road and rail infrastructure for handling heavy and large casks. It essentially -- we're assessing bridge capacity, clearance for bridges and trestles and, in general, the overall conditions of the transportation infrastructure outside of the fence.

It, too, is assessing upgrade potential for the area; if there are minor -- or if there are possibilities for increasing the area's capability for handling casks. Its general scope includes approximately a 25-mile radius around each of the reactor sites and it, too, includes 76 sites, which includes 122 reactor sites.

DR. PRICE: When will these studies, the FICA study and the NSTI study, be done?

MR. ROTHMAN: The FICA study is nearing

completion right now. I think -- Chris, do you know when the first report is due on that?

MR. KOUTS: I believe it's in December of this year.

MR. ROTHMAN: And the NSTI study, we will be getting interim reports throughout its progress. It is scheduled for completion two years from the start-up date, which it started last July.

MR. KOUTS: Last month.

MR. ROTHMAN: Last month, right.

DR. PRICE: And it's a two-year study?

MR. ROTHMAN: It's a two-year study.

We are also in the process of finalizing a study assessing modal options. Essentially, this exercise has a very straightforward scope or objective, and that is to identify modal options for spent nuclear fuel; that is, can it ship by rail, can it ship by barge, can it ship by truck, and what cask capacities can you handle.

In doing this assessment, we are doing a -- we are comparing life-cycle costs and life-cycle dose associated with each of the options.

To elaborate a little bit more on what the potential transport modes are, we have legal weight casks, which are hauled by trucks, and that includes a 28-ton cask with a 3/7 assembly capability. Overweight -- this, by the way, is representative. There are casks designed right now, as you heard this morning, that I think are for legal weight trucks that are designed for 4/9 capacity. So this would be a conservative estimate.

Overweight trucks are being considered, and they include casks up to 40 tons and have a 5/12 capacity. That is a conservative estimate, too. I think current design or considerations are at least that that can be increased.

Heavy-haul trucks, these are trucks designed to haul 100-ton casks, rail casks from a reactor site to a nearby railhead. Essentially, they represent the same thing here as the regular rail casks, which is a 100-ton cask, and this has an estimated capacity of 21/48.

Again, there are design variations from that, but that approximates an average, I would say. There is also a hefty rail, which is a 125-ton cask and which has a larger capacity of 24/60.

DR. PRICE: Do these studies include the costs to the infrastructure itself, for example?

MR. ROTHMAN: No.

DR. PRICE: Overweight trucks and highway damage and so on?

MR. ROTHMAN: No. The scope of these -- the life-cycle costs, the scope of this study includes the hauling costs for the actual shipment, the loading and handling costs at the reactor and at the repository, and that's the limit of this estimate.

MR. KOUTS: I should mention that these are the assumptions that we used in the study for the casks. Obviously, there is no overweight truck cask presently available that has a 5/12 capacity. We made some assumptions associated with that. The same for the hefty rail casks. So these are assumed for the purposes of this modal option study.

MR. ROTHMAN: Okay. Some examples of the options study include the 100-percent legal weight truck, that's obviously where everything is carried by legal weight truck, and then the base case, and this is the 44-percent legal weight truck and 56-percent regular rail.

That is the case that represents what we think is currently the capability at each of the reactor sites. In other words, 56 percent of the reactors are able to handle regular rail and are, therefore, attributed to be handled by rail; the rest remain, the 44 percent then by legal weight truck.

Another option includes 100-percent rail by transferring truck casks to a nearby railhead. Then we did a case where we maximize overweight trucks and where we maximize large casks as identified in the previous slide, which is 125-ton.

Comparison of these preliminary results or comparisons of each of these cases show the following: 100-percent legal weight truck is most costly and has the highest dose compared to other cases. That's not surprising since legal weight truck is the least efficient. It has the lowest capacity, cask capacity, and therefore you have to do that many more shipments.

The base case, 44-percent legal weight truck and 56-percent regular rail, approximates the optimum cost scenario. In other words, we can't get a whole lot -- we can't reduce our costs a whole lot less than by going the base case. I'll explain that a little bit later when I get to the other cases.

Maximizing rail by utilizing rail transfer facilities does not significantly reduce cost. That is, when we go 100-percent rail and we take the rail -- these heavy casks and transport them from the reactor site to a railhead, you don't gain that much from an overall cost savings standpoint because you have so much added handling costs, the transfer activity itself just offsets some of the increased capacity that you gain by using larger casks.

Total dose is reduced by maximizing rail. As you reduce -- as you increase rail usage, the large capacity rail casks usage, you are significantly reducing the amount of exposure to the public, and as you continue to maximize rail, you therefore reduce the dose.

It's important to point out that dose is generally viewed to be relatively insignificant from an overall population standpoint, so when we talk about reducing these dose levels, it, in fact, is reducing something that's already very small.

DR. CARTER: Does this include accidents, or is this just routine operation?

MR. ROTHMAN: No, this assessment is

directly based on routine operation.

DR. CARTER: No accidents involved?

MR. ROTHMAN: No. When we calculated dose, however, we used the RADTRAN/TRANSNET code, which we'll discuss tomorrow, and that does, from a probabilistic standpoint include accidents.

MR. KOUTS: And accident releases.

MR. ROTHMAN: And that will be explained in some detail tomorrow by Sandia.

DR. BARNARD: On your third bullet, when you use the rail transfer facilities, do you actually -- you take the cask off the truck and then put it on the rail?

MR. ROTHMAN: Yes.

DR. BARNARD: Okay.

MR. KOUTS: I should mention one of the assumptions of the study again is that the emissions rates from the casks are at the regulatory limit, so, therefore, if you have more rail casks in the system and you move more fuel by rail, you're getting more inside each individual cask, but the dose remains the same. So as the result, you have fewer shipments and dose rate and that's why the dose goes down substantially.

MR. ROTHMAN: Okay. We have an error

here. This should be 70 -- actually 66, something like that; 100-percent rail reduces dose by more than 66 percent from the base case.

Again, the point being made there is that as we -- the base case, which has 44 percent by truck, legal weight truck, all that material is shipped by rail, and when you increase that capacity, rail capacity, you're minimizing the public dose and you have a significant -- numerically, at least, significant reduction.

DR. CARTER: What effect does that have on cost?

MR. ROTHMAN: When you go 100-percent rail, you don't reduce cost that much.

DR. BARNARD: Do you increase it? Does it increase?

MR. ROTHMAN: No, it's reduced slightly. I'll show you that in the next slide, I think. We don't have that case here, but it is slightly reduced, but not significantly. Yes.

DR. RAJ: Can you define dose? Dose to who and where? What's this dose?

MR. ROTHMAN: All right. There are two principal doses being calculated in this assessment, and that's occupational dose, which is the dose of the workers, they experience a radiological dose, and the radiological dose that the public at large receives during the normal -- during the normal transport of these materials.

DR. RAJ: This is the dose to an individual in the public that is just standing by when the train passes by?

MR. ROTHMAN: It's based on average population, an estimate of population that occurs along a typical route. It's just a statistical assessment of what kind of population density will be along each of these given routes.

DR. PRICE: Do you factor in yards and terminals and things like that, dwell time there?

MR. ROTHMAN: Yes, that is, in particular, in the handling exercises. Now, when you're loading and unloading, that time is accounted for.

Now, when you have a hauling -- when you do your cost analysis, when you're at a yard, the switching occurs; if it occurs, that is accounted for from a cost standpoint.

DR. PRICE: Say again. I didn't hear you.

MR. ROTHMAN: When you have the basic

assumptions or when you have an origin-destination point, you have a hauling cost per mile between those two points. It's also based on time of shipment. So in that assumption, you are accounting for holding times. Crude estimates are made for holding times at railheads.

DR. PRICE: And do you assume in that the closest route rather than the long hauling that occasionally goes on?

MR. ROTHMAN: In this study, we used an average route. In other words, I think the average was 2,000-some miles between origin and destination point. This study simply took the average between all the reactor sites and a hypothetical of all the proposed sites being analyzed now, which was Yucca Mountain, and did an average mileage estimate.

MR. KOUTS: Again, this is a scoping analysis where we're trying to get some perspective as to what different modes of transport should be used in the system and what they would do from the standpoint of cost and dose.

You'll be hearing a lot more in a little while about routing and also about the types of models we used for that, and tomorrow you'll be hearing about the RADTRAN which is being used for the risk assessment purposes.

I think what we're trying to demonstrate with this study is that we are looking at these types of issues and we're looking at generically what the impacts of going to 100-percent truck might be or what the present modes that we have are.

There are a variety of other options that Rob did not go through. We looked -- how many were there totally in the study, Rob?

MR. ROTHMAN: We had nine variations.

MR. KOUTS: We looked at about nine different variations and we're about ready to publish a study and you may be interested when we do that. Again, it's to provide some insight as to the impacts of the system.

MR. ROTHMAN: Finally, the last is overweight truck reduces cost and risks slightly. There is a minor reduction there.

The last slide here illustrates some of these points.

DR. PRICE: Excuse me, I do need to ask, does that bottom bullet mean that overweight truck is, in fact, the most optimum?

MR. ROTHMAN: From a cost standpoint, no, it's not the most optimum. When you -- by maximizing rail, you do get to about one point -- I think 1.2 billion.

DR. PRICE: It reduces costs and risks slightly from what, then?

MR. ROTHMAN: From the base case.

MR. KOUTS: We need to show the next slide which will give some perspective on this.

MR. ROTHMAN: Okay. 100-percent legal weight truck, that's the most expensive case. That's the bounding scenario, 100-percent legal weight truck, and that cost is estimated to be 2.1 billion dollars, and you can see what the overall population dose is.

Now, the base case, which is from our standpoint the -- at least at this point in time, the most probable case, is approximately 1.4 billion dollars, and you can see what its population dose is.

Now, if we compare legal weight truck to the base case, you can see that -- by the way, legal weight truck represents about a reduction of 9,000 shipments, so it's a significant reduction in total number of shipments, but, nevertheless, the total costs when you include handling is relatively minor in terms of reduction.

Again, when you increase cask capacity like you do with the legal weight truck, you do have a reduction in dose.

DR. PRICE: I think some of us are having trouble understanding what number three is.

MR. ROTHMAN: Number three is legal weight -- okay, legal weight truck with overweight truck. What that means, of the 44 percent in the base case where you have legal weight truck, this represents that 44 percent of the reactor sites can accommodate legal weight truck. Of that 44 percent, X percent can handle overweight truck; some cannot, in other words.

So what we've done in this case is all those reactor sites that can accommodate over- -- truck sites only that can handle overweight truck, we use overweight truck to maximize or optimize that case.

Does that clarify it?

DR. PRICE: Yes.

DR. RAJ: Could you elaborate, is that 66/44 as compared to the previous slide?

MR. ROTHMAN: I'm sorry?

DR. RAJ: The 56/44.

MR. ROTHMAN: That's switched wrong. It

should be 44/56.

DR. CARTER: In steady state, how many metric tons of uranium is going to be shipped?

MR. ROTHMAN: 3,000 metric tons per year.

MR. KOUTS: At steady state, or do you want the total amount?

DR. CARTER: I was just trying to get some perspective on the person rem number on an annual basis.

DR. PRICE: Now, that slide makes it look like number three is the least costly.

MR. ROTHMAN: It is, and of these three that I've shown you, it is the least costly.

DR. PRICE: Is it not the most effective?

MR. ROTHMAN: Well, the point -- when you talk about this much of a reduction of a segmented total systems cost, these numbers will be overwhelmed by other costs associated with the operation of the system as a whole. So you have to ask yourself, yes, it does have -- in this narrow scope, the narrow scope of this study, it does have a positive impact from a cost standpoint, but from a larger standpoint, from a systems standpoint, does overweight truck cause problems? Can those larger casks be accommodated within the entire system effectively, so on and so forth? That hasn't been addressed completely to this point.

DR. PRICE: It hasn't been addressed, but by the sound of it, you feel fairly confident that that one-tenth there would disappear quite quickly?

MR. ROTHMAN: I'm confident it could. I'm not sure that, you know, the direction may further shift one way or the other. It's hard to say because of the -- you know, all the variations. We have permutations we can operate the system in and depending on 26 other assumptions, you never know.

MR. KOUTS: I think it's important to note, you'll be hearing more about the overweight truck in Rob's subsequent presentation and also on Wednesday. We're looking at whether or not we can permit overweight trucks on a national basis from the standpoint that it makes it feasible to use in our system. Again, that's an issue associated with this.

It's a question of whether or not we could just implement it, and that's something we're working on now. You'll hear about that on Wednesday.

DR. CARTER: If total rail is the most or the best in terms of risk, lowered risk and also lowered cost, why haven't you included that in the key combination?

MR. ROTHMAN: You mean -- we have included it in the study.

DR. CARTER: It's just not here.

MR. ROTHMAN: We're trying to simplify this and make this presentation go a little more expediently.

DR. CARTER: What would those numbers be?

MR. ROTHMAN: The lowest cost, I believe, is 1.2 billion dollars.

DR. CARTER: That's for 100-percent rail?

MR. ROTHMAN: 100-percent rail.

DR. CARTER: What about the collective exposure?

MR. ROTHMAN: Collective exposure goes down considerably. When you get down to 100-percent rail, maximized rail, your dose per MTU gets down to .010. Like I indicated earlier, it's a 70-percent reduction.

DR. CARTER: I thought it was 66 percent less in number two or thereabouts. I think you indicated earlier that you made a correction on the figure and that it was a 66-percent reduction.

MR. ROTHMAN: Right. I think that what it
was approximately was 66 percent.

DR. CARTER: 66 percent of .53, I don't

think, comes out to .01.

MR. ROTHMAN: Is that not what I said, point -- I think that's what I said.

DR. CARTER: I thought that's what you said.

MR. KOUTS: Again, you have to apply some real-world thinking in this. It may not be feasible to haul from reactor sites to railhead. The infrastructure may not be there.

DR. CARTER: I understand that. On the other hand, it may look like to be a key combination, you might have a few rail spurs added.

MR. ROTHMAN: It depends on what's important, what you want to put on that dose aspect. If it's understood that the dose -- if any reduction of dose is an objective, that's one consideration.

If you recognize this as a small dose, then you have to ask yourself from an operations standpoint, "Do we want to make a real small dose even smaller? Is it profitable? Is it proper? Is it the correct thing to do?"

DR. CARTER: When you think about it, if you're talking about reducing risk, risk to the public, risk to workers and reducing the economics, reducing the amount of money, I think both of those are fairly important. It depends how you do the costs. Now, I don't know whether you factored in the costs to put in rail spurs or not.

MR. ROTHMAN: Oh, no.

DR. CARTER: It's hard to put up a total 100-percent rail then if you're not including those kinds of costs.

MR. ROTHMAN: If you start including infrastructure improvements and whatever, those savings can be offset very quickly.

Again, we have to do system analyses, overall total system analyses to take these studies that were in the limited context, limited scope and say, "All right. Does it really make an overall difference?"

From this limited scope, it does make some difference, yes.

DR. CARTER: So what you're saying is with the numbers you quoted, even though they aren't up there, the lowest one of the 100-percent rail was

1.2 billion. That number can't really be compared
to these other numbers.

MR. ROTHMAN: It cannot be compared?

DR. CARTER: Yeah, with the cost to put in rail spurs, it would allow you to go 100-percent rail --

MR. ROTHMAN: That's right.

MR. KOUTS: That's right.

DR. PRICE: The infrastructure costs could be a major cost here.

MR. KOUTS: Absolutely, and that's something that could potentially raise the cost figure for 100-percent rail substantially above what we're looking at now for base-case system.

So maybe you have to ask yourself, "Is it worthwhile to spend additional money to reduce the dose that we've already recognized is at a minimum?"

Those types of considerations -- again, what we're trying to get over to you is we are looking at the various permutations the system could have and the potential impact and the overall life-cycle cost and dose rate.

MR. ROTHMAN: With that, we'll switch into specialty services. As we've talked about many times, we -- DOE has a lot of options available to it for operating system.

Three options of particular interest or importance are overweight truck -- the use of overweight truck, the use of dedicated train and the use of truck convoy. I will talk about each of these briefly.

Overweight truck, which will be discussed in more detail later, I believe, tomorrow, essentially --

DR. PRICE: Before you continue, special trains, did you just simply rule out, is that --

MR. ROTHMAN: I have a clarification on special trains in relation to dedicated trains following my discussion here on overweight truck, okay? There is a differentiation there and I'll point that out.

Overweight truck, as opposed to regular truck service, offers some obvious advantage and that is that they have larger -- they can carry larger capacity casks. As this overhead points out, legal weight truck has the 28-ton cask, which is the 3/7 estimate, and overweight truck, which a 40-ton cask has the 5/12.

As pointed out in the modal study, there are advantages from a life-cycle cost and dose standpoint.

Overweight truck, again, its advantages are fewer shipments and there is a potential reduction in system costs and risks. When I say "potential reduction," here again, the modal study was done in a very limited context and the system study needs to be done to truly get a correct picture.

The disadvantages include regulatory restrictions in some states. Some states do not allow the use of overweight vehicles and not all reactors can handle overweight trucks. There are some crane capacity or size constraints within the reactor site.

DR. PRICE: And wouldn't an additional disadvantage be damage to the infrastructure, particularly like in Nevada, if that were to be the -- where things start focusing in on?

MR. ROTHMAN: More stress on the system, yes.

MR. KOUTS: I'd like to address that point, also. I think that our perspective on the infrastructure is such that when you look at the massive amount of shipments that occur nationally or every day, for that matter, from a normal commercial standpoint, when we're ready to operate the waste management system, the most it will be operating in terms of truck shipments is about three to four per day.

When you look at the impact of potentially one or two of those trucks being overweight on the national infrastructure, it's really very minimal, even from the perspective of within the State of Nevada and, of course, we didn't look at that very closely.

Again, with the amount of shipments, you have to look at frequency and the amount that they are traveling, and typically with the amount of shipments within the system, we don't see a lot of impact. So in terms of assessment, I think you have to keep in perspective just the amount of shipments that we'll be moving over the life of the waste management system, which is not very much at all in comparison to the rest that goes on in commercial every day, overweight trucks included.

MR. ROTHMAN: Again, that will be discussed in more detail in another presentation.

Dedicated trains. Dedicated train is an operational option available to customers as opposed to regular train service. Dedicated train, in comparison the regular train service, has a number of advantages and this overhead illustrates those.

They can be designed to carry no other

cargo; it can move from one origin to one destination point; the shippers have more control over routing, the schedule; you can avoid rail switching yards; regulatory requirements are facilitated, such as physical protection procedures; you can take advantage by lumping and controlling protection procedures when using a dedicated train and routing procedures, and from a regulatory standpoint, are easier to handle.

Also, we are studying -- last fall, we were studying system risk and cost advantages or disadvantages associated with dedicated train. As I mentioned earlier, to clarify or differentiate between dedicated trains and special trains, I'm not sure there is an absolute definition between the two service types, but, in general, special train does have significantly more restrictions or more -- some restrictions that the dedicated train does not have, and two of the most important include it restricts maximum speed -- I think 35 miles an hour is a number that I've been advised of -- and it limits passing, there are passing constraints.

In other words, if a special train has to pass another train, the other train has to stop completely, and those kinds of restrictions obviously are not perceived from an operational standpoint to be to our advantage.

Dedicated trains have been used by utilities in the past, they've also been used in defense shipments. Three Mile Island is using dedicated trains and there is no requirement by law or regulation to use dedicated trains.

DR. PRICE: Will dedicated trains increase the travel time for other trains operating in the network? Will there be a ripple effect from the dedicated train?

MR. ROTHMAN: Do you want to -- could you state that again, please?

DR. PRICE: If you have a dedicated train present in the network, will it have a ripple effect on the times of other trains, the increase in travel time and so forth?

MR. ROTHMAN: Well, by having dedicated trains, you are adding a new train to the system, to the tracks. As far as once it's on the tracks, it's operational, it shouldn't create a problem. I'm

getting way out of my area of expertise and I don't
want to -- I don't know if that --

DR. PRICE: To your knowledge, it won't
require any special servicing or special facilities

or anything like that because it's a dedicated --

MR. ROTHMAN: That's a good point and it's one of the things we plan to look at with dedicated trains. As I pointed out earlier, we are doing a system cost and risk assessment and we also plan to do operational considerations; in other words, assess the impacts of dedicated trains from an operational standpoint, what kind of logistical advantages and disadvantages there are.

DR. PRICE: Are there different priority rules, for example, for a dedicated train?

MR. ROTHMAN: Not that I'm aware of.

MR. KOUTS: To elaborate on that, I think, a dedicated train provides you a certain amount of advantage. You have a greater likelihood that the time that you're expecting the shipment, it's going to be there.

In addition to that, there will be no -- stoppages on the way are generally limited. With regular freight, typically if you turn a railcar loose into general freight, the railroad generally makes its own decisions as to how it's going to move that piece of freight along. There are rules associated with that; there are DOT regulations, I think, that consider setting up to ten days in some

cases; again, until the next train comes along.
A dedicated train doesn't have that kind of problem. It does have certain operational advantages and also costs substantially more than regular freight service, which is something you have to take into account when looking at these analyses, and it's also why we look at the life-cycle costs and risk analyses.
DR. PRICE: Is the phenomena of long hauling as likely to occur with a dedicated train versus a regular scheduled train?
MR. ROTHMAN: Your operational advantages from conducting a long haul are increased with dedicated train. As opposed to regular service, you avoid the constant visitation and switching yards and so on and so forth.
DR. PRICE: I was referring to the practice where a car is on a segment of a rail and it's under the control of a particular company and they maximize the distance it travels to maximize the revenue for long hauling kinds of things. I

would suspect with a dedicated train that would be less of a phenomena.

MR. KOUTS: That's correct. You can select the route more. You have a dedicated crew for each railroad that would handle that and typically they move along at a route that you've identified.

DR. PRICE: So the resultant exposure, as well, should be reduced with dedicated trains as well as regularly scheduled trains.

MR. KOUTS: That's right.

MR. ROTHMAN: Because of less delay, is that your --

DR. PRICE: Because of less distance, less routing changes, less population, perhaps.

MR. ISAACS: I think it's also important to recognize that when we finally do get this system up and running, this is going to be treated as a very special kind of shipment in this country.

If we have an MRS, as we think we ought to in the department, we'd be essentially having one of these trains about every two weeks, so it would be a very special shipment. I have great confidence in the fact that when we get to the point where we're actually beginning operation of this, that train is going to be treated quite specially and quite different than most trains in this country.

DR. RAJ: But in order to have a special train, you need to have some yard operations anyway because you're not going to have a trainloadful of stuff coming from one reactor, so the reason --

MR. ROTHMAN: There would be an available site and those are, again, some of the things that we want to look into; the constraints, the operational constraints, such as available siting, to, in fact, create a dedicated train.

DR. RAJ: I think you seem to imply that dedicated trains are special trains, and I guess the difference here is that special trains go at a much slower speed than the dedicated trains.

MR. ROTHMAN: I think there are other differences than that. I think the special trains tend to be more restricted in their speed and there are passing limitations and there may be other limitations, but I'm not aware of specific delineations between the two other than that.

DR. RAJ: Just a comment in response to Dr. Price's question. There is some concern in the railroad industry that when you reduce the speed, in fact, you're increasing the accident probability

simply because that can cause rear-end collisions
and so on. This train is going slow and there may
be a fast training coming behind, because class four
or five or six types of track are really a

passenger-rail quality of track.

MR. ROTHMAN: Right. I'm aware -- I think the word I heard was you're going to disturb the harmonic isolations of the system.

DR. DEERE: I like that. Let me write that down.

MR. ROTHMAN: I'm sure there is substance to it and that's a good point. Okay.

DR. DEERE: But the advantage, as Tom pointed out, would be with an MRS, then you have just one site, you don't have to have all the places to be making up your train because it's made up there --

MR. ISAACS: That's correct.

DR. DEERE: -- and you can take off on schedule.

MR. KOUTS: That's right.

MR. ROTHMAN: There are some apparent very clear-cut advantages.

Okay. Truck convoy. This is another service that we're evaluating, which is a truck convoy in comparison to regular truck service. Obviously, a convoy involves the movement of two or three trucks at one time as opposed to single truck operation, and it offers the advantage of sharing escort personnel and vehicles.

Truck convoys have been used for shipments by utilities and DOE defense operations. They, too, are not required by regulation.

We are in the process of studying truck convoys. Areas of interest are truck convoys -- again, in comparison to regular truck service, areas that we want to study include system costs and risks, logistical implications, institutional implications and whether or not operational efficiencies can be experienced or gained by convoys.

That concludes my presentation.

DR. CARTER: Let me ask a question. You may be the wrong person to ask because Ron Pope mentioned the statistics in terms of the commercial fuel that we move in the country, but I was just curious and perhaps you do know what the transportation modal basis for that experience was.

MR. ROTHMAN: I am not in a position to

give you a good estimate there.

Ron, can you help? Are you there?

DR. CARTER: Anyway, let me address that question to DOE. I'd be very interested in the

transportation modal mix of the experience that
we've got; how much by barge, how much by truck, how
much by rail.

MR. KOUTS: We'll look into that and see
if we can provide that to you.

DR. CARTER: Appreciate it.

DR. DARROUGH: Dave Joy will now talk with
us about routing, the regulatory framework that we
have in place, as well as the models that we have
for rail and truck route.

MR. JOY: Thank you, Beth. I'm going to
be covering two subjects in my time slot this
afternoon. I'm going to talk about the regulatory
framework as it applies to route selection. You've
heard a lot about other parts of the regulatory
framework, but this will be looking just at the
route selection process. Then I'm going to discuss
two routing models developed at Oak Ridge for the
Department of Energy and give a couple of examples
of how these models might be used in the future in
some of the DOE work.

The routing regulations, I'll start first, we're looking at the regulations that will affect the highway shipments of what's commonly known as route-controlled quantities of radioactive material.

Department of Transportation has set forth a philosophy of trying to reduce the transit time of a shipment and has directed that the shipment will travel over a preferred network. This network consists of interstate highways, interstate bypass highways around urban areas where they exist, and the DOT regulations also give the states and Indian tribes the right to designate alternative preferred highways that may be added to this network; however, in order to make this alternative preferred highway designation, the states' Indian tribes do have to perform a safety analysis and prove that the alternative road is as safe as the interstate highway it's designed to replace.

All such state-defined alternative roads must be registered with the Department of Transportation or they will not be considered as part of the preferred route network. To date, six states have registered preferred highways with DOT.

In the making of radioactive shipments, the carrier is normally responsible for selecting the route prior to shipment and ensuring that this route does conform with the Department of

Transportation regulations; however, DOT is not required to approve a route before shipment.

The carriers are required to report actual routes driven to DOT within about 30 days of making the shipment.

The Nuclear Regulatory Commission also has some regulations regarding routes. In general, the NRC is mainly concerned with the safeguards aspects of a particular transportation route. The carriers must obtain NRC-route approval prior to shipment and under certain conditions the NRC will require escorts to be used in urbanized areas.

The amount of regulations pertaining to rail shipment is relatively small. Basically, the Department of Transportation does not have any specific routing guidelines for the movement of radioactive material. Some guidelines are being considered, but as to date, none have been formulated.

The Nuclear Regulatory Commission does have routing requirements for the movement of spent fuel and other radioactive materials and, again, it's being judged from a safeguards standpoint. The one difference between the rail-routing requirement and that of highway is the NRC usually requires an escort to accompany the shipment from origin to destination.

The Department of Energy has issued some orders which look at the routing of radioactive material. There is no specific routing requirements, per se; however, DOE does require that the shipper give consideration to the class of railroad, the class of track, the reduction of time in transit, reducing the number of interchange points and reducing the time at these interchange points.

DR. CARTER: David, let me ask you, more generally, what kind of criteria are normally used in routing? Does risk play any role in this? Certainly, indirectly it does, but I don't see it listed so far.

MR. JOY: Indirectly, the Department of Transportation, in developing a highway routing requirement, is trying to minimize the risk. They have correlated risk with the amount of time it's going to take to get the shipment from the source to the destination. Their requirements do not require a risk evaluation of a particular route. They are mainly interested in trying to minimize the transit time, saying that this will minimize risk to the public.

DR. CARTER: So time is a surrogate for risk reduction?

MR. JOY: Yes, they don't say anything about population or other aspects.

The second part of my talk will discuss some of the routing models being developed that have been developed at Oak Ridge.

We started developing these models in the early 1980's, but we're quite interested in how shipments might travel from various reactors to waste disposal sites, wherever they might happen to be, and we're interested in what areas these routes will traverse and also what might happen if there are impediments placed in the way, how the routes tend to move.

The purpose of the development model was to try to predict likely routes of the spent fuel, and I'd like to stress the word trying to estimate or predict routes. At this time, we are not selecting routes.

Auxiliary capabilities that were deemed to be necessary was the use of graphics so we can produce maps to visually illustrate the types of routes that we're talking about and also to calculate population statistics along the routes for subsequent risk analysis, which in our area are conducted by the RADTRAN folks out at Sandia.

We have developed two models. One is the highway model which we use for modeling highway transportation routes, a rather unique name for that one, and the second one is the interline model, which we use for modeling rail and/or barge routes.

There are two parts to a routing model that we'd like to talk about a little bit. One is the data base, which describes the network of interest, and the other is manipulating the data in the data base to make a route selection or predictions in our case.

The highway routing model data base contains a description of over 244,000 miles of highways in the United States. The data bases includes all interstate highways, essentially all US highways and primary state highways. I used the term "essentially," we do not include the US highways that closely parallel toll-free interstates under the assumption that truck traffic would be on the interstate rather than the more local road.

Other roads are included in the data base, such as access roads into the nuclear reactor sites or DOE waste management facilities.

DR. RAJ: Do you have in this data base information on something such as bridges, age of the bridges and so on?

MR. JOY: No. No, we had the network described, but we do not have bridge information associated with the various components of the links in the data base.

DR. RAJ: Or the capacities?

MR. JOY: Or the capacities. The information is available, we've just not had the opportunity to try to link our data base with the Federal Highway Administration.

DR. PRICE: How about sensitive features, such as lakes or other things that might be --

MR. JOY: No, but other data of this type is available. It's a matter of trying to link two very large data bases together. At this time, we have not undertaken those activities.

DR. CARTER: Tunnels, the same way?

MR. JOY: Tunnels, the same way. We know

where a few tunnels are because we've had to use them in our analysis, but we have not specifically identified them along a particular link.

DR. RAJ: Do you anticipate doing that in the near future?

MR. JOY: I think as we get further into looking at actual route information, we'll have bridge information, tunnel information, and we can state for the public which of these features will be encountered.

The data included for each highway segment is normally distance and estimated driving speed, and these are the two factors used to make the route prediction.

All the locations in the data base are identified by name and geographic coordinates. There are approximately 13,500 highway intersections and there are 76 commercial nuclear reactors sites identified by a distinct point in the data base, so that when we study the route from reactor A, we're actually starting from reactor A and not a nearby town or intersection.

DR. PRICE: Do you expect to add to the data base some of these things that have been mentioned? Accident rates, for example, per segment?

MR. JOY: We would like to. We've been talking with the DOE and the people at Argonne about what is the most reasonable type of data to add.

Accident data, it would be nice if we could get consistent accident data across the entire country. We have over 18,000 links in the data base and they all have to be defined at a consistent level or are going to bias your calculations in trying to make the trade-off studies.

The answer is that we've been talking about a lot of these over the last couple of years, but we've not taken any formal action yet.

DR. RAJ: One other thing that concerns me is that we've heard in the newspapers and so on about the quality of the bridges that are 40 years old, and we're now talking about maybe much higher tonnage going on bridges that will be even ten more years old when these fuel shipments are taking place and, therefore, they certainly are going to increase the risk in some fashion, risk of accidents.

MR. JOY: I agree with your point. You do have to worry about the bridges, but I do think that part of the interstate highway system, since it's much newer than the rest of the highway system in the United States, I would say the bridges there are probably in better shape and were designed to a higher standard than you would find on typical US or state highways.

The point is, whenever you travel, they are always repairing a bridge somewhere along the route you're traveling on, and I think this will be a continuing process throughout the time frame that we're going to be working on the highway area.

Some of the features of the highway routing model are the ability to estimate shipping patterns or routes that would be used by commercial carriers and also to simulate routes for the movement of radioactive materials. These include following the interstate highways and conforming to the Department of Transportation regulations.

The model has the ability to calculate alternative routes, if so desired. We can calculate alternatives by following DOT diagrams or we can find alternatives by bypassing a specific geographical area. This might be useful as we get closer to operation and we could bypass areas of heavy construction, bad weather and where bridges happen to be unsafe or whatever consideration.

DR. PRICE: What is the accuracy of

the routes that you have? Is it relatively
accurate?
MR. JOY: I think so. There is no right
answer. I've got a real advantage.

For the route, we predict that the distance is correct. I've generally found that where we've been able to make verification of the time estimates, they are reasonable within five to ten percent, but if you start to ask somebody, "What is the right route or correct route" -- I'll use an example, from Oak Ridge to Richmond, Washington, there is no exact answer. You start to get into human-type factors to make selections. You can find alternative routes that are three miles difference and it's very hard to judge which is right and which is wrong.

The way we've been trying to validate the data base is we have routed people's vacations, and it works. Someone will take this -- he'll say, "I need to go down to here," so we'll plan the route that looks logical. We've had a few times they've come back and said, "That's stupid, man," and that's how we've found some errors in the data base.

We've had a study at Oak Ridge through the NRC where a lot of our people had to drive to nuclear reactors particularly in the southeast and we would predict the routes for them out of the Oak Ridge area. They would come back and say, "Hey, these routes worked."

In general, we probably find about 75 to 95 percent of the routes that we predicted, the drivers came back and said they were quite satisfied with them. I've had a few which I think have not worked well or may not seem reasonable and we've generally been able to trace that back down in the data base. We've got an average driving speed on an US highway that's going through a bunch of hills in Southern Alabama that says 65 or 70 miles an hour, and we had a typist type in the wrong number rather than set that at 40, and that influenced the calculations.

DR. PRICE: And driving time on this particular routing model isn't specific? For example, how long does it take you to get from one side of the Atlanta city area to the other side of the Atlanta city area? You don't get down time for population density?

MR. JOY: You can if you want to. We have an estimated speed for each of the links in the data base.

Remember, going from one side of Atlanta to the other, you're probably going to transverse about 30 separate links because the network is very dense in that area. The speed is based upon the type of highway under consideration.

Interstate highways will have a higher average speed than the noninterstate highways or state highways. It's also based upon whether you're in an urban area or rural area, to some extent the topography of the area. If you're in a mountainous area, it will be a lower speed than if you're in a more level area.

You can make estimates of this by saying, "I'm going to start at this point and go to that point," and give you the speed between the two. If you bring those speeds say to a metropolitan area, you can break out what you think will be the speed across the metropolitan area.

DR. PRICE: You're going to tell me at 4:30 in the afternoon versus --

MR. JOY: No, we don't do time of day route. We're looking at average. We assume you're equally likely to come through here at 3:00 in the morning as you are to come through at, say, quitting time; so we try to find an average between the two.

Most of the longer routes, we do put in break times for the drivers. We normally will assume a two-driver team and assume that the shipment will move four hours, will take a half-hour break and move four hours. This gives us a pretty good, long-term average driving time, but we do not identify specific break sites.

DR. RAJ: Do you have the facility to give weather as a parameter, the effects of weather?

MR. JOY: I can in one way. If you would tell me that there is a bad snowstorm in Wyoming, I can take and remove the State of Wyoming from my network and find a route to pass around it.

We don't have an automatic input into weather, except that in the wintertime we will not use a northern route or summertime maybe we won't go as far south to keep from overheating, but it's not automatic. You can, by removing geographic areas, determine how the route would look.

Here is an example of some alternative routes from the Crystal River Plant in Florida to the Hanford site in Washington. I want to say that this is used for illustration purposes only and does not mean that DOE is going to be making any shipments between these two sites in the foreseeable future.

We've picked this route for a couple of reasons. One, it's a fairly long route, so it gives us a chance to play with some alternative routes and, secondly, it's compatible with the route that Jon Cashwell is going to use tomorrow in his RADTRAN demonstrations.

I've used four routes on the map and these are the orders in which the highway program will predict the route. We've found that if you compare the various routes together, that the difference between route two and route one is about two percent in distance and roughly about two percent in driving time.

We found that between two and three, you get the same difference; between three and four, you have the same difference. So any of those four routes, we'd say, are probably within six percent of each other, depending on weather, road conditions or traffic conditions or maybe even with driver preference, you could get a different switch between the various routes.

We've also looked at the population across the routes and found that routes one, two and four have essentially the same population; route three does have a somewhat higher population since it runs through the Chicago and the Twin Cities area.

DR. DEERE: I do note that all four routes go within about two blocks of my house.

MR. JOY: Sorry about that. I've had a lot of interest in some of these talks. I'm the first person that clearly identifies whose back yard we're going by.

Let's switch topics now and move into the interline program. This is our rail routing program. Our data base contains all the railroads in the United States with the exception of industrial spurs.

The source for the data base was the Federal Railroad Administration. We obtained the data base in about the mid or late '70's and have extensively updated it and modified the data base to take into account the most recent rail abandonments and mergers of the rail companies.

There are a couple unique features that we have to include in this model. Routing on the railroad is not quite like routing on highways. The railroads are privately owned and company A does not use company B's tracks, in general, and there are also identifying interchange points between the various railroad companies.

In the United States, currently there are about 96 companies who are competing for your services and also they cooperate with each other to make cross-country transportation possible and efficient, which means that for most of our shipments that we're looking at in the DOE community, that we're probably going to be dealing with at least two or three railroads for each individual shipment to move from the eastern part of the United States to, say, the Yucca Mountain area or somewhere west of the Mississippi.

DR. PRICE: When you say that we are probably going to be dealing with, who is "we"? Who has the authority to determine a rail route? Is it the FRA or is it DOE or is it --

MR. JOY: I would say at this point it would probably be a negotiation between the DOE traffic manager responsible for the shipment and the railroads involved, would be my best guess of how that would be selected.

MR. KOUTS: It also depends on the type of service that you're getting from the railroad. Again, regular freight, you don't have as much control as you would over dedicated train, for instance, or a special train.

So, again, the higher price you pay for the railroads, the more certainty you're going to have if you're going to go over a specific route that you would like them to go over, and this is one of the things we're working on and it's one of the things that we're certainly aware of.

MR. ISAACS: Let me just add again, I think this is probably obvious to all of you, but bears some reinforcing.

Number one, even if we're very successful, we're not going to start this system moving anything for 10 to 15 years, and a lot can happen in 10 to 15 years, an awful lot can happen.

Secondly, perhaps even more importantly, we still conceive of a system with an MRS in it. We have no idea now where the MRS is going to be. As of a little more than a year-and-a-half ago, things flipped around. For awhile, we didn't know where the repository was going to be, but we thought we knew where the MRS was going to be.

For now, we have a leading candidate site for a repository, and even that's not a certainty, and we won't know about that site for a number of years. We certainly won't know under current law where an MRS is going to be for a number of years as well.

If we had an MRS and it was someplace toward the east, anywhere toward the east, you would probably hope that -- to define at that point in time a linkage -- a single linkage with the repository wherever it turned out to be. So all of these kinds of things, it goes back to the opening comments I made and reinforced later that there is a sequential nature to this problem.

What we've got to get in place now is an understanding of the basic building blocks, the basic tools, the basic sensitivities, and apply them to make smart decisions and not think that we should somehow obligate ourselves to make all those decisions now, because we surely can't make good ones.

MR. JOY: Thank you. I just want to make two last points about some of the capabilities of the model. One, the model does include the ability to calculate the impact of a long-haul advantage for the originating railroad. We talked about this a little bit earlieer. This can be activated in the model. Normally, it's not and you have to deactivate it if you wish to not use.

The model calculates alternative routes when multiple options exist for most spent fuel shipments. This would mean the intermediate railroad system, the originating railroad and the final railroad system are pretty well fixed, but there are still some options between the railroads we'd use to bridge between the two.

I just want to bring one example of a railroad that's for nonradioactive-type shipments. The point I want to make is --

MR. KOUTS: Dave, would you reinforce my assurance that Florida isn't located in the State of Texas?

MR. JOY: Yes, but I sure got someone who can't type up there, don't I?

MR. ISAACS: We are concerned about Don Deere's sensitivity about those shipments coming too close to his house.

MR. JOY: I apologize for that. I've got an assistant who never makes a mistake, but, boy, he just made a boo-boo on that one.

No, we're trying to go from Houston, Texas, to Portland on this example. The point I want to make was where options exist, routes can cover different areas.

Both of these cities are on -- the Southern Pacific, Burlington Northern and UUnion Pacific all provide services, and depending on which railroad is selected, whether this is based upon cost or what other factors are used, the routes can move dramatically different.

This shows some of the uncertainty that's going to be involved at this point, just where these shipments be and makes risk analysis a little bit more difficult. I'm an engineer; I'm not a geographer.

We have included the ability for barge routing inside the interline model. The network does include the inland waterways, intercoastal waterways, Great Lakes and St. Lawrence Seaway and Panama Canal for inside the US waters. We do include the location of all the locks and dams.

We've identified the interchange points where a barge shipment can interchange with the railroad network and are able to calculate barge-rail intermodal shipments, if so desired, or we can specify the intermodal point.

One last point I'd like to talk about is the population density work. One of the major applications of the routing model has been to help supply population statistics for subsequent risk analysis. We base our population density data upon the 1980 US Census enumeration areas or block counts. This is the most detailed information on residential population that we could get from the US Census Bureau.

In the future, we're going to start to look at the location of daytime population. Some of this information is now available with respect to the 1990 Census and they have more information, so we'll try to get some idea of where the population is, say, at nighttime and where it happens to be in the daytime because there is a definite shift in population from suburbs.

The population data from the Census Bureau has been processed and we've defined every section of the United States to be located in one of 12 population density groups. If you look at the overlay of the population density on the map of the United States, we have a very complicated contour-type map. Each of the contours represents a constant number of people.

Our population density groups vary from zero people per square mile up to, at the other end of the scale, over 10,000 people per square mile.

The population density distribution -- that is, the fraction of each of the links in the highway and the interlying data base that lie within each population distribution class -- have been defined and have been added to the data base to make population calculations essentially as simple as making a routing calculation.

One of the underlying principles of doing all this work was to be sure that population density information that we're working with is compatible with the type of data that's required with the RADTRAN risk code.

That concludes the formal part of the talk.

DR. CARTER: You have these 12 distributions already done? Have you done any essentially ground checking or random verification of those numbers?

MR. JOY: The checking we have done is -- yes, we have. We build up to a rather complicated series of systems and we come up to what we call our basic enumeration district area, which is unknown.

The Census Bureau does not give us the shape of the enumeration district, so we have to estimate those and then try to make the population surface a continuous function. As we make this smooth function across a large area, we do go back and check and make sure the population in each enumeration district matches that which the Census Bureau has given us so we do not change any of the enumeration district data through the computer manipulations.

The process is quite good if you're looking at areas east of the Rocky Mountains where there is more of a continuous movement gradient of population. You get into some of the western areas where the land is very sparsely settled and there are a few isolated clusters of towns. Not knowing the shape does tend to give us a smearing effect through there, but we use exclusion or inclusion areas and shove the population back where it belongs.

DR. CARTER: Actually, this is one of the major criticisms in the past on the risk, that detailed information wasn't available and they used this rough cut of three population distributions.

MR. JOY: Well, they used this, but that three cut is based upon our 12. We just aggregate our 12 into those three zones and I believe --

MR. ROTHMAN: Not in the EA's.

MR. JOY: Yes.

DR. CARTER: A lot of people would like

you to use the actual population distribution along the line.

MR. JOY: I think that's just a matter of some minor modifications to RADTRAN, but the data is available at this particular level.

MR. KOUTS: Thank you, Dave.

We have one more presentation today. It was intended, as I mentioned this morning, to be given by Carl Gertz, who sends his apologies that he's not able to be here.

I'd like to introduce Mr. Bill Andrews of SAIC Corporation who will be giving Carl's talk and discussing basically the main thrusts of the transportation program within the State of Nevada by the Economic Project Office.

MR. ANDREWS: First off, I have to say that I'm no Carl Gertz, but I'll give it my best shot.

Carl asked me to relay to you his apologies in not being able to be here today and also that he considers transportation to be a very important part of his program in evaluating a potential host state for repository in the State of Nevada and that it has dimensions in its own right, much as the national program does, but because public opinion about transportation is also tied to general acceptance of the site.

A little overview of the presentation here. Because the program in Nevada is more detailed, I'll spend a few minutes giving you the lay of the land, if you will, and talk about highway routing. We recently published a report on this topic.

There is no current rail access to the Yucca Mountain Site. I'll talk about how transportation is an integral site and transportation -- talk about interaction with Nevada as an integral part of the program, therefore, the site development.

The objective of transportation in the State of Nevada is to implement the headquarter's program in evaluating the Yucca Mountain Site as a potential repository location. The advantage of dealing strictly in the State of Nevada is that we can feed some of the results of the headquarter's program you've heard about so far today and will know more about in the next couple of days and get some direct feedback from the State of Nevada affecting county governments and cities that are involved with DOE at this time.

Also, as you heard, rail is the preferred mode of transport to the site, so a major part of our program is to develop rail access to the repository site. The current main-line railroad is about 100 miles from Yucca Mountain, and we're fortunate in having three main-line railroads in the region of Nevada: the Union Pacific, Southern Pacific and Santa Fe Railroads.

In implementing the policy on following DOT regulations in the State of Nevada, highway access would currently be through Las Vegas.

As I said, transportation is an integral part of the site program, and in several surveys, transportation routinely shows up as the issue of most concern to the public in Nevada.

Some general strategies associated with developing site access for highway is it's primarily to implement the DOT regulations and to offer technical assistance to the State of Nevada in their evaluations of alternative routes.

To date, some technical tools have been

provided to the Nevada Department of Transportation, who is doing an evaluation of alternatives to the interstate highway system. Those models you'll hear more about tomorrow during the risk assessment portion of the presentations.

The rail strategy is to develop access to the site. As I said, there are three main railroads in the vicinity of Nevada, but at the same time, it's an institutional issue in that you have to address the real issues, the engineering, getting the land, the environmental concerns, with the perceived issues of the people along the potential routes.

One of the perceived issues is, for example, the availability of the spur for use in economic development.

I'll talk first about the highway work that's been done. There have been a couple evaluations completed under the existing DOT regulations. Traffic would go on Interstate 15 through Las Vegas and to the site, and we know that the state is evaluating alternatives.

The Section 175 Report was a report to Congress on potential nonnuclear impacts of siting the repository, and in that report it looked at all transportation to support the site except the nuclear aspects of high-level waste transportation. By that, I mean, it looked at the increase in car traffic and truck traffic and trucks associated with highway transport of high-level waste in terms of their impact on traffic ingression. It was found that some small increase in congestion could occur in the vicinity of the site during various phases of the repository development. It also looked at potential pavement degradation in this increased traffic.

In general, the revenues that would be expected to be generated from this increased traffic appeared to be able to more than pay for the anticipated degradation to the roadway.

A report on highway routing of high-level waste shipments in Nevada was completed in April of '89. To kind of give you the lay of the land a bit, there are only two interstate highways that go into Nevada; Interstate 80 in the northern part of the state and Interstate 15 that comes through the southern part of the state and continues down to LA.

The state is roughly 500 miles long and about 200 miles wide, so it's fairly large. The site is here, or roughly 100 miles from Las Vegas up US Highway 95.

So in the case of Nevada, the interstate infrastructure is relatively sparse and that forces the DOT regulations to suggest that you would have to go through Las Vegas and take US 95 to the site.

Some of the other models that have looked at highway routing suggest that shipments would come down from the north this way, also Interstate 80, I-70; shipments across the southern part of the United States would come this way over to Barstow and back up here along with a few shipments from California.

The purpose of the publication in April was to make three major points. First, to educate the public about the role of DOE as a shipper under the DOT regulations. DOE is a carrier of large quantities of radioactive materials in that they would be moving spent fuel on the highways, but were not the only large quantity carrier in the State of Nevada. So that tempers on how you would implement the routing regulations from the point of view of the State of Nevada because, obviously, the regulations will apply to all shipments of this type.

And, again, the routes can't be selected until nearer the time of shipment, and it's the carrier's responsibility. This point was lost in some of the public discussion that was ongoing there.

The second point was to communicate to the public on who selects the routes. At the time of shipment, the carriers will look at available alternatives and seek to minimize the time of transit, as was discussed earlier.

As an alternative to the interstate system, the state can designate alternate routes, and that's what they are looking into now. DOE does not have the authority to designate alternate routes and must select from the available alternatives.

The last point was to look at some routes that would be of interest to the OCRWM. It's not particularly desirable, from the point of view of DOE, to go through Las Vegas. The point is that under the current regulations, that would be the route that would be available to us.

Second, the environmental assessment a few years back that was reused to evaluate the multiple repository sites looked at a route that would go across Hoover Dam, and that's a large tourist attraction in Southern Nevada, and this report hoped to clarify that the DOE has no plans to cross Hoover Dam.

This is a map that came out of the report. Here you see the interstate system, as we saw before, and some of the alternative routes that would be potentially of interest to the program because of their relatively direct access to the site.

Let's turn a little bit to rail now. At this point, some paper studies of feasible alternatives in the State of Nevada have been completed. By this, I mean, we've looked at existing topographical maps, land use maps, and made some inquiries into what the current restrictive use of lands are. We've talked to the regional carriers and asked if they are interested in hearing more about high-level waste transportation. We've received a positive reply from all three of the carriers.

The evaluation has focused on three criteria at this point. Again, we're trying to make a quick cut so that we could focus down from a total of 13 routes, and now we have three that passed these initial criteria evaluations. The first is carrier access. It's desirable to have access to more than one rail carrier because with the deregulations of the railroads, it puts you in a better competitive position, although some routes were identified they do not have that.

Second was engineering feasibility. The criteria there were limited to two-and-a-half-percent grade, eight-percent curvature and some other criteria, again to be compatible with main-line standards at this time.

The third -- and it turns out to be the most difficult -- is to be compatible with existing land uses. The desire would be to avoid developed private land and second to avoid land that has been withdrawn from public use for defense or other purposes and also to avoid land that is restricted due to environmental or other uses, such as parks and things of that nature.

Of the 13 routes that were looked at, three passed the initial screening and the others will be monitored because we recognize that land use and the desires of people for their use of their land would change over time.

DR. PRICE: By your definitions there, did that exclude the Nevada Test Site?

MR. ANDREWS: That's correct. That has been withdrawn from public use for a special purpose. Several routes were submitted to us, though, from Lincoln County in Nevada, two of which -- two of the three submitted do cross the Test Site, so we do have some of the 13 that looked at crossing there. We're currently monitoring them to see if there will be some resolution of that land use conflict.

The Union Pacific and Southern Pacific track run across the northern part of Nevada. The Union Pacific also has some track that runs down the southern part here and connects eventually with the Santa Fe Railroad which runs across the southern part of California and Arizona.

Some of the routes we looked at are shown on this map, although not all of them, and three passed the interim screening. One is from Carlin here to the north which would connect to the Southern Pacific and Union Pacific track, travel nearly the length of the state to Yucca Mountain here.

The second one is Caliente, starting on the Union Pacific track and going primarily around the withdrawn land for the Nevada Test Site and the bombing and gunnery range and at Yucca Mountain.

The third one starts south of Las Vegas with the Union Pacific track and parallels the state line and goes to the site.

Quickly, the results of the initial evaluations are shown on this slide. The routes range in length from 120 miles to 400 miles long; fairly long routes. They range in costs from several hundred million up to roughly 700 million. These costs are very preliminary and based on an assessment of about one million dollars per mile for level terrain and two million dollars a mile for mountainous terrain, some major bridge structures and graded separations, to the extent we are able to identify them from these paper studies.

If you think back to some of the comments that were made in Rob's talk, his total difference in the 100-percent rail case versus the mixed case was about 200 million dollars, and if you think if it were all level terrain, you might be able to develop 200 miles of total rail spur in the national system to promote your 100-percent rail case, and that isn't very much mileage because we're looking at several hundred miles to one site here.

DR. CARTER: Excuse me a minute. Why would you study the Caliente thing any further compared to Jean, for example? Jean connects two railroads, it's much shorter, much cheaper and so forth.

MR. ANDREWS: The reason that we carry that along -- oh, Jean --

DR. CARTER: It looks like Caliente is already lost.

MR. ANDREWS: -- was we felt that the work that's been done to date was not detailed enough to make that evaluation. Also, there is some headquarter's policy related to rail routing where the MRS might be located and other open issues that encourage the DOE to carry as many options along as reasonable.

These three have the advantage of kind of bracketing the state and you could handle some wide variation in future decisions related to these routing and siting issues.

DR. CARTER: I guess the one from Caliente and the Carlin, they both would avoid going through the bombing and gunnery range. Is that the reason for the routing?

MR. ANDREWS: None of these would go

through the bombing and gunnery range.

DR. CARTER: So it's a circuitous route?

MR. ANDREWS: Yes, it is. The Jean route is, of course, the cheapest. The access to the

Santa Fe is indirect, so that the shipments would have to -- if they are coming across the southern part of the US, they would have to go to Barstow and come back up. There is an existing track use agreement between the two railroads, but if you started to make a significant number of shipments, there are some uncertainties there.

There are some operational issues. We haven't talked enough to the railroads to make sure these are completely feasible.

DR. CARTER: Another specific question for the Jean route, which way would that go around the mountains? To the east or west?

MR. ANDREWS: The Spring Mountains? Show me that map. If you've been to Las Vegas, which you obviously have, you come down to Jean --

DR. CARTER: I've never been to Vegas. I've been to Jean.

MR. ANDREWS: There has got to be a story in that.

DR. CARTER: The group here has obviously never been to Jean.

MR. ANDREWS: It's one of my favorite places to show people where the rail routes might go. There are some mountains there called the

Spring Mountains, and at this point, we said, "Is there hope that" -- or "Is there a potential, feasible route through these mountains where we couldn't get into a lot of problems?"

There would be a lot of earthwork here. There are fairly steep grades, but there was some existing trackage in there, narrow guage in years gone by such that we felt for the initial go-around that would be feasible. We could also look in the future maybe at looking at something that might go around here; it's more level that way.

That's a question of cost and land access issues. You get into some environmentally sensitive lands over here, although just skirting around there would not get into that area. So that's the story on that.

In the case of Caliente, it does go around -- it's circuitous to avoid this withdrawn land. It has the disadvantage of going east to west in Nevada and most mountain ranges in the state run north-south, so it's a lot of rise and fall, so that's what leads to the higher cost.

The main advantage in keeping it in is it is one of two that has no identified land use conflicts. We could stay on federally owned land the entire distance at the present time.

DR. CARTER: I believe you indicated there were no problems with that for the Jean route, also?

MR. ANDREWS: That's also correct. There is some just preserving operational options at this point.

DR. CARTER: Another big difference is one connects with two railroads and the other one with one.

MR. ANDREWS: The Carlin route is the last one. It has the advantage of the two railroads, but it generally parallels these mountain ranges, so it would be much easier to construct, doesn't get up into the snow elevations as much.

The disadvantage to it is that there is a checkerboard pattern of private land ownership here that came from land grants associated with constructing the original transcontinental railroad right of ways.

I've been up there and it's largely

undeveloped, it's ranch land, but there are some land access issues there.

The plan would be to start some additional work beginning next year to take a more futureoriented and detailed look at the feasibility issues that have been looked at so far and refine technical feasibility. We'd look at land access and engineering aspects at a more detailed level and also grade crossings, drainage because the big weather condition in Nevada is flash floods.

From that you can derive a detailed cost estimate and provide primarily a basis for land access and environmental planning. Those are two major areas that have been troublesome for the Yucca Mountain Site, and we're trying to get a jump on that for this part of the project, as well.

Some additional state and local participation through informal meetings and other means would be embarked upon also as part of refining the feasibility. There you're looking to get some future feeling of the interest of the people and maybe for their desire to do economic development and also looking at future land use issues.

Finally, again, to support the

headquarter's planning and policy development.

To go to a slightly different topic and briefly why routing and transportation in a broader sense are tied to the site and that's primarily that routing is going to involve the evaluation of potential impact, and if impacts are identified, they are potential mitigation.

As a potential host state, Nevada has several options available to it that are unique under the Nuclear Waste Policy Act and the amendments to that. We've got the C&C Agreement, the negotiator, there is an ongoing grant program with the State of Nevada and affected local governments, so they are looking at a broad range of impacts.

By that, it means the infrastructure, the pavement degradation, potential for increased social services, hospitals, police, a broad range of things under items -- under the socioeconomic and transportation program. That causes us to take a broader view in that state than you would see from the risk assessment.

At this point, data collection has been initiated from federal agencies, state and local governments, and we'll eventually do some additional field surveys. We've driven every highway in the state that would be a potential interest for high-level waste shipments. In the case of the comment earlier about actual population, there are so few people in rural Nevada that we can actually count houses by mile posts and how far away from the highway they are, and it isn't all that many. You need more than your fingers and toes, but on some routes not too much more.

Again, we'll talk to the railroad companies. We've just preliminarily gotten an expression of interest from them and, hopefully, we can get some additional data.

The final point here is that the institutional aspects of the program connected with the site and transportation are important in the state. The issues for transportation are not different than the national issues you've heard here, only they are tailored to the local situation.

Routing by both highway and rail is important, but only in the State of Nevada. There is less interest in the national interests other than how it will come to the state.

Cask safety is an issue and the people

tend to translate those issues of the accident conditions and exposure to their local situation, so we're trying to become familiar with those localized places and answer their questions.

Down the road a ways, looking at emergency response, some of the grantees are looking at their existing emergency response capabilities. Carl feels that it's important for transportation and the site work to maintain a current dialogue, and he holds semi-annual public update meetings. There are two information offices, one is open now and the second will open soon in Las Vegas. He makes numerous presentations to community groups, over 125 to date.

In summary, like the national program, Yucca Mountain transportation issues are both institutional and technical. The position that's been taken in the state is that highway routing is a state and carrier responsibility and DOE has provided technical tools to help the state in their evaluation of alternative routes.

The rail routing is both a technical program and one that seeks to involve the local communities more so in the future than it's done in the past, but our feasibility evaluations will become more detailed in the future.

Finally, transportation is a public issue and it's tied to the site and we're attempting to take a broader look at infrastructure issues to address some potential mitigation strategies that might be suggested under the NWPAA.

That's all I have.

MR. KOUTS: Thank you very much, Bill. I have 15 minutes of summary and conclusions and I'm not going to try to summarize or conclude.

I would like to make a few announcements, if you will, so we can conclude very closely to where we intended on concluding today.

Dr. Price expressed an interest on DOE interpretation of NRC regulations, and what we're going to do is we have a variety of technical papers on the subject within the transportation program and we're going to make those available to the board so you have a little bit more information as to our view of the NRC regulations.

I'd also like to make some comments about the Sandia tour tomorrow, if that's all right. We've decided to deviate a little bit from what you see in your agenda there. Those people attending the tour, what we would like to do with them is immediately after the presentations -- or shortly after the presentation is finished in the morning, we'd like to load you up on a bus and take you over to the Sandia site. Lunch will be available there at a place called Commodore Club.

We'll then also be able to provide you with some video tapes and a viewing, if you will, of some of the things you'll be seeing and I think some interesting tests that have been done in the past on the casks, so you have some frame of reference prior to the time you go out to the site.

In terms of clothing, the suggestion is that if you would dress comfortably, once we leave the Commodore Club and lunch, there will be a derth of facilities available for general use, and I guess the only recommendation I can make is don't drink a lot of iced tea for lunch because you will be out on the site most of the day until we get back to the robotic lab area where we'll be giving you a robotics demonstration.

So just a few helpful reminders in that regard and if you'll keep that in mind when you plan your attire for the day, because we plan to be leaving shortly after the time that we finish the presentations in the morning.

I would like to mention the no-host reception tonight. It is going to be held at 6:00 and we do have a site for it, it's going to be in the atrium area of the hotel, and anybody here in attendance from the audience, certainly the board and DOE presenters and officials are certainly invited to attend.

I also told Mr. Bill Coons earlier that we do have a room for the board to go and meet right after, it's the Aztec Room directly out of here and off to the right and you'll see it. That's been provided for your convenience in case you'd like to have some deliberations after we close today.

I certainly want to thank you for your attentiveness and attention and comments. We'll look forward to seeing you again at the no-host reception or certainly at 8:30 in the morning sharp.

Thank you.

DR. PRICE: Thank you for a fine day.

(Proceedings adjourned at 4:55 PM.)

STATE OF NEW MEXICO)
)ss.
COUNTY OF BERNALILLO)

I, Kathy Townsend, the officer before whom the foregoing matter was taken, do hereby certify that I personally recorded the proceedings by machine shorthand; that said transcript is a true record of the proceedings; that I am neither attorney nor counsel for, nor related to or employed by any of the parties to the action in which this matter is taken, and that I am not a relative or employee of any attorney or counsel employed by the parties hereto or financially interested in the action.

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