UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD

PANEL ON THE ENGINEERED BARRIER SYSTEM:
REPOSITORY DEVELOPMENT AND DEFENSE HIGH-LEVEL WASTE

June 15, 1994
The Tower Inn and Conference Center
Richland, Washington

BOARD MEMBERS PRESENT

Dr. Donald Langmuir, Acting EBS Panel Chairman
Dr. John J. McKetta
Dr. Garry D. Brewer

CONSULTANTS

Dr. Ellis D. Verink
Dr. Dennis L. Price

STAFF MEMBERS PRESENT

Dr. William Barnard, Executive Director NWTRB
Dr. Carl Di Bella, Senior Professional Staff
Dr. Sherwood Chu, Senior Professional Staff
Dr. Leon Reiter, Senior Professional Staff
Dr. Daniel Fehringer, Senior Professional Staff
Dr. Daniel Metlay, Senior Professional Staff
Mr. Russell McFarland, Senior Professional Staff
Ms. Linda Hiatt, Management Assistant
Ms. Donna Steward, Staff Assistant

I N D E X

P R O C E E D I N G S

DR. LANGMUIR: Good morning. My name is Donald Langmuir. I'm Professor Emeritus of Geochemistry at the Colorado School of Mines in Golden, Colorado, and I serve as Acting Chair of the Board's Panel on the Engineered Barrier System. The EBS Panel instigated today's meeting.

First, let me introduce my colleagues; Dr. John McKetta, who's Professor Emeritus of Chemical Engineering at the University of Texas in Austin; Dr. Ellis Verink, Professor Emeritus in the Department of Materials Science and Engineering at the University of Florida; Dr. Dennis Price is Professor of Industrial and Systems Engineering, Director of the Safety Projects Office, and Coordinator of the Human Factors Engineering Center at Virginia Polytechnic Institute and State University, which many of us know as VPI.

Until their terms expired on April 19th, Dr. Price and Dr. Verink were in the EBS Panel, and Dr. Verink chaired that panel. Since April 19th, they have served the Panel and the Board as consultants.

I would like also to introduce Dr. Garry Brewer. He's Professor of Resource Policy and Management and Dean of the School of Natural Resources and Environment at the University of Michigan. Dr. Brewer chairs the Board's Panel on Environment and Public Health, and is both a member and acting chair of the Board's Panel on Risk and Performance

Analysis.

The only previous visit of the Board to the Hanford area took place slightly more than two years ago. That, too, was a meeting of the EBS Panel, and Dr. Verink chaired that meeting. In the interest of continuity, he has agreed to preside over this meeting, so I'm now going to turn the floor over to Dr. Verink.

DR. VERINK: Thank you, Don. I hope I'm not going to be the whispering monster today. I hope my voice will hold up.

I have a few more introductions I'd like to make. At the end of the table to my left here is Dr. Bill Barnard, who many of you know, and is the Board's Senior Professional Staff Executive Director.

Several other Board staff members also are with us today. Let me introduce them briefly, and ask them to raise their hands and wave at you, also: Linda Hiatt, at the back table there, is in charge of meeting arrangements. Donna Steward, who is sitting next to her, is a member of the support staff.

Most of you know Russ McFarland back there, who's senior professional staff member, serving the Panel on Structural Geology and Geoengineering. Dr. Dan Metlay, over here, also a member of the senior professional staff. He works on socioeconomic, institutional, international, and other related sorts of areas.

Dr. Sherwood, better known as "Woody", Chu, over here, senior professional staff member who serves the Panel on Transportation and Systems. Dr. Leon Reiter, over here, senior professional staff working in the areas of geology and performance assessment, and Dr. Dan Fehringer, right here in the middle, senior professional staff, working in areas of health physics, environment, and regulatory analysis.

This Board, as many of you know, was created by the 1987 amendments to the Nuclear Waste Policy Act. The amendments provide simply that the Board shall evaluate the technical and scientific validity of DOE's activities under the Nuclear Waste Policy Act. The Act itself was passed in 1982, as you know, and provides for DOE to develop repositories for high-level waste and spent nuclear fuel by following an orderly process of repository site characterization, approval, and construction, and, as many of you are aware, currently, only one potential repository site is being evaluated. It's at Yucca Mountain. Site-specific work for a second repository is not authorized, and cannot be, under any current law, until at least the year 2007.

The high-level waste from reprocessing which exists in many single-shell and double-shell tanks on the Hanford reservation is eventually destined for deep geologic disposal in solid form in one or more repositories, and, consequently, that's our principal interest today. We want to know how the waste will perform in a repository. In the last analysis, that's the question. We want to know how the waste will impact the repositories. Actually, this is kind of the final test of the radiation protection standards for protection of the human environment.

We want to know how much waste there is, what its composition is, what sort of separation and solidification treatments you're considering for it, how it might be packaged before it comes to the repository. We are also hoping to learn where DOE draws the line of responsibility between the so-called EM and RW categories, which I presume you're all very familiar with; whether this line is a continuous one, or whether there are gaps in that line, and whether all parties understand where this line of delineation is and what it means.

We lasted visited Hanford in May of 1992. At that time, if I recall correctly, there were some rather firm plans, at least for the double-shell tank waste. My recollection is that the low-level portion was to be made into grout and disposed on site, while the high-level portion was to be vitrified for deep geologic disposal in one or more repositories. I think you were only a few weeks away, at that time, from breaking ground for a mammoth vitrification facility.

From what we read in the newspapers and the trade press, the plans are now very different from what they were two years ago. We would like to know what those new plans are, and any impact that they could have on the ultimate geologic disposal.

There's another major difference now from two years ago. Two years ago, there were materials that had been irradiated at Hanford production plants, but had not yet been reprocessed to produce plutonium, uranium, and high-level waste. At the time, it wasn't considered a so-called waste, and, therefore, did not enter into the discussions.

Since that time, however, the decision apparently has been made that the material will never be reprocessed, and will instead be disposed of in deep geologic repositories after appropriate conversion treatment and packaging.

We're very much interested in hearing about this material: how much of it there is, what are its current form and its composition, what may be done to ready it for a repository, and what its impact on the repository may be. I expect much of this is yet to be determined, but at least we hope to hear what the process for developing plans for handling this material might be, and when the plan might be developed.

We're concerned about the impact of defense waste on repositories. We're also concerned about the impact of repositories on defense waste. Let me explain what I mean.

In theory, high-level defense wastes will be treated and packaged so that they will meet repository safety standards. In the case of tank wastes, treatment means that EM turns it, or at least the high-level portion of it, into a solid, something like a glass log, and that RW slips the log into some kind of an overpack before disposal.

What is the performance allocation in meeting the repository safety standards between a glass log and the overpack? Have EM and RW agreed on this? Could it be that they are each engaged in overkill? It could mean a lot of money diverted from other, perhaps more important, projects. Worse yet would be if each thinks the other's engineered barrier is to provide the protection function if something drops between the cracks.

We want to express our thanks to Richland's Operations Office for the meeting today and the tour tomorrow. I want, particularly, to thank Phil LaMont, and I understand he's been working closely with the Board's staff in arranging the meeting, and in setting up tomorrow's closed tour. We realize that the repository is an important issue, but does not have the immediacy at Hanford of other issues, such as remediation.

Besides of question of plans to prepare and package tank wastes for ultimate disposal, and the question of what will be done with the irradiated but unreprocessed material to ready it for disposal, we have a third issue on today's agenda. This is the issue of planning for the disposition of surplus weapons plutonium.

We know that several proposals have been floated regarding plutonium disposition, and these will involve things on, near, and otherwise associated with the Hanford reservation. But that's not at all why we are discussing it in today's meeting. We are discussing it here today because the technical topic of plutonium disposition falls within the EBS, the Engineered Barrier System Panel's responsibilities having to do with the waste form, because the topic is timely, because plutonium is considered a defense waste and the EBS Panel has not conducted a public meeting on the subject of defense waste for more than a year, and because the Panel does not plan to conduct another public meeting on this subject for another nine months or so, so it just kind of fits into the scheme of things in order to keep the planning program going.

Two gentlemen from Washington, D.C. will address the topic of disposition of surplus weapons plutonium at the end of this afternoon's program. Like other defense wastes, our interests are the same: how much is there, what is its composition, what might be done to get it ready for disposal, how will it impact the the repositories? Same questions. This is a "hot" topic and we are all looking forward to it.

Now, tomorrow, a full day's tour of Hanford is scheduled for the Board, its staff, and invited parties. Phil LaMont will give us a few words about the tour later today.

I know each speaker has much more to say in his or her topic area than can be delivered in the time we're going to have available, and I'm very concerned that we try to stay on time so we can give every speaker a reasonable shot at it, so, to the speakers, I say, let's try to keep it on schedule. I'll give you a five-minute warning and a two-minute warning so that you can make your plans. Try to reserve a little time for questions.

In regard to questions, I will first be soliciting members of the Board and staff for their questions, and, if time permits, from the floor after each one of the speakers has completed their presentation. I'm going to do my best to stay on schedule, so if I don't get your question in, or your comment, hang onto them. At the end, we're going to have a final wrap-up and try to get everybody's input and questions taken care of.

Are there any general announcements, Bill, or anybody, that need to be made?

(No audible response.)

DR. VERINK: Okay. The first set of presentations, then, before the morning break are overviews, and our first speaker is Ronald Izatt, Deputy Manager of DOE's Richland Operations Office.

The floor is yours, Ron.

MR. IZATT: My remarks are simple. I welcome everybody here today. I welcome the Nuclear Waste Technical Review Board, the support staff, the professional staff, the stakeholders, and, perhaps most of all, the public. It's a great opportunity that we have today for the Board to be here, and we're looking forward for the next days with the presentations, as well as the tour tomorrow.

Of course, the purpose here is to share information, and we hope that by listening to the length of questions that we've heard this morning, we think we're prepared to at least address most of those topics in completion.

I would offer to the Board that when you get through to the end of the period, if you're still missing some information, we're committed to support your needs, so, as soon as you can give us the request, we'll be happy to try to get that information in a timely manner.

Again, I'm Ron Izatt, the Deputy Manager at Richland. Some of you, I've not had an opportunity to meet, but lots of you are old-time acquaintances, having been, in days gone by, the Monitor Retrievable Storage Program Manager for the nation, which sited a facility in Tennessee, which is still in standby, and also the Deputy of the Salt Waste Isolation Project, I guess I have a piece of my life and my heart associated with this program, and so it was a great honor today to be asked to come and say the welcoming remarks.

We specifically designed the weather here for you. If you were here the day before, you would know that this place about blew away, but we also have the Secretary of Energy coming this evening. That's probably partially why we've got the weather the way it is as well.

Listen carefully to the information that you want to cover. I will tell you that of the topics, at least, that we are prepared to address directly were, obviously, the high-level waste tanks, but something that wasn't mentioned this morning--at least I didn't hear it--was I want to talk to you about strontium and cesium capsules, because, in our defense waste EIS, there's an expectation that that will go to the repository as well, as well as some of the spent nuclear fuel that we have on site.

Again, I'll tell you that the plutonium and the surplus weapons issue is something that's being addressed by headquarters, and that's not really in the Operations Office scope, so I'll just tell you that's a program that's outside of Richland at this particular time.

One piece that was touched on was the changes to the program since the last time you were here in the last two years. I should tell you, those changes are not just casual changes. Those changes are enforceable through the Tri-Party agreement. We have an obligation, both in the Hanford tank waste remediation system, which we call TWRS, and the spent nuclear project that we have enforceable milestones and we're about to get some more, especially in the spent fuel area, and that puts the onus on us to make key decisions up front on, obviously, the final waste forms, and that affects, of course, the design, the construction, the operation of the facilities, and the clean-up, and so this is an iterative process.

We've talked briefly about the EM and RW interactions. Their relationship is very closely tied, and so, we're very, I guess, keenly awaiting what the Board's recommendation might be to the Office of Civilian Radioactive Waste Management, because what you might suggest, direct, or encourage, can have significant impact on our program, and, again, we are pushing very hard, and are being pushed by the regulators--both the EPA, and, mainly, the state in this area--to get on with the waste and get it to a better home, and, ultimately, get it to a repository.

I'll tell you the concentration. There was one comment that was made that perhaps we're concentrating more on remediation than we are on this particular waste. I'll just do it for you in rough dollars. We spend about $1.3 billion working on the waste and the waste form, and we spend about $200 million on remediation, so, in terms of perspective, I just want to tell you, you're where the action is, and that's the emphasis, also, for the Hanford site.

I guess, in order to get you back on schedule, I'll keep my remarks really brief and just thank the DOE, Westinghouse and PNL staff, and the presenters who will be discussing topics with you later today, as well as the presenters tomorrow when you're on tour, and just thank them for the support, and, again, I thank Phil LaMont for orchestrating this.

For those who may not know, it seems like of all the people left in Richland, Phil and I are probably the ones that have been associated with your program the longest, and so, it was nice when he came back and touched me again for the opportunity.

So, on behalf of John Wagner and the Hanford employees, welcome to the Board, and to the staff, and, again, to the general public, and thank you very much.

DR. VERINK: Thank you very much.

Our first speaker will be Steve Gomberg.

MR. GOMBERG: Thank you, Dr. Verink. Let me thank the Board for giving me the opportunity to speak here today, and let me also reinforce Ron's point about we are working hard to foster EM and RW cooperation on these issues.

What I wanted to talk about today was to provide an overview of the documentation that we've established between the EM and RW on the waste acceptance requirements, and, also, to describe briefly some of the key interactions we've had with EM in implementing the process that these documents embodied, what we sometimes loosely call at least a key part of the waste acceptance process.

I'm going to digress a little bit, because I think most of the Board members are probably familiar with this aspect of the, what we call the technical document hierarchy. This is the RW top-level technical requirements baseline. The top level is the Civilian Radioactive Waste Management Requirements Document. We call it the CRD, and the CRD identifies all the statutes, regulations, DOE orders, executive orders, whatever, that are applicable to the development and operation of RW equipment and facilities.

The key four system elements are covered at the next level, within the Civilian Radioactive Waste Management System. Those are the acceptance, transportation, storage, and disposal elements. The one I want to focus on for the waste acceptance issues is the technical baseline document that establishes the requirements for acceptance of waste forms into our system, and that's the Waste Acceptance System Requirements Document.

The Waste Acceptance System Requirements Document is composed of three groupings of requirements. The first set of requirements are interface/contractual requirements that apply to all of the waste producers whose wastes will be coming into our system. They include quality assurance, documentation requirements, contractual requirements, top-level interface requirements, and training.

I'm not going to focus on the spent nuclear fuel requirements. Those, however, are applicable to commercial spent fuel. Primarily, they're derived from the standard contract 10 CFR Part 961, and, in addition DOE spent fuel will also entail the development of specifications, and those will be developed. Those are not currently in the document right now.

The high-level waste requirements apply to, currently, the vitrified high-level waste specifications. At one time, they applied to the Hanford waste vitrification plant, which was under development a couple years ago, as was alluded to earlier. And then other high-level waste form specifications, we can identify waste forms and get some characteristics. Then they would be incorporated into the baseline documents.

In a sense, the high-level waste requirements serve three basic purposes as far as the Civilian Radioactive Waste Management Program is concerned. The first is to provide minimum acceptance criteria--and I'll talk about that on the next page--the second is to provide us with a design envelope and interface information, because the waste form is one of the key interfaces between EM and RW, and, ultimately, that will be what needs to be isolated from the public.

The third is to provide general canister waste form characteristics to provide us with information, and to give us the allocation of performance that needs to be met by the overall, either the engineered barrier system, or the entire underground facility to meet the NRC and EPA requirements.

What I'm trying to do now is give a little more detail on the high-level waste requirements, give some examples of what they are. We tended to break them up in some very generalizing forms.

The only requirements right now that we have specifically on the waste forms, which I'll call the minimum acceptance criteria--the waste requirements say that if the waste form doesn't meet any of these five conditions, it will not be accepted into the waste management system. These are directly taken from 10 CFR 60.135, those requirements applicable to the waste form, or where the waste form has a key allocation in the ability of the engineered barrier system or the repository to meet its performance objectives under Part 60.

Primarily, the waste needs to be solid. It needs to be consolidated. It needs to be reduced to a non-combustible form. In addition, there should be no free liquids in such an amount that would compromise the ability of the facility to meet its performance objectives, or that there be no explosives, pyrophoric or chemically-reactive materials such that would contribute to the facility not meeting its objectives. These requirements apply to all waste forms.

Now, specifically, for vitrified high-level waste, we've identified a term called the standard form. The standard form, primarily, are the physical characteristics of the waste, and they provide us with a design envelope, the idea being that when we design a facility to transport or dispose or handle the waste forms that we will be getting that are vitrified, that we have some sort of envelope on the characteristics of the waste so that we know what we're getting, basically, and they include things like--the current standard form for vitrified high-level is a borosilicate glass in a 304L austenitic stainless steel canister. There's length, diameter, weight, fill height requirements, heat generation, temperature, and leak rate.

In addition, we require all waste producers to report certain information, and this will be used to design and to determine the overall performance of the facility. Primarily, they are chemical, radionuclide specifications, and the canister material and fabrication methods so that we know that that won't impact the ability of the repository to isolate waste.

Now, this is vitrified high-level waste requirements. I want to point out that that's the way they're currently described in the document. However, these are key concerns that would apply to any waste form, and would need to be addressed accordingly. Criticality safety is a big issue. The compatibility between the waste form and the canister is a big issue, the stability and the integrity of the waste form. Hazardous waste determination under the Resource, Conservation & Recovery Act is also required. That's incumbent on the waste generator to provide that, and a product consistency test, which gives a general idea, at least in the short-term performance of the glass, to ensure that it meets certain requirements, compared to a bench mark glass that was the basis for borosilicate, and that we feel is a very durable glass product.

In addition, there are specific requirements on the canistered waste form. Those include the various type of requirements we've set forth here: canister impact characteristics, labeling requirements, handling features so that they can be accepted into the facility and handled, and consistent designs that we plan for our handling equipment. Also, during shipment and handling, we need to have certain limits on dose rate, external contamination, the physical condition and the contents of the canister at closure, and, at the time of acceptance--what we refer to here as "at shipment."

And, in addition, we have other requirements for records, QA requirements, and various other things that I have talked about earlier. We've sort of created two additional terms. I've talked about the standard form. We've sort of tweaked the contract, the standard contract, which has standard and non-standard form, in order to deal with the specifics of high-level waste, and we've created a non-conforming and a non-standard form.

The non-standard form is basically a waste form that doesn't meet the currently accepted standard form of the waste. That requires special disposition when that is identified to accept into our system. Non-conforming are those wastes which specifically do not comply with the specific performance or technical requirements in the Waste Acceptance System Requirements Document.

Now, that was the RW side. What I want to lay out here is the hierarchy of joint RW/EM documents, which ultimately determine how the waste form is designed.

The top-level EM baseline document is called the Waste Acceptance Product Specification. We refer to that as the WAPS. The WAPS is the top-level EM document. That takes all the requirements that are allocated to the waste producer, and flows them into the WAPS. In addition, any other requirements that EM needs to establish on the producers are identified in that document, and that, then, forms the top-level control set of requirements.

The producers then prepare waste form compliance plans, which provide a detailed description of how the waste producers plan to show compliance with the requirements in the WAPS. These documents are all controlled within the respective offices, change control boards, and reviewed in accordance with quality assurance procedures, and I'm going to talk about that a little bit later.

Now, as I said, the EM WAPS translates the RW requirements, provides requirements on the waste form producers, and, currently, it's tailored for the defense waste processing facility at Savannah River and the West Valley Vitrification Plant in New York. Those are the two facilities that are the closest to operations, and those facilities are designed right now to produce a vitrified borosilicate glass product.

As I said before, the requirements in the WAPS, at one time, were applicable to the now on-hold Hanford Waste Vitrification Plant. And also, then, the Waste Form Compliance Plan, which is the bottom of the RW/EM hierarchy, outlines the plans for compliance with each specification, and provides compliance strategies, and it also identifies what is required for objective evidence.

Now, the objective evidence is going to be compiled in something called a Waste Form Qualification Report, a WQR. That is not formally part of the joint technical baseline, but is also a very important document that is managed by EM.

And so, these four documents, in a sense, form the technical part of the waste acceptance process to ensure the integration between EM and RW. The important point to make is these requirements are not fixed. They represent a baseline in any given time, and we refer to the process as one that allows the integration, the communication between both of our offices to ensure, primarily, that we know what we're receiving, they know what requirements we impose, and then if we need to have changes, that no one is ever surprised that there is a change, and these are all very top-level documents within both of our programs.

Now, the next part is going to talk a little bit about the formal interactions and the other interactions that we have with EM and RW. I've tried to focus primarily on those that I think are relevant to Hanford. As you can guess, there's not as many, because DWPF and West Valley are much farther along in actually identifying a physical form that we would accept into our system.

On April 4th, EM-1 and RW-1 signed a memorandum of agreement for control of the technical baseline documents, the four documents I previously talked to you about before. The first set is it established requirements for review of the technical documents, and that is that they are reviewed in accordance with the appropriate quality assurance procedures of the offices conducting their reviews.

RW uses a quality assurance procedure to do technical document reviews, and EM has participated in those technical reviews.

EM has interpreted the document review requirements a little differently, which is perfectly fine, and they've created a technical review group. There are several technical review groups. Those are the standing bodies of people who are responsible for the technical reviews of EM quality-affecting documents. The particular technical group that we are discussing in this MOA is the Waste Acceptance Technical Review Group. There are others.

In addition, we allow for participation in each other's change control process. EM and RW are both members on the other's corresponding change control boards. In addition, RW is working to establish an interface control working group, which will be the group of experts representing all of the affected system elements, and to ensure that there is one controlled set of documents, and a point of contact for resolving joint issues, and they would basically do it through this formal interface control working group, and EM can call meetings, and is expected to attend meetings whenever we discuss waste acceptance issue, to ensure that their issues and points are addressed.

In addition, we have quarterly RW and EM waste acceptance meetings to discuss general issues and points of resolution, or status.

Now, other interactions which occur regularly--they're not as formalized as this MOA--we have been working with EM to support some of the options that they've been developing on the tank waste remediation issues. We've been looking primarily at impacts--there's not a slide up here, so if you're looking for it, don't; you won't find it--impact on disposal fees, general disposal performance, transportation issues, various things that are joint issues across both organizations.

We've been supporting some interactions with EM with the NRC. An example is the recently-closed comment period, I think, on the dual containment exemption under 10 CFR Part 71.63, which are the transportation requirements for 20 Curies or greater plutonium.

In addition, we have another MOA with EM, which allows us to provide quality assurance audits and surveillances of their activities, and, also, we are working on a comprehensive memorandum of agreement. The MOA that we're discussing here, the technical baseline MOA would also be incorporated into that comprehensive MOA, which would be the formal total waste acceptance process.

I wanted to talk about two last things, which I don't know if you really want to hear about, but I wanted, for completeness, to discuss them. Obviously, EM has another major responsibility, and that is to dispose of all the intact DOE spent fuel. There's various other forms of fuel out there; research reactor fuel. The list goes on and on.

We hope to develop an MOA similar to the high-level waste acceptance technical baseline documents with EM on the other DOE waste forms. We've been supporting EM through EM-37, John Jicka's office on DOE spent fuel exchanges, and their meetings with their stakeholders. We've also reviewed and provided comments on the DOE Spent Fuel Program's quality assurance program, and on the program plan.

Now, in addition, I wanted to talk a little bit--very shortly, we, also, are planning on conducting a system study. It's, I guess, a parametric study or a sensitivity study to try to assess the impacts of high-level waste options currently under consideration on the Civilian Radioactive Waste Management System.

The key uncertainty right now is on Hanford. We have a pretty good handle, we think, on DWPF and West Valley, and so, the purpose of this is to look at alternatives and various other issues for identification for various waste forms that Hanford might produce, and also assess the impacts, such as the key things: the number of canisters, the type of waste, the size of the canisters, and then various pickup schedules of how that would affect the system, that we start actually accepting the waste into our system.

Basically, then, in summary, I think what I've tried to show here is that we have a close working relationship with EM, and we're working to develop a controlled set of waste requirements, and to work with them to resolve associated issues that will affect both of us.

With that, I'll open it up to any questions.

DR. VERINK: Any questions from the Board? Yes, Dennis?

DR. PRICE: Steve, on your system studies to identify alternatives, could you be a little more specific about what alternatives? Are you talking about alternatives with respect to thermal loading and that kind of thing, or other alternatives, other than repository things?

MR. GOMBERG: Until we know specifically a little bit more about the characteristics of the solidified Hanford waste form, we're somewhat limited in what we can study. So, what we're trying to look at are more of the macro issues that we see have major drivers on our program from the standpoint, for instance, of disposal fees, overall repository impacts, and overall transportation impacts.

So, the key things that will affect that will be the number of canisters that ultimately will be received. I've seen numbers anywhere from, I think, 20,000 to 60,000 canisters. There's various options being considered right now for even just the basic sizes of the waste form. So, we're trying to just provide some parametric information so we'll be in a better position to respond quickly to EM when they request us for information as how the options they want to pursue and the design alternatives will affect our system, and these three were the key macro impacts that we were going to discuss.

Of course, when we get more information, then we can look at it from the standpoint of the performance allocation within the repository, and how that would impact that, or within a repository, and how that would impact that.

DR. VERINK: Thank you very much, Steve. I think, in order to keep the schedule, we'll have to move along.

Bill Levitan is our next speaker.

MR. LEVITAN: My name is Bill Levitan. I'm with DOE headquarters in the Office of Hanford Waste Management Operations. That's within the Office of Environmental Management, and this morning, I'd like to talk about our perspective on the Hanford Waste Management Programs from headquarters.

At headquarters, one of our major functions is to formulate policy, and then, based on that policy, pass program guidance and direction down to the field, and to give you a perspective on some of that direction, I'd like to talk about some of the major factors that help formulate our program, and that, in turn, form the basis for the guidance we pass on down to Hanford, as well as other EM sites.

And, to do that, I'm going to first talk about our EM organization, for those of you who are not familiar with it, as well as the organization with EM that's directly responsible for some of the issues that you're interested in today, talk about the programmatic and legal drivers, then the budgetary perspective, and, finally, I'll briefly touch on the programmatic implications. I'll leave that in more detail for the speakers that'll be talking later in the day.

Within EM, under our Assistant Secretary, Tom Grumbley, we have nine offices. The top five here are mainly cross-cutting type offices. We have one dealing with planning, another one on public involvement, one on risk management--we're moving a lot more towards looking at our program in terms of risk--an administrative group, and one that deals with technical support and program integration.

Then we have the four program offices, if you will. These offices are responsible for program formulation, budgeting. We oversee the program implementation, as well, and provide guidance.

The Office of Waste Management is responsible for managing waste within the DOE system after it's been generated. We develop treatment, storage, and disposal facilities, as well as operate them, and the examples that we're talking here today about, spent fuel, and defense high-level waste in the tanks, that comes under the Office of Waste Management, as does the cesium/strontium capsules.

Office of Environment Restoration, EM-40, is responsible for the clean-up of past practice wastes. This includes both environmental contamination, as well as decontamination and decommissioning.

The Office of Technology Development is responsible for developing cross-cutting technologies that can be used throughout the complex, and to help us do our job quicker, cheaper, and more effectively.

And the last program office is the Office of Facility Transition and Management, and they're the ones that are responsible for receiving facilities from other programs that are excess or surplus, and then transition them either for beneficial re-use, or for clean-up. An example here at Hanford is the PUREX facility.

I'd like to just key in the Office of Waste Management, EM-30. They're the ones that I've mentioned are responsible for the management of waste after it's been generated. This office is organized mainly geographically.

There are some exceptions. We have an eastern, a western, and then the WIPP office, a program integration office, but key to your visit here today and tomorrow are these two offices, the Office of Hanford Waste Management Operations, of which I'm a part, and then the Office of Spent Fuel Management.

The Office of Hanford Waste Management Operations is basically the headquarters program office responsible for Hanford waste management, including the tanks, cesium, strontium, spent fuel.

The Office of Spent Fuel Management, which Steve referred to, EM-37, they're a cross-cutting office. They coordinate complex-wide spent nuclear fuel issues. As Steve talked about, they're the ones that deal with RW and development of some of the criteria. They also are looking at some NRC licensing requirements. They also form the top-level planning and policy for spent nuclear fuel within EM. That policy is then implemented by the program offices in the sites.

Next, I'd like to talk about the programmatic and legal drivers, and they are the major factor, really, that shapes our program, and I'll talk about each of these six individually.

The first is the EM goals, and these were set forth very early on by our Assistant Secretary. These six goals provide the guiding principles and priorities, if you will, of our program, and probably of most interest here today is Goal No. 1, which is managing and eliminating the urgent risks and inherent threats in the DOE system. And, specifically, what Mr. Grumbley is referring to there is the high-level waste tanks here at Hanford, as well as the spent nuclear fuel throughout the complex.

The second goal is to have a very skilled work force that's committed to health and safety, and that incorporates health and safety practices into their normal way of doing business.

Goal three is dealing with the implementing of rigorous planning, budgeting, and contract control system, such that we can be in control managerially and financially.

The fourth goal is to be more outcome-oriented, and by that, is to produce results efficiently, cost-effectively, in a risk-based fashion.

The fifth goal is to have a focused technology development program, and by that, we are identifying those types of technologies that we will get the most bang for the buck. We've identified, currently, five areas that are of major interest, one of which is dealing with high-level waste.

And the sixth goal, which is evidenced, I think, by the meeting here today, is involving our stakeholders and the public in our process, and that includes both assisting the public in understanding our program and our challenges, as well as involving them in the options analysis, and developing the options that'll help us meet those challenges.

Here at Hanford, the major driver is the Hanford Federal Facility Agreement and Consent Order, otherwise known as the Tri-Party Agreement, or TPA. That was initially signed back in May of 1989, and its purpose was to achieve compliance with RCRA, CERCLA, and other corrective actions, and, at that time, when it was signed, or specifically excluded, I guess, the waste contained in the single-shell tanks, and it did not address the K-Basins, where the end reactor fuel is currently stored.

Back last summer, the Tri-Party Agreement was renegotiated, and then it was signed in January of 1994, just this January, and probably the two big things that changed in it were that it now incorporated all 177 high-level waste tanks, and it also incorporated the K-Basin clean-out, and, specifically, there are two milestones in there.

Let's see, M-51, I think it is, is the first one that requires that high-level waste vitrification be completed in December of '94--or, I'm sorry--December, 2028. There are several interim milestones along the way, and, also, as an interim milestone within M-34, is the K-Basins be cleaned out.

There are several safety requirements, also, that are brought upon the site here, and with the time it takes, I won't go into too much detail on them. One is with the Defense Nuclear Facility Safety Board. They're a board much like you. They were set up by Congress. They report to the President and Secretary of Energy on public health and safety issues associated with the defense complex here at DOE, and there have been five recommendations that the DNFSB has come up with.

Several of them deal with the tanks. As you can see, the first four are basically dealing with the tanks, some of the safety issues that they felt merited some attention; in some cases, actually accelerating the program, in the case of tank waste characterization. And, most recently, just last month, 94-1, it applied pretty much to many facilities in the complex, but the DNFSB was recommending that we accelerate remediation of some of the issues in the complex, and here at Hanford it specifically talked about accelerating the K-Basin program and its clean-out.

Also, the Secretary of Energy came out with six safety initiatives back in '93, in the fall of '93, and, basically, these initiatives were for actions that we were already aware of. They were basically trying to highlight them and to accelerate the resolution of them, and listed here are the six issues, and it set up a formalized series of actions with schedules to get these issues resolved.

With regard to spent nuclear fuel, back on August of last year, the Secretary set up a working group to perform a comprehensive baseline assessment of the environment, safety, and health vulnerabilities associated with storage of spent nuclear fuel throughout the complex.

The working group visited 66 facilities at 11 sites, and they issued their report in December of '93, and, in that report, they identified 105 vulnerabilities. One was subsequently identified, and so, 106, and of those 66 facilities, eight were identified as high priority, meaning that they deserved management attention and immediate action.

There were, I think, about 33 vulnerabilities associated with those eight facilities, and three of those facilities are here at Hanford; K-Basins, PUREX, and the 200 West Burial Grounds, and those three incorporate about 18 vulnerabilities. There are also six other facilities at Hanford, and they are of lower priority, and, right now, many of these actions were already known. The actions plans are being developed and implemented; for example, with K-Basins as the TPA milestone indicates the clean-out of it.

There are several other drivers. I talked about RCRA and CERCLA, and the Federal Facility Compliance Act deals with mixed waste treatment. That'll bring a lot of resources to bear over the next several years. NEPA, and the records of decision, we've got several major NEPA documents; the complex-wide EIS for waste management environmental restoration, complex-wide spent nuclear fuel, and here at Hanford, both the spent nuclear fuel EIS and the TWRS/EIS.

The Atomic Energy Act authorizes DOE to manage its waste. We do that with the help of our DOE orders, many of which are undergoing, or being promulgated as regulations, and, of course, the Nuclear Waste Policy Act, wherein we are provided the ability to dispose of our waste at the repository.

With all those drivers, I just want to briefly talk about the budget, since the budget more or less is very reflective of policy, as well as program. I'm getting three years' worth here, so you get an idea as to the trend, 1995 being the Congressional request, and will probably be changing.

EM started in 1989, so it essentially went from a budget of zero to $5🗎 million in those four years, but in the last two years, and, in fact, in our formulation for '96, it's beginning to flatten out.

Hanford, specifically EM, which is all those programs, the restoration, the waste management and facility transition, it's seen a lot of growth as well. With the new TPA, we're seeing a large increase between '94 and '95, and a lot of that, as you can see, is due to the Hanford Tanks Program, the safety issues, the TPA.

Spent fuel was seeing a modest increase, probably more than the average, but, in fact, with the increased visibility, the program has really increased in priority, so, although in '94 it was budgeted at 38.1 million, there will be a lot of reprogramming efforts because of the increased program priority that'll bring the budget up to 56.3, and then for '95, we're going to be looking, also, at a possible re-programming because of the expedited program that we're going to undertake.

I just have one more slide, and this is the programmatic implication of the repository, and, obviously, we recognize is the end state for our waste, for the high-level waste and the spent nuclear fuel, and, as Steve talked about, there are many parameters that impact our program, that basically impact the upstream requirements.

Disposal fee estimates, they have an impact in terms of, for example, our pre-treatment; to what extent do we pre-treat in terms of reducing waste volume? The timing for waste transfer and repository acceptance will affect our storage facilities, both in terms of their sizing and their design life; and, finally, the technical specifications and quality assurance requirements, a myriad of things. They are canister size, glass performance.

And these types of issues are very important to us because they do drive back on our program, and, as Steve talked about, we're using those mechanisms of the memorandum of agreement, fairly high-level meetings with RW and EM to really work towards resolving these issues.

DR. VERINK: Thank you very much, Bill. I think in the interest of keeping the schedule, we'll defer any further questions for you at this time.

MR. LEVITAN: I planned it that way.

DR. VERINK: Good planning.

And our next speaker is Don Wodrich. Pleased to have you, sir.

MR. WODRICH: My name is Don Wodrich. I work for Westinghouse Hanford Company on the tank waste issues at Hanford.

What I want to do this morning is give you some information on three or four different subjects. One: First, some historical Hanford operations, a little bit about that, that generated the waste; a brief description of the Hanford tank waste; what our past plan for tank waste disposal was, the changes to those plans; and what the current plan and milestone changes are. So, I'll go through it in that order.

This, of course, here is the Hanford site in the State of Washington, along the Columbia River. Let me show you a blow-up of the Hanford site. Of course, you're down here in Richland. The Hanford site is divided into things we called areas, the reactors being in 100 areas along the Columbia River, and the spent fuel that you're going to be talking about is here in the east and west area, the bulk of it. The tank wastes are here in the center of the site, on the plateau, in the 200 east and west area, so all the Hanford tank wastes are located there, and, of course, you can see some of the other areas on the site.

The 300 area was a research and development area for the site; also, where the fuel was manufactured that went to the reactors, and the 400 area is a Fast Flux Test Facility, which is a test reactor.

What I'm going to show you now is when the plants, major plants operated here at the site, which generated the wastes. So, across the top, you can see the years of operation, and down the side, the different facilities, and the red bars indicate the time frames in which they operated. So, we have had nine production reactors over the years, the latest being the N reactor, which was shut down in about '87. The bulk of the other reactors shut down in the sixties and early seventies.

We have two major test reactors here on the site, the plutonium recycled test reactor in the 300 area, which operated in the mid-sixties, and the Fast Flux Test Facility, that operated in the eighties, and into the nineties.

Spent fuel from the reactors then went to fuel reprocessing plants in the 200 areas. We've had a number of generations as they've evolved over the years. The first two plants that were built, T plant and B plant, operated starting in 1944 into the fifties. They were a batch, a bismuth phosphate batch process and only recovered the plutonium. The uranium went out with the waste to the tanks, so they operated in that time frame.

The next generation was the REDOX plant. It was a continuous solvent extraction process, started up here and ran until the mid-sixties, and then the latest generation was the PUREX plant, which started in the fifties, and ran into the early seventies, was then shut down, and operated again here in the eighties. So, that's the separations plant, and, of course, they used different chemicals and had different processes, so that impacted what the waste looked like.

One other set of facilities that have operated over that period of nuclear material production, processing, the UO_3 plant, or uranium trioxide plant took uranyl nitrate from the REDOX plant and the PUREX plant, and converted that to oxide powder that was shipped off site for making new fuel, and it operated in conjunction with those separations plants.

Plutonium finishing plant, which is used to convert plutonium nitrate solution to metal also had weapons production, fabrication, and component fabrication for plutonium parts through part of its career, and also, a lot of plutonium recovery work, operated in this period, is down, and we expect to run it again a little bit to clean up the plant.

The U-Plant uranium recovery, as I mentioned, the first separation plants discharged the uranium out with the waste, and so, in the mid-fifties, there was a process started up and we sluiced the waste out of the tank and brought it into the U-Plant, and used a tributyl phosphate process to recover the uranium, and so that's what that was. And, of course, fuel fabrication for the reactors, paralleled the reactor operation.

In the waste processing area, we've also had a number of operations which contributed their set of chemicals to the waste tanks, and that's why I mention them. Waste scavenging occurred in conjunction with uranium recovery here, because as they recovered the uranium, the waste volume grew, so they'd take waste out of the tanks and recover the uranium, and they had to add chemicals and things to it, so the waste volume multiplied. They were running out of tank space, and so they scavenged the supernates in the tank to remove the cesium and strontium so they'd get low enough in radiation level, radioactive level that you'd discharge to the ground.

And so, this was a period in which ferrocyanides were added to the tanks, and which resulted now in one of our safety issues. It was a part of that process.

Then, in the sixties and seventies, we recovered cesium and strontium out of the waste. We actually sluiced wastes out of the tank, or pumped it out of the tanks into the B Plant, and then extracted those two radionuclides and put those in capsules. That was completed in the mid-eighties.

And then, all through this period, was have run waste evaporators, where that is a way of maintaining a smaller volume of wastes in a tank so you don't have to build so many tanks. If you pump waste out of a tank, run it through an evaporator, boil off the water, return it to the bottoms of the tank, and over this course of years we've had a number of evaporators fulfilling that service.

All of those things had some impact on the waste that's in the tank. The spent fuel, which was the source of the radionuclides that entered the tank, this is a picture of how much was reprocessed here at Hanford, showing the years across the bottom, and the metric tons of uranium per year that was reprocessed, about 100,000 ton in total. Three-fourths of that went through the PUREX plant, and the peak years were the mid-fifties to the mid-sixties, then none, basically, through the seventies, and a little bit in the eighties. So, that was the source of the waste.

This is kind of an overall flow diagram of the radionuclides on the site. I just want to use it to point out a couple of things. The major path was from the production reactors, the radiated fuel coming to the 200 area fuel reprocessing plants. Then the waste from that, primary radionuclides are in the waste tanks and in the capsules, strontium and cesium capsules, and this makes up the waste that's included in the tank waste remediation system program, so I'll talk about these two waste products.

The other one, of course, you're going to hear about today is radiated fuel storage, the bulk of it being in the K-Basins in the 100 areas, and then there's also a little bit in the 200 areas, and I'm sure you'll hear about that, and we have some at FFTF, that fuel, and there might be a few pieces in the 300 area, but you'll hear more about that later. So, those are the locations of the waste.

Now, what I want to focus on is the Hanford tank waste part of it, and talk about it in three pieces; that waste which is in the single-shell tanks--and that's just a, single-shell means the way the tanks were designed, the older tanks--the double-shell tank waste, and what's in the capsules, so I'll go through each of those.

First, the single-shell tanks, we have 149 of these, built from '43 until '64. They range in size from

55,000 gallons up to a million gallons. We have 16 in this 55,000 gallon size, and the others are a half-million, three quarters of a million, or a million gallons in size. The large ones are all 75 feet in diameter, reinforced concrete structure with a carbon steel liner down the sides and across the floor. The wastes were put in there in a high alkaline state, because they are carbon steel tanks.

They're six to ten feet below the surface of the ground, and the difference when they changed the capacity of the tanks, they were 75 feet in diameter. They just changed the height, so they were half million, three quarters, and a million gallons.

We have not put any waste into these tanks since 1980. We've had a continuing program of pumping out all the liquids, because we say 67 are assumed to have leaked, and so, the system has been to pump out the liquids so they could not leak, so that there were just sludge and salt cakes left in the tanks. We have pumped off, over the years, the easy to get to liquids. We're now pumping that which is residual down in the solids by inserting a pipe down to the bottom of the tank, with a screen section around it, as the liquids run down to that point, then pumping that out.

We've completed that on a little over a hundred of those, and have about 40 more to go, so that's ongoing now, but the volume of the waste in the tanks is equivalent to about 36 million gallons, and about 150 million curies, and I say a number of those have leaked. So, those are the older tanks.

The newer tanks we call double-shell tanks. They look very similar. They're a reinforced concrete structure buried underground. Rather than 75 feet in diameter, they're 80 feet in diameter, and the difference is that besides the reinforced concrete structure and the carbon steel liner down the walls and across the floor, there's another tank inside of that carbon steel tank, so it's a tank within a tank, and that's why it's called double-shell, a two and a half foot annulus between the wall here, leak detection in the annular splays, drainage grids between the two tanks, and also, below the second, such that if it should leak, you would find out about that.

We have 28 of those. We have plans to build six more. They're currently in design. The largest size, ranging from a million gallons to slightly over a million gallons, they currently contain about 25 million gallons. This is mostly liquids in these tanks, about 100 million curies, and none of these have leaked. We have never detected any leakage between the two tanks, nor outside of the tanks, so that's the double-shell tank.

The tanks contain a large amount of non-radioactive type materials, chemicals, so what you see here is an estimate of what's in the single-shell tanks, what's in the double-shell tanks, and a composite of the chemicals; more than 300,000 metric tons of material, lots of water, but also, lots of sodium and nitrate and a host of other chemicals, so the bulk of the material in the tanks are chemicals.

This is just to give you some appreciation of the number of tanks and where they're located. This is the dividing point between the west area and the east area, and each circle represents an underground tank, and this represents a collection which we call a tank farm, so those are all in west. It's about evenly divided between the two areas. There's only three double-shell tanks in the west area, 25 in the east area, and we've been trying to do more of the operations in the east area in recent times, so there are a lot of tanks, and between all these tanks, there are many, many pipelines.

The other waste form of tank waste is cesium and strontium capsules. We have about 1900 of these, twice as many cesium and strontium. The capsules are 2[illegible] inches in diameter and 20 inches long. They're a metallic capsule, stainless steel, for the most part. The inner, on the strontium fluoride is a Hastelloy, but it's a capsule, a metal capsule within a metal capsule.

This contains a lot of curies of material, 150 or

160 million curies in these capsules, I mentioned about 1900. Most of them are stored on site in water basins at what we call the waste encapsulation and storage facility, and I believe you'll visit that while you're here. They're in basins with water to provide cooling and shielding, and the capsules are in racks in the bottom.

There are a few hundred still off site that have been used for commercial irradiators. We're now in the process of shipping the last set of those back from Colorado, and maybe they're somewhere else, but in the next few years, they'll all be here at Hanford, and it will be up to the Department to dispose of those.

Now, let me talk about past plans. In the eighties, there were a number of alternatives looked at of how to dispose of the waste, and in '87, an environmental impact statement final was issued, and in '88, a record of decision on what to do with the waste, and that was the basis of the Tri-Party Agreement, or that agreement that was signed in '89 between the EPA, State of Washington, and Department of Energy, that established milestones for carrying out that plan, and the plan said we would take the capsules, overpack those, and send them to a geologic repository.

There was some question whether that waste form would be acceptable to the repository. If it wasn't, we might have to treat that waste first. For the double-shell tanks, the waste would be removed, it would be divided into two fractions, so that the bulk of the chemicals and a small part of the radionuclides would be turned into a cementatious grout waste form and disposed on site in near-surface vaults, and the bulk of the radionuclides and a small amount of chemicals would be vitrified, packaged, and sent to a geologic repository off site.

And for the single-shell tanks, the decision on what to do, that was deferred. There was still discussion going on, should the waste be removed and sent the same path as the double-shell tanks, or could some or part of that waste be left disposed on site? So, that was the plan that was put into the Tri-Party Agreement, and we were moving forward with until about a year ago.

Since that time frame, several things have occurred that resulted in changing the plans. In the '89-'90 time frame, a number of waste tank safety issues were identified and escalated in visibility and concern, and so that changed the focus of the program to put a lot more effort there. The Department has chosen to plan to retrieve the single-shell tank waste. That resulted in about a four-fold increase in the waste volume that has to be dealt with.

We had planned to use the B Plant, refurbish that, and use that for a pre-treatment facility for the double-shell tanks. That was deemed to be not a practical solution, part of that based around the hazardous waste laws, and double containment, and what it would take to do all of that, and there were concerns raised about the grouted low-level waste form, whether that was an acceptable product, particularly by the public or outside stakeholders were concerned about that. So, those were things that came up in the last few years.

As a result of that, alternatives for disposal were again evaluated. There was a lot of stakeholder values sought and incorporated, a lot of meetings with the stakeholders to see what their values were, and a number of public meetings; also had a Tank Waste Task Force that was formed and convened last summer to review the plan, and as the new plans developed, they were out for public review and comment.

There was also concern, particularly out of Washington, D.C., about how this could be funded, whatever the plan was, and so, that had some impact on how things were lined out, particularly with the milestones. This new plan was negotiated with the regulators, and this Tri-Party Agreement amendment was signed, then, in January.

Here are some of the public input values that we received that were applicable to the tank waste; certainly recognized safety had to be first, protecting both the public and the workers, no debate on that, and because the tank farms are old, we were in an upgrade program, upgrading a lot of the old equipment, like air compressors, instrumentation. They supported that strongly, but they had a strong message that we should not delay anymore, that we need to get on with the cleanup, and do what you know now rather than setting it and trying to come up with a perfect solution. Find an acceptable solution and get on with it.

There was not support for the grout. They wanted a better waste form, and they would like retrievability. As I view that, we've had leaking tanks at Hanford. There is this worry about, so you put it in something else, somewhere else, might it leak, also, and so, you ought to be able to do something about it just in case something goes bad.

Get on with it, using available technology, and if you find something better in the future, then worry about putting that in the system, rather than waiting for the best.

Get the waste out of the tanks and in stable form. There would be an acceptance of glass; concerns about don't contaminate a whole bunch of new land at Hanford. In particular, this is related as we looked at disposing of the low-level waste on site, to try to minimize that volume.

They wonder whether there will ever be a repository, and so kind of accept it'll be at Hanford for a long time, and make sure it's stored safely, and minimize transportation off site, and, of course, use the money wisely.

The results of all that is this current strategy for dealing with the waste. I'll spend a little bit of time at this, see if I can walk you through it.

Here are the three waste types we have, the double-shell tank waste here, single-shell tank waste, and the capsules. The plan is still to send the capsules to the repository. If we can do it by just overpacking, we'd do that, probably. If that's not acceptable, then we'd go up here toward a vitrification side.

For the tanks, both single-shell and double-shell, there's a lot of activities that we're conducting today in the tank farms; resolving the safety issues, upgrading and improving the tank farms, the operations and the equipment, accelerating the waste characterization and analysis effort of what's in the tanks, so those are ongoing now, and the rest of this, then, is things that would happen in the future.

We would plan to retrieve the waste from all the tanks, and we would like to be able to sluice the waste out of those tanks as a primary method. There's concerns about the leaking single-shell tanks, whether you can hydraulically sluice that waste; if so, how much might leak out, and so we're looking at developing barriers to see whether we might be able to develop a sub-surface barrier you could build around the tanks, which might range from grouting around it, or freezing the ground, or whatever. We're at least going to look at the development of that, see if that might be applied to these tanks to contain potential leakage. That's a question that's yet to be answered.

Once the waste is retrieved, it would go through what we call a pre-treatment process, a separation of that fraction which becomes the low-level waste, and that fraction that becomes the high-level waste, and so, most of the chemicals in the tank are soluble in water or alkaline solutions, so what we want to do is get the bulk of those chemicals into a solution, and route them in this direction, remove the remaining radionuclides, and that becomes the low-level waste stream, which would be vitrified, and left on site.

And the remaining that would not go into solution, basically, the sludges, would come this way and become the high-level waste stream, be vitrified, stored on site in interim mode, and then go to an off-site geologic repository. There's a big question here of how well this will work, in that we have said we want to get this high-level waste stream down to an acceptable volume, not defined, of what is really acceptable. We would like to be able to do that by always working on the alkaline side as far as the separation process.

If we can't get the volume small enough, then we'll probably have to work on the solids, the sludges, which would mean dissolving those in nitric acid and maybe some other chemicals to reduce that volume of high-level waste, and so, we have a development program as a backup here, that would look at additional pre-treatment on the acid side, to reduce the volume of high-level waste to make that an acceptable amount.

We're also looking at more aggressive alkaline side processes to leach out some of the chemicals that impact glass loadings, and so on, so the plan, as a base plan, is just to work on the alkaline side to get an acceptable glass volume. If that's not successful, then we have a backup to do more aggressive work, but this adds a whole set of chemical processes that we'd rather not have.

And so, in both of these streams, there are development activities going on for radionuclide removal. We know we have to remove cesium and plan to do that, and that's pretty well-known technology. Whether we need to go further than that, there's some debate on.

We need a very large capacity melter system, one or two hundred ton a day range to handle the waste, and so there's a program to try to select and get that. The amount of waste we're going to send on the high-level waste side is a considerably greater capacity than DWPF. We're talking 15 or 20 ton a day, probably, here, where the Savannah River melter is about 2[illegible] ton, so there's activity here and an increased capacity for melters.

So, that's the plan. Of all the waste that comes out of the tank, on the order of 5 per cent will come this route, and 95 per cent will go the route and be left on site, so basically, all chemicals that tend to drive the radionuclides here, and the chemicals to low level. So, that's the current plan.

There are a number of milestones associated with this plan. It's kind of a demand schedule. I have two pages of those. What these charts show you, the major milestones that are in the Tri-Party Agreement here, what the previous date was; that is, a year ago, this was the date we were signed up to do, what that was changed to in the January, '94 amendment to the plan, and a little bit here on the reason for the change.

Some of our milestones were slipped, other milestones were added to address other aspects. This just addressed the tank waste. It does not address spent fuel or environmental restoration or any of that, but let me point out a few.

We added milestones on safety issues, and if you look in the agreement, there are a lot of sub-milestones below these, more near term, but providing some additional double-shell tanks was added, milestones upgrading the tank farms.

Now, if you get down on the disposal side of the business, a complete closure of all single-shell tanks was slipped six years. The date to get all of the waste out of the single-shell tanks remained at 2018. That remained the same, to get it out of the tanks by then, so that's an important date, and we have to initiate some near-term demonstration of retrieval, and we're on schedule to do that. So, this is getting out of the tanks and getting closure.

This chart talks about the pre-treating or separating the waste, what the milestones are there to start construction of a low-level waste pretreatment facility by '98, and to start that up by 2004, and for the high-level waste side, to start up a pretreatment facility by 2008 are dates in the system.

The vitrification part for the high-level waste, that date slipped, basically, ten years. We were going to start, we were committed to set up in '99. That went to 2009, and what happened there, once we decided not to proceed with grout, the critical path became how do we dispose of the low-level waste fraction, because when you start to retrieve waste out of the tanks, the bulk of the waste is on the low-level waste side, and if you can't get rid of it, you have to build lots and lots of tanks, because, in getting it out of the tanks, you have to dilute the waste several-fold to get it out of the tanks. So, it's very critical that we have a way of disposing the low-level waste fraction in parallel with retrieving waste out of the tanks, because where the bulk of the waste goes.

So, the effort then shifted toward the low-level vitrification, away from the high-level waste vitrification, and so, here is the low-level waste vitrification milestones in this area; to select a reference melter by '96, to initiate construction on the facility by '97, and have it in operation by 2005. So, there's a lot of emphasis being given to this part of the activity.

So, that's a little bit on Hanford tank waste that I wanted to communicate to you, and if you have any questions, we have time for that.

DR. VERINK: There will be some time for some questions now.

Don?

DR. LANGMUIR: Langmuir; Board.

I'm impressed how much has been learned since I last heard about this program a few years ago. I was surprised and hopeful that, in fact, you do know what's in all the tanks. Not long ago, it was a real issue, what's in the tanks, and you had tables which showed, in some detail, tank content. Is it true, in fact, we know pretty exactly what radionuclides and other components are in each of those tank systems?

MR. WODRICH: No. There's a lot of emphasis and a lot of concern about what we know about what's in the tanks. We know pretty well what into the whole tank system by looking at the essential material records for the plants that generated the waste. So you can say this many tons of these chemicals pretty well went into the tanks. But how that was disbursed in the tanks, because the waste was pumped from tank to tank over the years many times, then the question of what's in individual tanks is much more difficult to answer.

The same way with radionuclides; you can go back to the reactor codes of what the radionuclides were that were produced and do the decay change and so on and say this went in, but the distribution of that becomes much more difficult. So on an individual tank basis, we have a lot to learn there. We have a very strong program to take lots of samples, analysis and also search historical records and do process evaluation to say what should be there. So there's a lot of work in trying to move us into knowing a lot more about the tanks, but we still have a lot of questions on individual tanks.

DR. LANGMUIR: But it sounded as if you had a plan for dealing with the tank contents regardless, and maybe you don't have to know a lot about--everything about each tank to deal with it as you're proposing, but you seem to have a plan regardless.

MR. WODRICH: I think that's right, because when you take it out of the tank, a lot of it's going to get blended and mixed again. So we have kind of the characterization part of finding out what's in the individual tanks is kind of focused on two things. On individual tanks, there's a big drive to know some things about it from a safety issue resolution standpoint, because if you have a safety issue with a particular tank or wonder whether you may have a safety issue, you need to know something about a specific tank pretty well. So that's kind of an individual tank focused effort.

When you get into the processing side, then the individual tank thing is not nearly as important as knowing on a little grander scale. And we can await some of that information. I mean, once you take it out of the tank and get it blended into a feed tank, you can also analyze and tell you something about how you adjust the process. So there are some other opportunities to deal with it when you get into the disposal side. But we have a big program to learn more about what's in the tanks.

DR. LANGMUIR: And one other at the moment. Not a word was said about the radionuclides and other contaminants that have made it out of the tanks into the geologic media and the ground water. I presume they're obviously going to be cleaned up. But when you extract radionuclides from geologic materials, where are they going to be disposed? What's the plan for disposal of the leak materials from these tanks?

MR. WODRICH: Well, it hasn't been decided what will happen to that. It's supposed to be addressed, as far as what's leaked from tanks, is to be addressed in the closure plans for the tanks, which won't be available for a few years. And that is a question; can it remain there or does it have to be removed. If it has to be removed, what do you have to do with it? That's an open question.

The actual amount of radionuclides that's in the ground leaked from the tanks as compared to what's in the tanks is a fraction of 1 per cent. It's still, you know, thousands of curies, but it's still very small in comparison to total.

All of the radionuclides in the soil, I mean, what's leaked from a tank is only a small part of what's in the soil that's come from other sources. When I say other sources, where we deliberately discharged low levels of activity into cribs, which is mostly water, but carries some radionuclides, what we have buried as solid waste in the soil. So those are all questions and there's a lot of questions raised, well, if you do that here, how does that affect that over here, and not all that's ironed out.

DR. VERINK: Any other questions from the Board? Yes.

DR. DI BELLA: Carl DiBella, Board Staff. I've got two questions that aren't really related.

One is you mentioned at an earlier slide that part of your public input was a desire to minimize transportation off site, and this sort of surprised me because I would assume that most of your public input would have come from the local public, and the local public would want to maximize transportation off site, that is, get rid of it. Tell me the thinking behind--that went in behind that particular public input.

MR. WODRICH: Okay. The public that we did discuss--that was involved in the discussions also included people from Oregon, and there are mixed messages there. There is a segment of the population who want Hanford returned to the pristine, and that means send it all to that off-site repository, and they have strong feelings about that. There are people from Oregon and other places who live along the transportation corridors who aren't interested in having a lot of waste come by.

Also, one of the alternatives we looked at that was proposed is why not send it all to Savannah River for vitrification, and that was part of this discussion that says that doesn't seem reasonable that you would want to have that kind of--that much stuff shipped across the country. So, on balance, I think there was some balance of people recognizing the reality of other places.

DR. DI BELLA: I have a second question. Steve Gomberg earlier this morning presented some standard specifications for vitrified high level waste. There were some minimum specifications derived from regulatory documents, and there were some other specifications, such as the size of the canister and the weight of the canister, a product consistency test, and so forth. How much are those latter standard, not the minimum, but the standard requirements; how much are they influencing the plan that you have developed here?

MR. WODRICH: On the size, if you talk about the size of the package, we have had discussions with repository staff on what the latitude might be there, and I have indications that they would consider different size packages. We believe from a cost standpoint, there would be advantages to the system to make larger packages. We think certainly you could go to the size of a spent fuel package without any problem, I mean, it would seem reasonable, and of course if you do that, you can basically double the amount of waste you put in any canister and so reduce the number of packages you have to handle.

We also, from our view, think there might be an incentive to go to significantly larger packages, and I believe that hinges a little bit on how the repository is going to--what kind of packages they're going to have and how they're going to dispose of those. That's an open issue, yet we've had some of those discussions. But at least we have some encouragement that would be considered.

Would that change our plans if it was a small package versus a large package? No, I don't think so. The only place it would impact is what's this reasonable amount of glass to send to the repository, and I see reasonable amount meaning something about the volume that you want to store there and also the cost associated with disposing of it there. So there's kind of two factors. But I don't think we're that far--it would swing it that much of a change. It might say we ought to be a little bit more aggressive in how much--how well we reduce the volume that goes there, but I don't think it would be a big swing.

DR. DI BELLA: What about the product consistency test; do you feel that's limiting?

MR. WODRICH: I'm not very good to talk about that.

DR. DI BELLA: Do you know if it costs you a lot to follow it or it limits the size of the package in any way to do that? Would it save a lot of money, or it doesn't make any difference?

MR. WODRICH: Well, let me give you just some impressions. We're looking at two products; one would be more like a monolithic pour in a canister and let it cool and whatever. The other would be maybe producing some smaller particle size glass where you could do product sampling and recycle if you had to before you put it in the container. Now, whether the repository would accept that, that's a different kind of a thought and I think there's a lot more discussion there whether that would be acceptable. But we have people on the processing end who really favor doing something like that.

DR. VERINK: Bill Barnard, you had a question?

DR. BARNARD: Yeah, Bill Barnard, Board Staff. Enjoyed your presentation, Don. It was excellent.

I have a question about the low-level waste, the grout. Other than the disadvantage of it not being retrievable, were there any other problems with the grout? They had just completed one of the monoliths a couple years ago when we were here.

MR. WODRICH: Yeah, there were other questions, because one could make grout retrievable. I mean, you could put it in a box or something. And the view we have is that we believe it was technically acceptable; if you could show that it would meet performance acceptance specifications, it was technically acceptable. The public stakeholders really have strong feelings about it. My view is there was a wide range there, not always consistent between people, but a wide range of views. It takes up a lot more space than--I mean, it's about four times as much volume as we predict we will have out of the glass product. So that impacted those who say let's not contaminate more land.

There was the long-term stability of grout for containing some of the long-life radionuclides, and would it really meet that, you know, over that very long term. So there were those things. And then the retrievability issue they saw poured into this big monolith as, gee, if it went bad, you'd never get it out of there. So it was kind of those kinds of things.

DR. BARNARD: Was there evidence that the radionuclides might be leached from the ground?

MR. WODRICH: In doing our performance assessments, and when you look out 10,000 or more years and do the predictions with the codes, the technetium is still around, the iodine 129 and some of those. And so under certain scenarios, they would exceed limits of 4 milligram, and they occurred several thousand years down from now before they became an issue. And, of course, the reliability of how well you can predict that then comes into question. So we did some measures, took some measures associated with the vaults to counteract that potential, like putting an asphalt cocoon around the vaults, and some things. So that was one of the challenges of the program. However, I believe we ended up with a performance assessment and conditions in the vault that said that we could contain it to meet the requirement. But that has been challenged.

DR. VERINK: Okay, thank you very much. I think we're on schedule to take a break at this time. We'll reconvene promptly at 10:30.

(Whereupon, a recess was taken.)

DR. VERINK: Our next speaker is Steve Schaus.

MR. SCHAUS: Good morning. My name is Steve Schaus and I'm with Westinghouse Hanford. I work on the Tank Waste Remediation System, specifically in the High-Level Waste Program Office.

What I'd like to discuss this morning is to focus a little bit on the disposal piece of TWRS Program. As Don Wodrich described it, it's a very large program. Bill Levitan pointed out that this is over a $500 million a year program here at Hanford, so as a result of its size, we have basically broken it into eight or nine program elements with two primary groupings; one, the safety and operation side, which is sort of our on-going tank waste management program, and the other is the forward looking program, our disposal program, which will ultimately decide the fate of the waste as it's presently stored.

Just as a reminder, we're specifically looking at the single-shell tank waste, the double-shell tank waste, and the cesium and strontium capsules. The last topic there, the cesium and strontium capsules, we're devoting a special presentation to that. Ed Randklev, who is also on the staff here at Westinghouse, will be talking about that later this morning.

Taking Don's diagram that showed the overall tank waste remediation system and focusing on that part that we've described as the disposal, we start over here with the waste retrieval. The waste retrieval program basically provides the link between the ongoing operations and the disposal. You have to take the waste, of course, out of the tanks and transfer that then to our pretreatment facilities which will provide the feed then to the low-level waste and the high-level waste immobilization processes.

This is the area which I think the Board is primarily interested in hearing more about, and that will probably be the main thrust of the rest of my presentation this morning. We also show again strontium and cesium capsules and the decision there on how we package those.

Again, Don showed the whole spectrum of recently negotiated Tri-Party Agreement milestones. I wanted to focus on those that impact our disposal program. We have a very aggressive program to complete the characterization of the tanks. In fact, at the present time, I'm on special assignment to that particular program to look at ways of accelerating that work.

As part of the support infra-structure that we will require for treating and disposing of the waste, we currently have in our planning six new double-shell tanks. Again, Don described those tanks as they currently exist. The plans for the six new tanks are similar to what Don described earlier.

As far as the low-level waste is concerned, we're looking at a fairly early in the next century, 2004, 2005 time frame, having both the capability to pretreat the feed that would go to low-level waste, as well as to now vitrify rather than grout that waste stream.

The high-level waste, we're going to basically side-pocket the sludges, the solids, until later in the first decade of the next century with a plan to start our pretreatment in mid 2008 and the start-up of our vit. plant in late 2009. We're on track then with a goal of completing that vitrification within about twenty years.

As mentioned earlier, in terms of again looking specifically at the high-level waste portion of the feed that has to be immobilized, we're looking at a caustic sludge wash process as our primary means of reducing the waste volume that goes to vitrification.

We will continue to look at other means of treating that waste as a way of further reducing the volume in the event that we don't meet our goals for volume, and if there are indications again from the repository program that the volumes that we're currently projecting are unacceptable.

The organic destruction process, we need to continue to look at that both from a standpoint of resolving some of our safety issues with regard to the tank, but also the organics tend to complex some of the radionuclides that we would like to remove and vitrify as part of the high-level waste stream. And then I've again shown the two dates that refer to the start-up of our pretreatment facilities.

In terms of our current planning for immobilizing the high-level waste, we continue to look at a vitrified waste form that would be put into canisters. That waste, canistered waste, would be stored on site until such time as a geologic repository is available for disposal. Our current planning is that we would have sufficient storage capacity on site to store every canister of waste that we produce here. We would not count on having a repository available before 2028, is basically what we're looking at.

In terms of answering the question that Carl raised earlier about the canister size and so forth versus cost, right now, because we backed away from HWVP as a vitrification plant, and as you'll recall probably from your last visit here, HWVP was really looked at as a sister plant to the Savannah River plant, to DWPF, and it was essentially a carbon copy of that, and so our planning base at that time was the two foot by ten foot diameter canister--two foot diameter by ten foot long canister.

Since we've had sort of, if you will, a reprieve based on the Tri-Party Agreement milestones, we're relooking at that. We're really saying based on the volume of waste that we have here and other considerations, does that two foot diameter by ten foot canister make the most sense. And so we are looking at that, and in some of our discussions which we start, which have actually been ongoing over the years, but which we're re-initiated specifically in terms of this program about a year and a half ago, almost two years, it was October of '92, we did get some indications from the repository program that they were looking at what they call our multi-purpose canister, which is on the order of five feet in diameter by 17 feet long, some dimensions like that anyway.

And so, again, for planning purposes, we've been looking at that envelope as something that we could utilize for purposes of containing our waste, whether it would be in multiple smaller canisters that would fit inside something like an MPC or directly somehow filling that MPC, we have, again, not totally converged on that. We continue to look at the options.

As Don mentioned earlier, the vitrification facility that we currently envision requires a capacity substantially larger than either DWPF is currently constructed for or that HWVP was being designed to. We're looking at something in the order of 15, perhaps even as large as 20 metric tons per day. We plan to start construction of that facility in 2002, and hopefully have it operating by the end of 2009 and, again, complete our vitrification mission by 2028.

This shows some of the same information that Steve Gomberg showed you earlier this morning. If we were to ask RW today what they expected to get from us, this is what they'd tell us basically, two foot diameter, ten foot long glass monolith, borosilicate glass, they'd probably even day, and a thermal output that doesn't exceed 1500 watts. This is our standard design basis.

Using our current planning base for TWRS, we would expect to produce something on the order of 10 to 28,000 cubic meters of high-level waste. What does that mean in terms of the standard DWPF style canister which contains about six-tenths of a cubic meter? You can see what that means in terms of canister count, something upwards to perhaps as many as 45 or 50,000 canisters.

The total thermal load of that, getting back to the question that was asked earlier, when indexed to the year 2021, is just under 1000 kilowatts, and equivalent metric tons of heavy metal, about 2600. So in terms again of the current limits, legal limits that are put on the first repository, we would contribute at Hanford from our waste a fairly small fraction of that total.

Perhaps this slide gets at the meat of the reasons that you're interested in hearing more about our particular activity with regards to the tank waste remediation system program. Some of the options that we're currently looking at and that we have discussed with RW, again as far back as October, '92, an elongated DWPF or West Valley style canister, basically taking that two foot by ten foot and just stretching it five feet. And that actually gives us a volume of about 1.3 or 1.4 cubic meters of volume, would substantially reduce, cut by more than half the number of canisters that I showed on the previous slide.

The large canister or cask which has an internal volume approximately 10 cubic meters, again is based on the MPC style container, or at least something that could fit into an MPC, if that was used as the over pack.

Don mentioned again earlier that one of the things that we're looking at besides the monolithic type waste form, the glass log as it's commonly called, that's the DWPF and West Valley design base, is smaller particles of glass, either as a cullet or perhaps as some kind of a shape like marbles or gems.

Now, we also showed as one of our technology development activities looking at other melters, one of the other melter types that we're looking at is a high temperature melter. The high temperature melter allows us to go to, among other benefits that it has, a higher waste loading of waste oxide per unit volume of glass. That of course, again, is one way we can reduce the number of canisters that we produce.

If we're going to higher temperatures, that also then allows us to go to different types of glasses, one of which is the aluminosilicates. There may be some others out there that we haven't necessarily looked at at this point, but we are looking at alternative melters, and as a result, glasses as well.

Then the cesium and strontium capsules, again, our record of decision based on the 1987 Hanford Defense Waste EIS, was to overpack those capsules and put them in canisters and send those directly to the repository. However, we've had some indications from our discussions with the repository that perhaps because of the corrosive nature of those salts, and it's really primarily the halides, not the cesium and strontium, that's of concern, that we may have to look at ways of blending those salts in with some of our other waste streams. And, again, we'd probably want to blend those because of the high heat of those particular salts. That was the main reason they were taken out of the waste in the first place, was to reduce the heat load on our single-shell tanks.

And referring back then to the previous slide in terms of our technical rationale for some of the options considered, as far as the larger size canister is concerned, obviously that reduces the number of units that have to be handled, both here and at the repository, fewer number of canisters that have to be transported. Again, that was mentioned as a stakeholder value.

And, again, in conjunction with our discussions with RW, we're really trying to take advantage of some of the good work that they're currently doing in looking at packaging and transportation concepts. So we're really trying to piggyback some of our thinking on the work that the repository program is currently doing.

As far as non-monolith glass is concerned, if we would find that our glass is out of specification, something that's in particle size is certainly much easier for us to recycle. And it perhaps would also allow us to better utilize the large column canister or cask concept. Trying to pour a monolith in something five feet in diameter may be somewhat of a challenge. So the smaller particle glass forms would allow us to perhaps fill that kind of a canister directly.

As I mentioned earlier with the non-borosilicate glasses, that does potentially afford us higher waste loading per unit volume. The current reference waste loading that

DWPF uses is about 25 per cent waste oxide by weight per unit volume. And that may even tend to be on the high side. I think they typically quote more like 20 to 25 per cent as a range. But with some of the non-borosilicate glasses, we're predicting we could possibly double that waste loading, get upwards to 50 per cent waste loading. So there's, again, potentially some real incentive there.

As far as the cesium and strontium capsules are concerned, obviously the overpack, if we can just go ahead with a direct overpack, it reduces the amount of handling and processing that we have to do here on site. The flip side of that is that in some of our at least initial looks at deencapsulating those strontium and cesium capsules and blending off those materials, it substantially reduces the number of canisters, the increment of canisters that we would produce as a result of the cesium and strontium.

I think in terms of the integrated data base, which is an RW document that's updated yearly, the overpack scenario, we were predicting somewhere on the order of 300 canisters from that waste form. Some of the early indications as far as blending is concerned, the incremental number of canisters would probably be maybe two dozen, something on that order, 20 to 25 additional canisters.

As far as the cost incentives, the primary purpose for our initial contact with RW back in October of '92, once the TWRS program was initiated, was to request some support from RW in terms of looking at disposal fee related to various pretreatment and canister size scenarios. And the results of that work that Carl Conner and the Weston support people did very clearly demonstrated to us that going to a larger canister, whether it's the two foot diameter by 15 foot, or even the much larger canister, definitely paid dividends in terms of reducing the associated disposal fee.

As far as the non-monolithic glass is concerned, again, the ease of recycling converts to dollar savings in terms of cost there, and also it would possibly be necessary to use that if we went to the very large 10 cubic meter canister.

Non-borosilicate glasses, again, because of the reduced volume of glass, directly converted to reduced storage, transportation and disposal fees.

Overpack, the advantage there is, again, less capital investment. That looks like something that could be handled right in the vitrification plant, and obviously then also lower operating cost because of less handling, less processing.

The blending of the cesium and strontium capsules converts directly into less disposal fee associated with it.

Steve Gomberg mentioned the MOA that's been recently signed between EM and RW. Using that as a point of departure, we strongly desire from an EM perspective, from a Hanford perspective, to continue that dialogue. We, I think, established a very good working relationship with RW and their project people at the Yucca Mountain site as well, and we want to get more specific in terms of discussing some of these options and getting more official, if you will, responses from them in terms of acceptability.

So that results in or requires establishing some official points of contact between RW and EM, getting agreement from RW to provide evaluations of our options, again from their system perspective. We've got our own system in terms of trying to optimize our costs and minimize schedule impacts. Obviously, they also have a system that they have to work our options into.

And then based on that MOA, we need to agree on a process for formally transmitting requests and getting responses from the RW program. Basically, the question is is the waste acceptance process that was promulgated back in 1985 or so, is that still the marching orders that we're working with today.

So that kind of lays out in summary fashion where we're at and where we see ourselves going, hopefully collectively, RW and EM working together over the next few years to define what the waste form and canister for the Hanford high-level waste will be.

Any questions?

DR. VERINK: Before we start on the questions, I want to report that I made my first mistake. I neglected inadvertently to introduce Carl DiBella, who is Senior Staff Member, who is the primary support of the Engineered Barrier System. So sorry, Carl.

Now, any questions?

DR. LANGMUIR: Langmuir; Board. I was, Steve, interested in some of the proposed waste form ideas that you were coming up with, and one concerned me quite a bit and that was the cesium and strontium halide capsule. My sense would be as a chemist or geochemist that that's an extremely soluble form.

MR. SCHAUS: Very.

DR. LANGMUIR: And to put it as such in a waste package where it was vulnerable to environmental--at a repository would strike me as a rather hazardous thing to do.

On the other hand, cesium and strontium should be very soluble in these high temperature aluminosilicates melts of yours, and that would be a nice way to put them in a form which was less vulnerable to leaching. What are your thoughts on that?

MR. SCHAUS: Well, again, some of the indications that we have--initial indications, unofficial, that we've gotten back from RW would indicate that perhaps because of the solubility concerns, the highly corrosive nature of those salts as well, that those salts are probably not, or at least possibly not acceptable in their current form for direct disposal into the repository. However, we haven't had that dialogue officially and so a lot of the information that we have received has been kind of I would say personal technical opinion.

We share those concerns and that's why we're keeping our options open, why we're continuing to look at ways of disposing of those salts through blending them with some of our other waste to dilute the thermal load per canister and dispose of it in that fashion. So, yes, we are continuing to look at other options besides direct disposal.

However, the reason we show that as our baseline at this point in time is because the NEPA documentation which is still, as I understand it, in force here for the double-shell tanks and the cesium and strontium capsules does indicate that those would be directly disposed in a manner that's acceptable to the repository, by the way.

DR. LANGMUIR: Doesn't your program presumable have--I'm sure that you do, and I think earlier in the day, Steve Gomberg mentioned the building integrity requirements that you have for your materials in the environment. Am I not correct that you have leaching tests that you do, rates of leaching, leachability tests that you perform on the different waste materials you propose to put out there?

MR. SCHAUS: Certainly on the glasses there's a standard leach test that's used. Again, you know, if we were to put a stainless steel canister and subject it to that same leach test, the canister itself would pass the leach test but, you know, there's got to be obviously a concern for the long-term integrity of those capsules and if they were to develop pin hole leaks over a long period of time, what happens to the materials inside and so forth.

DR. LANGMUIR: One last thing related to that. You suggested that granular materials were more versatile in terms of what you could do with them. They obviously also are more soluble, much more reactive surface area is exposed when you make it granular. Was a consideration that the granular material itself might be an ultimate form for disposal?

MR. SCHAUS: There has been some initial looks at that. But, again, the higher surface area to volume ratio obviously gives us higher rates of dissolution. We also have some concerns, quite frankly, with dispersability in certain transportation scenarios and so forth. So we are continuing to look at alternatives to the monolithic glass as we look at that in conjunction with canister size, but we don't have any final decision on that yet. And, again, these are questions that we need to get feedback in a fairly formal fashion from

RW as well.

DR. VERINK: Bill Barnard?

DR. BARNARD: Bill Barnard; Board Staff. If you did blend the cesium and strontium capsules in with the rest of the wastes, you'd reduce the number of canisters. But would that require you to use a more robust container, canister, on the outside, or could you still go with the stainless steel that you're planning on right now?

MR. SCHAUS: Again, we haven't really looked at that in any detail but, again, our initial look at blending the cesium and strontium would not be as halides. It would be to take those and convert them to some other form of cesium and strontium salts so that the halides would not be part of the glass waste form. If that's your question. Are you talking about a question about corrosivity?

DR. BARNARD: Well, you've increased the long-term hazard of the glass, haven't you, because you've added cesium and strontium which has a longer half life.

MR. SCHAUS: Cesium and strontium has a very short half life.

DR. BARNARD: Relative to the others?

MR. SCHAUS: Yes, 30 years. You know, ten half lives in cesium and strontium, you know, 300 years, you basically don't have a problem with either of those.

DR. BARNARD: Okay. How about the--

MR. SCHAUS: About the time they start the repository.

DR. BARNARD: I think I'll leave it right there.

MR. SCHAUS: I couldn't resist.

DR. VERINK: Garry?

DR. BREWER: I'm not an engineer, but it seemed that many--

DR. VERINK: Can you be closer to the microphone?

DR. BREWER: Yes. This is Brewer of the Board. I'm not an engineer, but it seemed that many of the implications of the cost incentives in your chart Number 11 were really to go to containers that would be hotter, and I wondered if there had been consideration given to the thermal loading in terms of transport handling and eventual disposition in the repository, particularly since there isn't a strategy for thermal loading in the repository.

MR. SCHAUS: Well, we're still using the constraint that Steve showed earlier and that I reiterated in one of my earlier slides that we would use a maximum of 1500 watts per canister based on the standard canister, the .6 cubic meters of glass kind of a thing.

Actually, our waste--and when I say our waste, the defense waste in general is fairly cool compared with the spent nuclear fuel. I think a lot of the thermal considerations with regard to our waste form really has more to do with the centerline temperature of the glass itself and the long-term performance of the glass rather than necessarily the thermal load it adds to the repository itself.

We've got some glass experts back in the audience, Tom Weber, Jim Creer, if either of you guys want to add anything to that. But my understanding of that thermal limitation is really more one to do with the waste form and its performance rather than any consideration of the heat that it would add to the repository system.

Does anybody else care to--

MR. RANDKLEV: You put so many watts into the can, and that's going to raise that centerline temperature up, and you don't want to get up into the region where you could end up with devitrification problems. And that's, again, from the repository perspective.

DR. BREWER: So, what, in Mr. Gomberg's presentation, it was 400 C. was the less than or equal to?

MR. RANDKLEV: There's a specification that puts you down below that level is where you want to be in terms of temperatures. But that's the historical concern.

DR. BREWER: Okay. It's just different kinds of wastes and I'm trying to get a sense of what the difference is.

MR. SCHAUS: Well, understand it isn't so much really different, because there's still a lot of cesium and strontium in the wastes that we're currently planning to vitrify, and also remember that the cesium and strontium materials came out of these very wastes. So what we're talking about doing is perhaps putting back in.

DR. LANGMUIR: Langmuir; Board. One last related question. I was pleased to see you're going more geologic, or going to materials that are environmentally very stable for aluminosilicates as a possible glass. What about the devitrification temperature for those? I would assume they're higher than borosilicates, that you've got a better material there for a high temperature repository. Is that true? Have you looked at that?

MR. SCHAUS: I'd have to defer to somebody who is more of a glass expert than myself in that light, Ed or--

MR. RANDKLEV: That's certainly a consideration. But, again, it's the repository program that has to really think about that in the context of the emplacement schemes and the performance allocation strategy that they are thinking about as a reference relative to waste form versus other barriers as part of the waste package.

DR. LANGMUIR: It's giving you some options at least.

MR. RANDKLEV: Sure. It's one of the parameters that can be dealt with.

DR. BARNARD: Bill Barnard; Board Staff. As I understand it, OCRWM plans to intermix the defense waste with the spent fuel inside the repository. If you had a preference, would you mix them or would you have a dedicated part of the repository just for the defense waste?

MR. SCHAUS: You're asking EM? I don't know that we've taken a position one way or the other on that, Bill. I think what we have said is that we will provide a waste form and canister that meets the specifications that are imposed by the repository, and that what the repository chooses to do with it in terms of final emplacement, whether it's segregated or commingled, is their call.

MR. GOMBERG: These are the kind of things that I think we're still studying that we really don't know what the optimum blend is in the facility to keep a certain aerial power density or other things, and those are all still somewhat being developed as we get more information on the characteristics of the site and the type of heat loads that it can handle. So I don't know that we can really answer it if we have a specific preference or not. But the spent fuel tends to be much hotter, relatively, and the glass tends to be much cooler, and that may be a basis for a loading strategy as we get more information on the site.

DR. VERINK: Carl, I think you had a question.

DR. DI BELLA: Yeah, thanks. Carl DiBella of Staff. You mentioned a study done by, I think, WESTON that showed the disposal fee would decrease.

MR. SCHAUS: Right.

DR. DI BELLA: And that certainly makes sense. But I'd like you to go into a little bit more detail, because a larger--the amount of repository area that you occupy is fundamentally going to be determined by the amount of heat you put into the repository. And you're not doing anything with a larger container to modify the total amount of heat that you put into the repository.

MR. SCHAUS: That's right.

DR. DI BELLA: And so there has to be some other contributing factors to reducing the disposal fee I would guess, things like the number of movements into the repository or transportation costs. Is that what we're talking about?

MR. SCHAUS: I believe that's the handling, you know, the transportation costs are reduced, the handling on site, that kind of thing. And, again, we provided a, I will call, a four by four matrix to RW. We were at that time looking at four different canister sizes and four different pretreatment scenarios, canister sizes ranging from, and using the standard DWPF canister, all the way up to a self-shielded cask type canister with a nominal 10 cubic meter volume for the glass.

The pretreatment ranged anything from none at all, take it directly out of the tanks and vitrify it, all the way to some of the extensive pretreatment scenarios that we've been looking at where, as Don Wodrich was describing, we would go after the sludges very aggressively with acids and thereby reduce the amount of high-level waste sludge considerably.

If we looked at the scenario that we're currently using as our planning base, the caustic sludge washing and the various canister options, just focused on that particular one, my recollection is, and these are kind of round numbers, but for disposal fee of the canisters associated with a sludge washing where we're looking at nominally 20,000 cubic meters of glass, it was something on the order of $7 billion.

When we went to the elongated canister, 15 foot long, two foot diameter, that disposal fee dropped to something under 4 billion. It was like 3.9, as I recall. Going to the very large container dropped it to just a little over 3 billion. And then because of things like weight considerations and so forth when we went to that same envelope but a shielded type of a cask, it kicked the cost back up to about the same, right at the $4 billion level, about the same as the elongated two foot diameter canister.

Again, we gave them our scenarios. They cranked it through their cost model, kind of a black box. They gave us the numbers back. But that's been well documented, that information, they sent us a very nice report July of '93. I've got file copies of that if you're interested in getting that. Steve, I think you've got that as well.

MR. GOMBERG: Yes. As a matter of fact, we recently did some informal work looking at smaller canisters and provided that input also. The model we've been using that WESTON uses is the TSLCC, the Total System Life Cycle Cost Analysis model. There are errors, obviously, in predicting costs at that level, but basically what we do is we put together an assumptions document that provides the operating and material assumptions, and then when Steve gives us parameters to change, we can use that as the basis for identifying the costs, and that's what we give back to him based on the best available knowledge or understanding that we have on their options and how that we affect the total system life cycle costs.

DR. VERINK: One final quick question from Langmuir.

DR. LANGMUIR: Langmuir; Board. Maybe I've already heard the answer and wasn't listening properly, but you seem clearly excited and it sounds good to me in principle that you can go up to 50 per cent waste in the aluminosilicate glass as opposed to a max of maybe 25 per cent radionuclides and other products in the borosilicate. Are we getting 50 per cent to the point where the thermal loading contribution of the glass has become a significant factor in placement in the repository?

MR. SCHAUS: Potentially. Again, it depends a lot on what the particular waste stream is, what the constituents are of that particular waste stream that's being vitrified. And, again, that would have to be a consideration as we trade off higher waste loading versus higher thermal loading, which could tend to be a negative as well. But, again, if those are less prone to devitrification, which is the primary constraint on the 1500 watts limitation, then we also may have some additional latitude there as far as the thermal loading is concerned.

One thing, you know, so we don't get too enamored with the higher waste loading, one of the things that we do sacrifice, obviously, is the higher volatility question that we have to deal with here on site in terms of designing off gas systems that can accommodate the higher temperature melters, and also what do you do with that waste stream then once you've captured it in an off gas system. So, you know, there's lots of pros and cons that we have to look very carefully at as we develop a total melter system.

DR. VERINK: Thank you very much. Our final speaker for this morning is Ed Randklev.

MR. RANDKLEV: My name is Ed Randklev. I'm with Westinghouse. I'm currently working with the Vitrification Development Group. I've been on HWVP before its cancellation here of recent, and in years past, I had worked on the Basalt Waste Isolation Program, which is of course the RW side in the investigation of the Hanford Basalt as a possible repository. And what I'd like to talk to you in a little bit more detail, although there's been quite a bit of discussion already this morning about these cesium and strontium capsules, I'm going to give you a particular presentation on a little more background, and we can talk some more about some of the points that have been raised if you'd like.

So this is the matter of the disposal of the cesium and strontium capsules. Again, as Steve and some others have mentioned, this is cesium and strontium material that's in the form of salts that is doubly encapsulated in metallic barriers stored on site in water basins to keep them cool. That material came out of the high-level waste tanks and was purposely extracted out of those wastes in order to get the high heat contribution of those materials out of the waste so that they could compact, if you will, more waste into the tanks and not run into a heat problem, because both of these salt materials that we're speaking of are relatively short half lives, they're on the order of 29 and 30 years respectively. This is cesium-137 and strontium-90. So we're talking short half life material, very high, you know, activity, decay activity and, hence, a high heat--decay heat producer.

Going back to some numbers, around 1990, to give you a perspective, this inventory of cesium and strontium capsule salt materials accounted for approximately 42 per cent of the total cumulative inventory of radioactivity of wastes on the Hanford site. So we're talking from a curie standpoint a significant fraction of the total inventory of such materials on the site. And, of course, as part of the Hanford site cleanup, the manner of disposal of these cesium and strontium capsules needs to be resolved, and it needs to be resolved in a fairly near-term manner relative to some planning.

The background that's been mentioned, particularly by Steve's discussion, was that if you look at the current NEPA type documentation, or even any other documentation, and that's certainly the higher level documentation that we would point to at this time, you find that in the '87 EIS for the Hanford site, it called for cesium and strontium capsule materials, once overpacked, as being candidates for repository disposal. The overpack in that case would be some sort of very likely metallic shell for transportation purposes, of which the capsules would be put so many at a time into that carrier device, if you will, and transported to the repository for emplacement within presumably some other barrier system for containment, and would go from there.

The record of decision, which was issued in '88, likewise reiterated similar language, saying "Prior to shipment to a geologic repository, these wastes will be packaged in accordance with repository waste acceptance specifications." All of that did not presume that these materials were automatically acceptable to a repository. It just said that, hey, the preferred option at this time is judged to be try to simply directly dispose of these materials in the repository and, therefore, what needs to be done is for now the EM side to deal with RW in the repository program and disposition this question; are these materials suitable in some form of waste packaging as disposal candidates in the repository.

Likewise, this question of disposal was reiterated again in terms of even the more recent signing of the renegotiation of the Tri-Party Agreement. As Steve noted, the latter statement here refers to some work that goes back to around 1990, started a little shortly before that, where there was an evaluation done looking at the feasibility of taking the sale materials out of the capsules and either directly adding the salt materials selectively to certain waste types that would be fed into then the reference was the HWVP melter system, to go into a borosilicate glass, or to process the salt materials in some manner to change their compound form likely to a carbonate, nitrate, things like that that would be a little easier to accommodate in the glass. Because if you put just cesium chloride and strontium chloride in, you run also chloride and fluoride limitations relative to a glass being able to handle these materials from a solubility consideration.

And so that investigation was done. It was by no means what we would say a definitive statement on the question. It gave some preliminary costing analysis and particularly addressed the primary considerations of the technical feasibility. And certainly it was technically feasible, but it is by no means without cost and impact on numbers of glass logs and difficulty in doing the job.

Now, the form, as we've already talked about it in some of this conversation, is in the form of, for cesium, it's in the form of cesium chloride. It's a simple cubic material that was--contains a certain fraction of impurities such as sodium, potassium and rubidium. These are again in solid solution type materials from a phase consideration with cesium chloride. And the impurity levels are on the order of 90 percentile plus for the cesium content of the material.

In some of the cesium capsules, there is evidence that some significant impurity levels of silica, aluminum and a smaller amount of iron have come in via some filtration material, zeolite type filtration materials, I believe, that were part of the processing stream for the cesium chloride. Cesium chloride was processed in a system that melted this particular chloride. It's got a melting point in the neighborhood of 600 and some degrees, I believe. It might be a little lower than that. I have some information on it. And of course the impurities will again suppress that downward. It was melt cast in the vertically hilled inner-capsule, and so there is shrinkage void, you know, in the capsules. They're not just 100 per cent fill in the capsule. And then that capsule was sealed and it's subsequently housed in another one.

The primary isotope is cesium-137, as I mentioned, the short half life. There is a small, very small fraction of cesium-135, which has a very long half life, 900,000-some years, and that inventory is on the order of only about 1,000 curies out of the total, which this one for the cesium-137 that was extracted, we're talking upwards of, you know, 90 to 100 megacuries, so we're talking a much different level of material.

The fraction of radioactive 137 versus the stable cesium is on the order of a third. It's plus or minus a bit on that. The cesium-137, from a decay consideration, goes to a metastable barium, and then to barium-137. That ends up changing the chloride from a chemistry consideration to a barium dichloride eventually so that you get some free barium, is what it amounts to, as you get through the decay. So over time, these are going to go through a chemical transformation, if you will.

For the cesium inventory on site, the current inventory that we would be working with in terms of capsules that have not been cut or processed in any way is approximately 1338. And I believe that number includes the several hundred, it's on the order of between 300 and 400 capsules that are going to be brought back. The first shipment I think has already arrived, and they come back something like 16 at a time I think from Denver.

A number of the cesium capsules, several hundreds of them, had been shipped off site some ten to fifteen years ago after their completion for a different mission for these materials, and that was they were used as sources for irradiators, for radiating all sorts of things for sterilization purposes. And there was a leak in one of those through a particular incident, and the DOE terminated that program, and the capsules from the other irradiator users have already arrived back on site, and these ones from Denver are the last ones.

So the inventory we would talk about in terms of whole capsules is on that order. There's approximately 2.7 kgs of cesium chloride per capsules. This just gives you a breakdown of what we're talking about then for total masses of materials. And we spoke about this concern over the fluoride, chloride source term, so we're talking, for that many capsules, you'd be talking on the order of 761 kgs of chlorine that, if you will, would be available. Because as has been noted, certainly cesium chloride as a material is highly soluble in water, whether it's cold water or warm water. It's more soluble than table salt, sodium chloride, if you will.

Curie levels, as I mentioned in terms of 1995 reference point, we're talking approximately 90 megacuries of cesium inventory for the 137. That works out to approximately 165 watts per capsule. But by 2010, we're already down to 63 megacuries, and dropping the wattage down to 116. This is just giving you a perspective on how rapidly this inventory is decaying away. In 300 years, it's essentially, you know, down below levels you don't worry about it, and at 1,000 years, for like the substantially complete containment period for the repository, is zero. The only thing left relative to the cesium is this total inventory of 1,000 curies of 135. That's from a radioactivity standpoint.

Strontium, on the other hand, is in the form of strontium fluoride. Its impurities consist primarily of some other fluorides of, in this case, barium, calcium and sodium. This is, again, in decreasing order of relative presence for that. And, again, the percentiles are on the order of 5 to 10 percentile contamination from these impurities.

The strontium fluoride has a much higher melting point. It was not melt cast, as was the cesium chloride.

Instead, for the strontium fluoride, it was put into a powder or granulated form from a processing standpoint, and then that material was loaded into this inner capsule and compacted in some manner. And with the temperatures that it's been at for some time, this is not something that just flows around in there. It's reasonably well agglomerated and packed down.

The radioisotope of concern is the strontium-90, which decays to yttrium-90, which eventually decays to a zirconium-90, and again that also leads to a chemical reformulation, because you don't end up with a difluoride, you end up with a zirconium tetrafluoride, which leaves you with a free zirconium in that process.

The strontium capsules are the lesser number. We're talking approximately 610 in this inventory. The strontium capsules have remained on site, to my knowledge. There might have been a very few of them--there have been a few of them shipped off for some other heat source applications. They were not used, to my knowledge, as irradiator source materials. But unlike the cesium capsules, the strontium capsules, except for a few capsules, have largely remained on site.

Their inventory is again, because of the same sizing involved, approximately 2.7 kgs, giving you a breakdown of the following, and again, this free chlorine, if you will, would be on the order of 498 kgs. So we're not talking huge amounts, but it's still appreciable in terms of the overall aggregate inventory.

Curie inventories is 95, puts you on the order of 51 megacuries, gives you 273 watts per capsule. And, likewise, at 2010, you're already down to 36 and 195. They remain a little hotter because of the little difference in the decay chain traps some of that heat internal, it's a beta decay, and they have substantially higher capsule temperatures, if you will, than the cesium capsules.

The barrier system, as we've already mentioned, is a matter of two metallic capsules, both well sealed, flat end cap type systems, one inside the other. In the case of the cesium capsules, the inner barrier is a 316L stainless, the outer barrier is also 316L. In the case of the strontium capsules, which I mentioned run a little hotter in temperature, they chose a Hastelloy C-276 alloy, which is a nickel base highly corrosion resistant alloy from Haynes. And then the outer barrier is the stainless steel 316.

And the way the selection methodology, there was a great deal of work done on this question of the encapsulation back in the early Seventies, in particular, by principally some people at that time from Battelle. The inner barrier is designed so as to provide primarily the corrosion containment, and the outer barrier is looked upon as providing the structural containment, if you will, relative to this compositing of barriers. And then as I mentioned, both of these capsuled waste materials are held in water storage on site. As even in the case of the irradiators that used them, the capsules were always water cooled except when they were pulled out to irradiate the product.

Here's an extract from an older report so that the numbers on temperatures and what not relate back to some of the higher calculational levels of activities, if you will. If that were in 1995 numbers, those would be somewhat lower. But this is basically the cut-away of the system. It's, as I said, a notched but still flat end cap seal system with the waste form in the middle, here's the inner barrier sliding in, if you will, shown partially extracted into the--and this is the outer barrier.

The dimension is again on the order of the two and a half inches diameter by 20 inches long. This gives you the breakdown in terms of centimeters. I think that's as much as there is to relate on that one.

And where we're at, if you will, in this fiscal year is trying to get at some of these questions and resolving what we do with these materials. By we, DOE overall, EM and RW putting their heads together. The major question to be answered is can the proposed geologic repository actually accommodate disposal of the cesium and strontium capsules in some packaged form. That's, again, certainly presuming that either if we ship the capsules just inside of a cask, just like they're being shipped up here from Denver, or if we package them even in some further handling envelope.

When they got to the repository, I think the general presumption would be, and has been all along, that they would go inside of, again, some containment system from the standpoint of isolation that the repository program would be addressing from their perspective of the circumstances of the repository, its geochemistry and thermal load, et cetera.

If the two waste forms, that would be the waste form--when we say waste form in this case, we are talking just as if you were saying glass, we're not talking the canister, we're talking the glass, and in this case, we're talking the salts--if the cesium and strontium materials, that's the cesium chloride and the strontium fluoride waste forms, are they acceptable. And we've already heard a number of questions certainly citing the expected and general concern that is out there to be addressed, which is can these materials actually be tolerated in the repository from a performance consideration, wherein the radioactive inventories of these materials will be gone, zero, at the time of the end of the substantially complete containment period of 1,000 years. They will be, you know, decayed away to negligible levels even at 300.

Your waste packages, they're talking that period being the 300 to 1,000 years, and then the gradual release on out to 10,000 years. Well, the concern I think that is largely raised here is, okay, you've got some barrier system for these materials, but what happens if and when some of those barrier envelopes fail, either just stochastically or because of some known degradation processes that take place, and you start leaking out what would then be some highly soluble inventory of cesium chloride, which is putting this chloride contamination, if you will, in the ground water, in particular, as well as the fluoride is much less soluble. We're talking a few milligrams per liter of water, whereas in the cesium chloride, you're talking grams per milliliter of water. So we're talking things that are highly soluble, and there's no question about that.

If the materials would be considered acceptable, given that background of their radioactive and chemical impact on things, then are the respective capsule types acceptable as part of the shipment? What that's really referring to, and I should have probably stated it a little more clearly, is can we just ship you the capsules, or do we need to put them into some other handling envelope.

Some of the work that was looked at a number of years ago simply envisioned taking a DWPF type canister and just creating a grid inside and axially putting four of the capsules, just as an example, right down the middle centerline. This was dictated just from a simple starting consideration by the thermal inventory, and the longer we wait to package these up, the less that inventory is and presumably the more of these you could stuff into a can before you get to these thermal limit considerations.

Now, here we're not talking of thermal limit based on devitrification concerns. We'd talk about a thermal limit based on, for instance, you wouldn't want to melt the cesium chloride, for instance. You don't really even want to go up above the solid transformation temperature. There is one at 400-some degree level in the cesium chloride, because there's a fairly good volume expansion at that point and you probably wouldn't want to do that. But you'd probably be concerned more about thermal burdens in relation to maximum rock temperature or something like that that you were concerned about.

If either of the two, the waste form and the capsule types, must be overpacked, what overpacking concepts would be considered acceptable and what would their acceptance specifications be? That just gets back to optimization questions, largely. Since we're talking a handling package, it's a matter of what package would be considered programmatically the most compatible with the needs of the repository to handle a few hundred of these.

And the last one is, of course, the one we've already talked about a fair amount, which is this matter of well, okay, if either or both of these waste forms, and we'd like to treat them as individual cases to be dealt with because there are substantial differences between the two in terms of their chemistry and some other considerations, if either of them are not acceptable and the presumption is that we would put them into the referenced high-level waste stream and waste form for the system, that means we'd put them back into the glass, what waste form packaging concepts would be acceptable and what would those acceptance specifications be?

This again gets into the question of how we would blend that material into some glass material. It's one thing to blend it over the whole spectrum of streams, and especially if our streams end up being highly blended themselves, that would be one set of considerations relative to concerns over either thermal limits initially for cesium and the strontium contribution, as well as solubility and volatility considerations for putting especially cesium into the feed stream and trying to get it into a glass, because you get a fair amount of volatility of this.

It also relates to if the chloride, if the cesium chloride for instance was just blended directly, you've got a chloride limit consideration. And that gets back to a needed dialogue with the repository on what sort of thermal burden, what sort of specialized waste form consideration we might want to talk about, because the repository program, we would certainly hope and expect that the repository program would be interested in looking at this question from the standpoint of is there something special we can do with this material in terms of emplacement that would somehow mitigate some of the concerns.

You know, it isn't as though there are thousands of these packages. There are a few hundred of them. If we even put just four or five to a can, there aren't that many. It's a matter of what could you do with them that would lessen the impact on a repository setting.

From our standpoint, we have had some contact, and we've had one very useful and helpful exchange meeting just in March with the Yucca Mountain folks and the DOE counterparts, TRW staff and the DOE people down at Las Vegas, where we were talking about these two waste form materials as well as the topics that Steve brought up about some of the alternate for non-standard waste forms that Hanford is thinking about. But as yet, we have not, from our perspective, submitted a formal request yet for dispositioning this question. We're at a dialogue stage, technical information exchange.

There has been some--I'll just mention there has been some other inquiries made by some DOE staff in relation to another program that concerns Hanford that also would have to deal with this question of what do you do with these capsules if they had to be blended into the waste.

And so the RW folks are internally aware of this concern about these capsules and have been giving it some consideration, because they have certainly given indication, going back definitely to the, say, 1990 time frame, as an example, just Yucca Mountain, there had been informal contacts at the time of this evaluation looking at placing this material into the glass, and some of the Yucca Mountain staff had given the opinion even then that certainly there were concerns about receiving these waste form materials as is in the capsule. And the concern, as Steve has accurately pointed out, is principally the one of solubility concerns for these waste forms, as well as the resultant impacts on corrosivity, if you will, or corrosion concern.

Now, I'm not entirely sure whether they were thinking about whether or not it would be hard to contain these materials. I should comment about that one because the metallic packages that they're in have stood up very well. The work that was done back in the early Seventies when they went through the material selection on these capsule materials made the determination that the primary attack of the alloy on the inner surfaces was occurring because of certain trace impurities that were in the materials, as an example. Principally in the cesium case, it was the presence of some chrome and iron chlorides that were identified as having been the aggressors in stimulating some of the attack. Those materials are present in very small quantities, and the expectation and even the post-test results, I believe have borne out that those materials get exhausted after a period of time, and then the attack just falls off from there.

The wall temperatures on these materials, they were looked at from the strontium capsules perspective. They were looked at in the alloy selection and the Haynes C-276 was looked at from the standpoint of being able to tolerate a wall temperature of 800 degrees C. and still have on the order of a 20 to 30 year life time. That was, again, particularly looked at very aggressively when they thought about possibly sending some of these off site for other usages out in the commercial sector.

So if the wall temperatures, and the longer we wait the lower they are in curie levels and wattage and, therefore, temperature, you get the temperatures of these capsule walls down in the order of 300 to 400 degrees C., the expectation is that they will contain this material indefinitely. There isn't an aggressive attack going on from the materials, because there's no moisture involved in these and they don't have a problem with radiogenically produced gases, et cetera.

Anyway, there's been the voiced concern about the solubility and corrosion concerns. In the case of where we're at now, we are simply at the point of wanting to continue this dialogue. The meeting in Las Vegas back in March gave us some direction that we needed to go talk to DOE RW headquarters people that are more directly associated with the topics of waste acceptance from a programmatic standpoint, and we have done that and clarified what amounts to the at least next technical step we need to take, which is to really go back to Yucca Mountain and resume the technical dialogue. And so I think everybody is getting a better perspective on where we're going to have to go and how we're going to start dealing with dispositioning the question formally.

I believe that's all I've got to put up there in terms of any further slides, and hopefully I've clarified a few of the other points that have been raised. And if you've got any questions, I'd be happy to try to answer them.

DR. VERINK: Any questions from the Board?

DR. LANGMUIR: I was just looking at the size of these capsules and they're 53 centimeters by 6 2/3. Among all your options, have you considered putting them inside of other--of a glass or inside of a container which had much thicker walls, perhaps wrapping it with a thicker walled low corrosion material as a cheaper route than simply taking them all apart and having to reconstitute the chemistries and start over again?

MR. RANDKLEV: The idea of just dumping them in a canister and pouring glass around them has been speculated on years ago. I know I personally have heard it. One of the concerns you certainly get into in a situation like that is the glass is highly thermal insulating and you've got to be somewhat sensitive to whether or not you end up melting in the case of cesium chloride the material inside. I'm not sure that would necessarily have bought you anything.

The idea that you could still take the capsules as received from us in some either additional handling package and put them into a particularly robust waste package, something even more robust than is envisioned for the standard, you know, spent fuel and/or defense class packages, is likewise there as an option, and that's a perspective we're certainly interested in hearing more about as a possibility from Yucca Mountain or tailoring the emplacement in some way that might help mitigate the possible impact of any, in this case, say the chloride, fluorine contamination of the ground water.

DR. LANGMUIR: Do you think those contaminations would be--you'd have four metric tons, it looks like, of these materials overall. I wouldn't think a fluorine effect would be very significant. Maybe so. About the same size as the mineral fluoride, about 8 milligrams per liter of fluoride.

DR. VERINK: Carl, I think you had a question.

DR. DI BELLA: Yeah, I think in theory anyway, the way one would--a major way one would determine the acceptability of a particular waste form and its accompanying waste package would be by means of a performance assessment. Have you in any of your dialogues so far with RW heard them plan to do a performance assessment, or are you going to do a performance assessment?

MR. RANDKLEV: No, we would not attempt to do their job, if you will, because they have a site specific perspective that we really need to get from them. We had discussion while we were at Yucca Mountain about the status of the performance assessment work in the Yucca Mountain program. As you know, they're going through a really large replanning effort in association with this major decision that's been made regarding this multi-purpose canister concept for spent fuel, and they indicated to us that the performance assessment activity was being scheduled out on a two year repetitive interval type iteration, as was the costing analysis work, of which they've assumed now this role of the WESTON because we asked about that also. They said they've taken on this cost model work from WESTON and will be doing that internally to the Yucca Mountain project, as we understand it, in the future.

None of the assessment work, et cetera, that we're referring to here has, to our knowledge, and by any indication they gave us, given any consideration as yet, formal consideration, to this matter of the cesium strontium capsules. However, informally, we're certainly aware that parties associated with that performance assessment work are aware of this question and I'm sure their opinion has been sought over the last several months, because there has been some dialogue and inquiry, you know, made between EM and RW about these capsules. And it's just that I can't presume to say what the level of that, you know, consideration has been.

At the meeting we had in March, that was primarily an information meeting on our part to present them some topical information, and they likewise gave us back a good perspective on where their program was at that point in time with regard to waste package design considerations and some of these downstream planning, you know, activities--or not downstream--planning activities that they were actively involved in at that time, considering topics like where is your performance assessment activity in relation to this.

So we hope to be catching up with that next iteration, that is, become a part of that next iteration for certain in relation to these ideas on options that Hanford has on alternate waste forms, as well as the consideration of cesium and strontium capsules. And we intend to push ahead with this cesium and strontium capsule question in a direct and, you know, compatibly aggressive manner between the two programs, because we feel that one is ready to go.

We have as much information as we think is needed for people to be able to do a decent technical consideration of can you tolerate these materials in some package form in the repository. And there's nothing to prevent us from, other than other program schedules, from moving ahead on that, seeking a disposition to this overall question. Because from our end, there's a need to get on with this and try to clarify this position, because if you are going to reprocess these materials and have them as part of your high level waste stream, even in the time frames that have now been somewhat delayed via the TPA agreement for the high level--resumption of the high level waste processing, these materials will still be thermally active enough and they're there chemically such that they present some considerable challenge to incorporating into practically any vitrified high level waste product that one might want to think about.

DR. VERINK: Bill Barnard, I think you had a question.

DR. BARNARD: Bill Barnard; Board Staff. You indicated on one of your slides that these capsules have an inner capsule and an outer capsule. Is there any way that you can easily check the condition of the inner capsule without disassembling it?

MR. RANDKLEV: I'm not sure what has been looked at from that standpoint of NDE consideration. Certainly they can be checked to see whether or not the inner capsule has failed. And Battelle has got an ongoing program that is associated with providing technical support to the integrity monitoring of these capsules, and several hundred of these, or I should say quite a few dozens of these have been, over the years, cut open and looked at. The majority of the ones that were cut were not looked at from the standpoint of a detailed examination. A number of them, the salts were taken out and used for other source materials. But there were certainly several tens of those that have been cut open, looked at in some detail, because there are a very few of the cesium capsules in particular that have shown a slight swelling down at one end. But that's a very small number and, you know, the work has focused on things like that. When kept in cool storage they're pretty modest temperatures and not much happens to them.

DR. VERINK: Thank you very much. I think maybe what we might do is allow some of those people who might have wanted to ask Bill Levitan a question or two to get a shot. Any questions for Bill Levitan?

DR. BARNARD: Bill, you gave us some indication of the scale of the budgets for the EM work. What's DOE's total budget? How does this compare with their overall?

MR. LEVITAN: I originally had that in the view graph and eliminated it because it can get pretty confusing because of the work for others, the power administrations. Generally, the line is that EM represents about a third of the DOE budget. But as I said, there are a lot of other factors. It is the largest program now in DOE.

DR. VERINK: Any other questions for Bill?

MR. LEVITAN: One point I might also make on that budget table is that although Hanford has seen a lot of growth, because of the Federal Facility Compliance Act and some other activities, restoration will be moving from a studies phase to more of a remediation phase. But even here at Hanford, the growth can't continue. There's just not--with EM's budget flattening out, there are just going to be a lot of demands and I think a lot of sites will be seeing their budgets flattening out, too.

DR. VERINK: There would be time for one or two questions from the audience if there are any. If you have a question, go to the microphone and identify yourself so the record is clear.

MR. COOK: I'm Bob Cook with the Yakima Nation. I wanted to ask about the question on the hazardous waste determination, how does that influence a decision as to whether waste is acceptable or not acceptable? I notice that's a determine that has to be made. And the other question had to do with the integration with these EISs, the strategy and how the RW and the ER and PEIS and all these things are going to be integrated, and where the decisions at Hanford fall. I mean, we're hearing a lot of things like it's a fait accompli, yet the decision as far as I know for glass making isn't even made yet. So those are two questions that I have.

DR. VERINK: Steve Gomberg.

MR. GOMBERG: I'll answer the one on the RCRA determination, and at least explain the requirement in the waste acceptance requirements document.

There's two aspects of RCRA; one is that the liquids in the tanks are currently considered RCRA characteristic wastes and they are managed accordingly because of their corrosivity. However they get vitrified that will become a new waste form, and our concern is that we have the understanding as to whether we are also accepting a RCRA waste into our facility, because that kicks in some other requirements that we need to impose on our facilities.

Currently, based on some limited information at Savannah River, the glass product has been tested--it's been a simulated glass product. It's been tested according to the--basically, it's a grind and leach test. It's the extraction--TCLP, toxicity characteristic leach procedure, and it has shown that the concentrations of cadmium primarily, which is one of the hazardous materials, are below detection.

So we don't have any major concerns as of this particular time that at least the borosilicate glass per the mixture at Savannah River is a hazardous material for disposal.

Other aspects, such as disposal of mixed waste or RCRA waste, during the whole process of handling, operating a facility, we expect there will be some RCRA waste generated in small quantities. We'd be a small quantity generator and we would comply with the EPA regulations on that. I hope that answers your question.

MR. COOK: Well, at Hanford then, we'd have to grind up this waste and check it out with respect to hazardous characteristics?

MR. GOMBERG: Presumably, Hanford would need, as part of the process, to take a sample of the waste. Obviously you don't do it with all the waste, and presumably verify that the waste is not an EP extraction procedure toxic waste.

MR. COOK: So the strontium fluoride would not work in that case, clearly. The fluoride would be way too soluble, I would think, for any acceptable fluoride. So right there you can say the fluoride is not acceptable. But I'm curious about the selenium and all the other heavy metals and the mercury and the chrome and everything else that doesn't even get necessarily incorporated into the glass when you grind it up. So that's something that ought to be looked at at Hanford seriously, I'd say.

MR. GOMBERG: I would agree.

DR. VERINK: Was there another facet that you were going to cover?

MR. LEVITAN: I'll talk about the--at the headquarters level, the programmatic EISs, both for the environmental restoration waste management and the spent nuclear fuel EIS.

There's a lot of coordination that's going on between the programmatic EISs on a daily basis. Within EM-30, we have some people that are just their sole duty is the integration of those EISs. Also recognizing that the NEPA strategy within DOE is a tiering type strategy, a pyramid strategy, so that the programmatic EIS will be the top level. A programmatic EIS generally looks at very broad programmatic concepts, that is, you come down to the site level, it tiers off and uses those EISs as a basis.

One example is the DOE's spent nuclear fuel EIS, which is just out this month, or maybe it's already out or just about to come out in a draft. The Hanford EIS will be tiering from that document, and there are several people at Hanford who are on the review group and the working team for that EIS. So it would clearly tier down from that.

MR. COOK: How does it fit into the RW, the disposal question; is that all going to be resolved and doesn't the repository also have an EIS that they have to prepare? So where does that all fit together, the waste form questions and the plutonium question, whether you're going to--maybe you want to put the cesium and strontium in the plutonium here at Hanford or something. Where does that all come together so you can get on with it, that's the question, particularly relative to the disposal form and the disposal questions? I don't know that the RW EISs coordinate with the rest of these things very well, you know, the repository things.

MR. LEVITAN: I can't speak to the plutonium disposition.

MR. COOK: Well, that's the key one. We're just talking about it, and we'll talk about it later on this afternoon. I think that's a good question that the Board should in fact post to Canter when he comes in, and figure out how that all gets cranked into the--I think it's a key issue with respect to the cesium and strontium disposal. You could make good use of the cesium and strontium in denaturing the plutonium in this system.

MR. GOMBERG: Could I--in regards to--

DR. VERINK: Sure. Give you name.

MR. GOMBERG: Oh, I'm sorry. Steve Gomberg. I guess could I make one additional point to my RCRA comment, which I think is important?

DR. VERINK: Yes.

MR. GOMBERG: Based on the data at Savannah River, the EPA concluded last year, or two years ago, that a vitrified glass is considered BDAT, best demonstrated available technology, for removing the RCRA characteristics from the wastes. I think that's an important point.

From the RW--I'm starting to sound like you, Dr. Verink--from the RW NEPA process, we've been working with EM to review and provide input as necessary in their NEPA documentation and their strategy. We've also been working to coordinate our NEPA activities because we have, in effect, a near-term NEPA activity related to the multi-purpose canister, and we also have a longer term NEPA activity in regards to the EIS requirement under the Nuclear Waste Policy Act to support a decision to develop a repository.

Based on the timing of the information and the details we have, the scope of the EM NEPA documents, from what I can--you can correct me if I'm wrong--are somewhat limited on the decisions and conclusions they can make with regard to permanent disposal. So we're trying to provide information that we can that's available within the scope of the EM, the EIS documents, but they I think almost by their timing and definition for the decisions that the secretary needs to make to support the EM decisions, are not going to be the final answer on the disposal issues. We will be managing those, and if we need to, supplement or whatever we need to do to the EISs to make sure that the secretary has all the information available to her to make the appropriate decisions based on the decisions and the timing that she needs to make them.

DR. VERINK: Well, I think we've had a brisk discussion on this and I see we're just a minute or two over on our schedule. Lunch time is now with us. I expect most of you know a lot more about where to get lunch than I do around here, but there's certainly a number of places nearby, including the hotel itself. But let's reconvene then at 1:15. We're going to start right as close to that as we can go.

(Whereupon, the luncheon recess was taken.)

AFTERNOON SESSION

DR. VERINK: The first speaker this afternoon is Jerry Ethridge, and I guess we'll go ahead and start and let them catch up.

MR. ETHRIDGE: My name is Jerry Ethridge. I'm from Pacific Northwest Laboratories, which is operated by Battelle Northwest, and Battelle is in a unique situation related to the spent nuclear fuel project in that it is assigned to a Westinghouse project, the M&O contractor here at Hanford, and I manage that part of the project that is responsible for the acquisition, development of technology that might be necessary to either mitigate, remediate or solve some of the problems related to spent fuel here at Hanford.

Very quickly, I'd like to talk about who's who in the project, including DOE and Westinghouse, the status of where we're at today, where we're planning on going, and this is where I'll provide a little bit more of the technical information related to the project and to the fuels that fall under the project, some of our strategic objectives related to the K Basin fuel, and I'll explain what those are in just a moment, and then talk about where we're going.

This is a who's who diagram for starting at the EM level, operations office, this is John Hunter here at DOE Richland, this has an acting director, Mr. Jim Daily, and then underneath that is what we call--or what he calls his project, if you will, and he has an EIS section, which is managed by Suzanne Clark, also of DOE. Several of these are open. The K Basin where most of the fuel resides is managed by Mr. Al Colburn, and they're in the process of filling the rest of those positions. So that's the DOE lines of authority, if you will.

Taking that down a little bit further, Mr. Lamar Trego is the president of Westinghouse Hanford Company, and obviously by placing his spent nuclear fuel project at that level, he is indicating the priority he's placing on solving the spent fuel problems here at Hanford.

If I break that out a little bit further, the basins and the operations of the basins are under the project. So it's not like we have a bunch of people responsible for the engineering that aren't kicking the tires every day. No, we've got the basins underneath the project and its operations.

Baseline control, we have an engineering and a systems engineering group. We have a fairly aggressive regulatory interaction and public involvement section. This is the area that I'm responsible for, the technology side. And in a matrix fashion, we have the support, the procurement, safety, QA and those areas.

This is what's really driving us, is our number one priority is protecting the Columbia River and of course the employees at the plant. No discharge from the facility and the site is acceptable. That's the goal we've set. In order to do that, we need to isolate the fuel from the environment, both water that may be leaking to the environment, or air or whatever, and we can do that, we feel, by putting the fuel in safe storage away from the Columbia River. And I'll show you where some of that is at and put that into perspective for you a little bit in just a moment.

The Defense Nuclear Facilities Safety Board who has jurisdiction over this fuel in 94-1, their recommendation is that the program that you have laid out we think is the right one, it's just a little too slow. We want you to accelerate that. And, again, the most important criteria is remediate if you can the K-East Basin fuels and get them off the river. So we've taken that very seriously and we have developed a program that--we've accelerated our program to try and meet that recommendation.

What do we have to do to do that? The basins, as most of you know, have had a history of leaking water to the environment. We need to be able to respond to that in the event that occurs again, develop some plans to quickly respond to that leak. The facilities are old, both east and west basins. They were built to standards that do not--are not consistent with today's standards. The basins have a great deal of sludge, which is basically corrosion products from the fuel, and the fuel is there and I'll show some pictures of that.

So what's important is work with the aging facility, develop plans that allow us to satisfactorily respond to the insult to the environment, and then as quickly as possible, understand what we have in the basin and then what we do to get it out of there.

It sounds easy. In reality, it's a puzzle for us, and this is where the formation of this project I think has made great strides to where we were not very long ago relative to dealing with the spent fuel at Hanford.

At this point, we can go and we can isolate the source term, but we really don't have any place to take the fuel off the river. So that's something the project is working on. This is metal fuel. It's a little unique. You can't use civilian or commercial fuel practices, storage practices for this fuel without first convincing yourself that's the right thing to do for this fuel type. And I'll describe the fuel types in just a bit.

What we do today we don't want to make bigger problems for my child and my grand kids, so we need to think about that in a systematic way, recognizing where there are technologies available in the commercial side, overseas, et cetera, that may help us solve the problem once and for all and not just delay it.

And then the strategy is whatever those solutions are, they need to be sufficiently robust and sound to provide us with a 30 to 50 year storage life time so that if and when this fuel or material would go through a geologic repository, there's sufficient time for us to safety store it before that's available.

Some of the decisions that we need to make; what are we going to do with the fuel and sludge, are we going to encapsulate it, just how are we going to do that. I talked about the expedited removal of the fuel. Again, the fuel is unique and there's going to be--it may be necessary some stabilization efforts that would need to take place before we can just simply take the fuel out of the basin. We're looking at that and what may be necessary to do that.

And then our long-term storage strategy of course has got to be consistent with both the programmatic EIS that's being managed by Idaho, INEL, and then also our own Hanford Environmental Impact Statement.

Let me go on quickly then to some of the technical issues with the fuel, where is it, what kind is it. You'll be following some of these roads tomorrow, those of you that will be going on the tour that's planned. This is the Hanford Reservation, 550 square miles. We're sitting down in here in Richland. This is the 300 Area, 400 Area, the 200

Areas, and then the Columbia River here, and then this is the 100 Area where all of the production reactors were located.

The red is where we have fuel today and where fuel--where the project is responsible for that fuel. We've got some in the 300 Area for research type purposes. We have the FFTF, which is a liquid metal cooled fast reactor that has recently been shut down. It has a large number of fuel elements that we have to deal with. The 200 Area and the T Plant, the burial grounds and then PUREX has a variety of different fuel types, and you'll see those in the next diagram. And then, of course, all the fuel has been removed from all of the 100 Area reactors with the exception of the K Basin. They've all been concentrated in the K Basin, and that's where the fuel is, and you can see it's right on the river. So you can appreciate I think the priorities that we're placing on getting that fuel out of there.

This is what the inventory is, how we describe it. We describe it in metric tons of uranium. The N Reactor, which is the last operating production reactor here at the site, almost 2100 metric tons of uranium. That represents about 80 per cent of the complex's inventory of uranium, of spent uranium. So we've got the majority of the problem as far as atoms of uranium that the complex is dealing with.

The single-pass reactor, which were the other types of reactors, very small, relatively small quantity. The shipping port core was shipped to Hanford. That's stored in the T Plant, about 16 metric tons. As I indicated, the FFTF, the fast reactor, has about 11 metric tons, and then the miscellaneous includes the burial grounds and what's in the 300 Area.

Okay, I'm going to go down each one of these and show you a picture of what the fuel looks like, and then talk about some of the specifics of the fuel.

This is a before shot, if you will, before it was irradiated. The N Reactor fuel, which is of course the bulk of the fuel at Hanford, about 26 inches long, about three inches in diameter, and it's an element inside an element, two cylinders slid together with each of those cylinders containing fuel and cooling water passing on the outside and up through the annulus of the tube in a tube. Each element is about 52 pounds. It's predominantly all of that weight is uranium. There is a thin zircaloy cladding on the outside, but all of the weight is virtually 100 per cent uranium.

The enrichment of this fuel varies slightly, but none of it is over about 2 per cent uranium-235 in total uranium. Its purpose was to produce plutonium, not to do anything else and, therefore, we wanted lots of uranium in there, and you don't need to have a lot of uranium-235 to do that.

Now what I'll show you is some of the other types of fuels in their current condition, and then I'll come back and revisit the N Reactor on what it looks like in its current condition.

This is a single-pass reactor fuel. I'll turn it over. These are buckets that were used in the processing of the fuel through the PUREX and other type facilities. There's a limited number of these elements sitting in K-East Basin. This is an aluminum clad fuel. Again, virtually all of the fuel is 100 per cent uranium. And what you see is some debris, if you will, corrosion products, silt, those sorts of things covering the fuel, and you can see why we're concerned and why we want to do something with it. It needs to have something done with it quickly.

Once the fuel came out of N Reactor, it was very quickly, after it had a short decay period, was sent to the PUREX plant for reprocessing. And what they did is virtually take buckets of these elements that I showed earlier and put them into dissolvers where then it was processed chemically. Only we had some low percentage basketball shooters, and some of them didn't make it into the dissolvers, and in fact they were outside the dissolver laying on the floor of the PUREX. And what you see is these are the fuel elements and then this is nothing that relates to the fuel necessarily, but the way the dissolvers were designed did not provide a lot of splash protection of the acids and so forth, and that's what concrete does when exposed to acids. But there's that fuel sitting there. We need to go find it. We need to find out what it is. We need to retrieve it and we need to take care of it, as we will with the other fuel.

This is the before shot, if you will, a cartoon of what the FFTF, the fast flux test facility fuel looks like, very clean, relatively new compared to the other fuel. FFTF went critical in about the 1980, '81 time frame. There's no fuel older than that at FFTF. This is a stainless steel clad 217 pins stainless steel ducts and clads. That's mixed oxide fuel, uranium and plutonium oxide. You needed that fuel in order for the fast reactor to operate. 76 of these assemblies constituted the core in FFTF, and there are probably three or four cores worth of that at FFTF in the core, and then in the storage basin adjacent to the core.

We also have fuel in the 200 Area burial grounds. This is an aerial shot of how the fuel was containerized and then entrenched in the 200 Area. These are what's called EBR 2 storage casks. They're cylindrical, maybe three feet high storage canisters, if you will. When we were doing a lot of the FFTF development, fuels development program, fuel elements were irradiated in EBR 2 in Idaho. They were shipped over here to Hanford and we did a lot of the destructive examination of those fuels. The result of those destructive exams, sample sizes, sections of elements, sections of cladding, sections of fuel, et cetera, as they came out of the hot cells were then put into these canisters, put on an asphalt pad in the 200 Area and then covered over. So most likely we will have to go get that fuel, retrieve it and then somehow remediate it.

This picture looks a lot worse than it really is. This is taken from a video camera from one of the hot cells that PNL operates. These are buckets of light water reactor fuel, very much like the normal light water reactors around the country. H. B. Robinson provided some of this fuel, and these are just--the large handles you see here are just for the buckets. But there are a number of elements or assemblies stored in the hot cells in air. Those aren't a big problem for us. We just need to recognize they're there and deal with them appropriately.

The last fuel type is Triga fuel. There was a small Triga in one of the fuel fabrication facilities at Hanford in the 300 Area. It was used for radiography. Those elements are still here at Hanford and we're responsible for those as well.

Well, going back to the N Reactor fuel, how do we get into the situation that we're in? This is a diagram that shows the number of fuel elements, if you will, and date starting in 1970 and operating--showing the operations of the N Reactor and the PUREX. And the dark is when the N Reactor was in operation; the dark down here is when the PUREX was in operation. And so what you see is that in about the 1972 time frame, the PUREX, the processing facility at Hanford, was shut down.

Well, the N Reactor continued to operate. It's generating fuel, it's generating the spent fuel, and something had to be done with that. So what I have plotted here is the inventory in the 105-K East Basin and the 105-K West Basin, and then just a total. And you can see as a result of the shut down of the PUREX in 1973 or '72, the inventory in the basins started to rise.

Then there was a short period of time in 1983 where the PUREX was started again. We could then remove fuel from the basins and process it, and that's why the inventories have gone down in that period of time.

Then finally the PUREX was shut down in 1989 and that's why the fuel is where it's at today at these levels, 2100 metric tons.

This is an aerial view of the 100 Area, specifically the K Area. Here is the Columbia River. Here are the two reactors, K-West, K-East. These are the ponds that are currently being used to raise young salmon or fish, and then when they get to a certain age, they're introduced to the river. This is area that is all clean, non-radioactive, has no problem in being used in that capacity.

The radioactive issues are associated with the reactor sites, and attached to the back of the reactors then are the basins. That's where the N Reactor fuel is stored. There is a basin both on the east reactor and also on the back of the K-West Reactor.

This is looking at the inside of the basin. It's a floor suspended from the ceiling. There's approximately four or five feet of clearance between the floor and then the pool of water. So this is how we do work in the basin. We're able to work on the floor, use the cranes and the overheads through these grooves, manipulate the fuel, move it around as we need to.

Here's a cartoon of what that looks like. Again, here's the floor that you just saw, the cranes that we use. The canisters are sitting on the floor of the basin. This water height is approximately 25 to 30 feet, provides us the shielding that we need.

Again, the facilities are old, and so this is not a facility that has a containment around it. It's not a facility that even has confinement. In fact, if you look-- and you'll see this on some of the tours if you go to K-West--that the roof has vents in it and you'll also notice if you were here yesterday that we have a lot of winds, and so we get dust and debris inside the basins that lands on the water, filters down and resides on the fuel.

This is the two basin, two history diagram. This is what the K-West basin looks like, its fuel. You're looking down through about 30 feet of water to the tops of canisters that half of the N Reactor fuel was encapsulated and put in those canisters. The decision was made not to do that in K-East and you can see the difference. What you have are buckets, some are steel, some are aluminum, and inside you're looking at the end of one of those tube in a tube N Reactor fuel elements. You see evidence of lots of corrosion. You see evidence of fuel that has broken apart, et cetera. This is what we need to do, and in an ideal sense, what we would like to do is take this and make it look like this. This water is clean, the basin floor is clean, it doesn't have any of these types of issues associated with it. And this just provides the history of each of those basins.

And what basically happened is we removed all of the water and fuel out of West, went in and put epoxy on the walls, cleaned and decontaminated and filled them back up, and only introduced encapsulated fuel into that basin and, in essence, isolated it from the source term.

TPA milestones that are driving us. I'm not going to read through all of these. I will point out a couple of them, however. Some of the important ones are in the June time frame, now. We are to begin K-East Basin fuel encapsulation. That strategy is being re-evaluated. There are other--the bottom line one here, though, is to remove the fuel and the sludge, and we're interpreting that to mean also the tritiated water from the basins no later than December of 2002.

Again, going back to what the DNFSB have said, we're planning on accelerating that significantly to do what we can to beat that date.

Okay, I provided also some additional technical material. If you would take a section of that and go around, what I'd like to talk about is what our strategy then is for trying to solve this problem.

This is our logic, if you will, and what I've done is looked at both the N Reactor and single-pass reactor fuel as one entity, and then I'll talk a little bit about the other Hanford fuels.

Of course, in the near-term, as I indicated, our encapsulation strategy is being re-evaluated. So there will be some continued storage in the K-East and K-West Basins for the next year or so.

Our baseline strategy then is to process that fuel in some fashion that would allow us to get it out of the basins and get it into some sort of interim storage condition that will provide us isolation of the source term from the environment until we can get a storage complex built that can receive this fuel.

The strategy is not very different for the other Hanford fuels. There will be near-term storage in the conditions that they're in right now for the next year or so. If there's any processing that would be required, that would be done. Ultimately, that then would go to the storage complex that's planned for the 200 Area.

And, finally, there are other nuclear materials that are not fuels, strontium, cesium capsules, et cetera, that most likely will have--the storage complex will be able to accommodate those. And so what we're thinking is that if it makes sense, this is not a decision that's been made yet, if it makes sense, what we'll do is take those materials and put them in that storage complex.

This is where we'll do the 40 to 50 year storage, and then once criteria have been established for how the fuel will ultimately be dispositioned, we'll then push that into that disposition block.

Taking this a little bit more in depth, here is the baseline, the fuels that we have with the existing facilities. We will go through a general evaluation, these are ongoing now, of what it is we need to do to adequately store this. Do we have to process it, the stabilization, passivation, whatever. Transportation is an issue. And what weaknesses or vulnerabilities might there be in our infra-structure that will allow us to either transport the fuel, process the fuel, store the fuel. Those all need to be evaluated.

From that, will come out a general strategy for the N Reactor fuel, and what will be required for us to complete that technical evaluation will be what's called a fuel characterization program. What does the fuel look like, what is its chemical composition, what is its physical condition, those sorts of things. With that data, the result of the technical evaluations and an options study, we will then make a decision on how to implement the removal of the fuel, the storage of the fuel, and implement the project.

Of course, influencing this is the integrated EIS from a national perspective, the foreign research reactor spent nuclear fuel EIS, and then ultimately the Hanford spent nuclear fuel EIS. All of those will influence then the decision and our implementation strategy.

Some of the general concepts that we're considering, this is not a complete list by any means, is to separate the fuel from its neighbors, from other canisters or whatever, and store it, looking again at some integrated complex for storage on the site that would accommodate both the N Reactor and other types of fuels. That's this one here. Storage options; dry cask or caisson, wet, dry. At this point, we're not eliminating any option; evaluating what other sites are doing, Idaho, Savannah River, looking at what's been done in the past and trying to put a laundry list of options together, go through a disciplined systems engineering evaluation of those options and ultimately come up with a recommendation.

Some of the stabilization options are just simply drying the fuel, whether that means evacuating it in a vacuum and allow the moisture to vaporize off the surfaces and within the fuel, or whether to go through a massive process, chemical process where we actually take it from its metal form now into the more stable oxide that you're probably a little more familiar with on the commercial side, or does it make more sense to separate out some of the bad actors from that fuel. All done, in order to provide a better position to store this fuel, not for any separations of nuclear material purposes.

Revisiting it, this is what's driving us right now is to get that fuel off the river and do it as quickly as possible. And we're hearing it over and over again. We're starting to believe it and we're starting to act that way.

How do we get there from here? This is just another way of saying that is take the West fuel, which you recall was on the right-hand side of your picture, a very nice encapsulated, not do very much with it other than to look at it to make sure that if we put the K-East fuel into that same condition, that we're not worsening the situation.

So we'll characterize that, but primarily we're not planning on doing much with it other than to store it in the basin until we can transport and get it off to our storage facility.

The K-East Basin, we're going to have to contain the fuel. Remember, that was on the left-hand side of the picture, contain that fuel, do something with the sludge that lays on the bottom of the basin, and if we follow our baseline, we'll do very much to this fuel what we did to that fuel a number of years ago, store that and then drop down into this box, which is transport and put it into some sort of stabilization or processing, transport that out to our new storage complex. That's where other fuels will come in. And then there's our final disposition option 30 to 50 years from now.

Again, that's easy. You lay all this out in time, and it gets a little complicated. Across the top are the dates. Here are some of the major elements that we have to concern ourselves with, remediate the situation in the basins immediately. What are we going to do with that fuel once we get it out of the basins, and then where are we going to store it? So here's the contained fuel and contained sludge that I showed on the previous diagram, and then store it.

At this point, 2002 if you recall, that was the TPA milestone that we're obligated to get the fuel off the river, out of the basins, if you will.

Well, fuel stabilization, there's not a lot of this stuff around the complex, it's somewhat unique and we've got to develop the process on how we handle that fuel and what we do with it when we get it out of the basins, whether that's to oxidize it, passify it, the other things I mentioned. That needs to be developed and that can be done locally, it can be done by vendors, it can be done overseas, whatever. We need to identify and then develop that process.

Once that's done, then there's a design and construction phase that would be necessary for whatever decision is made. The fuel comes in and then we start the process. The problem is you see that that's not going to be available to even begin processing until about 2003. That's beyond the TPA milestone. Now, I have two options. I can either try and fix this, either accelerate it or go to an alternative, or I renegotiate the 2002. I'm not interested in doing the latter. I am interested, though, in maybe looking at some alternatives to this baseline strategy.

The fuel storage situation is not as much a constraint because we can develop the design and construction of that facility in time to be able to allow us to start storing that fuel once we begin to process it. Unfortunately, the regulatory criterias aren't well defined right now. Is this going to be NRC licensed? Is it not? Is it going to be controlled by DOE? Is it not? So that's why, if you recall my wiring diagram, I had this regulatory compliance in public involvement box. That's an issue that that group is dealing with.

So what are the potential alternatives to this baseline, is to develop some way to expedite the removal of that fuel. And also we have had a number of overseas entities come to us and say, well, here's what we're doing over here, and I think you ought to consider that. And so we're looking at that. There are a lot of regulatory, political policy issues associated with that, of course, and that's what we're evaluating, as well as the technical side of doing something like that.

Let me expand a little bit, though, on this expedited fuel removal, if I could. This is, in bulleted form, the strategy is to look at what existing facilities do we have on the site that might be able to accommodate storage of this fuel, either wet or dry, and see if there isn't--I mean, one strategy would be to take the fuel out and go store it someplace in a PUREX or a T Plant or someplace that's large enough and has the facility existing. And then I would have to move it again once I decided how to process it, or whether I was going to oxidize it or process it or whatever.

Ideally, what you'd like to do is move it to someplace where that same facility could accommodate that processing. So one of the things that we're looking at is the fuels materials examination facility in the 400 Area. It's a large hot cell facility built to current standards, meets all the seismic criteria, et cetera, and is currently not being used. So that's something that we're looking at. Can we store the fuel there and yet have this existing facility that will allow us to develop the process, install and test the process and actually process the fuel without having to move this fuel yet another time.

What that allows us to do then is to get the fuel and the sludge out earlier. We would encapsulate it and then get it out of that basin before the 2002. It doesn't limit us to what ultimate stabilization or storage option that we take, because we're not doing anything different to the fuel. We're just encapsulating it the way it is in the same environment it is today, moving it off the river and putting it in a temporary storage condition while we then go and develop the process that would be necessary to put this fuel in a better condition to store it for the 50 year time frame.

What it does is it takes the stabilization, the storage options off the critical path and does not force us to be in that basin any longer than we need to be. It also then, from a budgetary perspective, we're not obligated to go out immediately and start building a storage facility or a processing facility that we don't know what the guts of are yet because we haven't had the time to develop the process.

This is what it looks like diagrammatically. This is virtually all the same, and this is the Phase I facility, either construct a storage facility or use an existing alternate facility. Here's the fuels and materials examination facility, the WPPSS #4 spray ponds or something we're looking at. We're not limiting ourselves to the things that we're considering for alternative storage sites off the river out of the K-Basin. We think we can get it up and operating by 1997, get it off the river five years earlier than the TPA milestone.

How do we do that? It requires that the NEPA review be concurrent with the facility design. It's not business as usual. Issue a notice of intent on our interim action. We have to secure the capital funding that might be necessary. We've got a fix on what the regulatory criteria are, and then ultimately begin to develop the acceptable retrieval and storage methodology for how we get the fuel out, get it transported to this new place.

This is the foreign alternatives diagram, if you will. It, in essence, requires we build no new facilities, or very few new facilities, has potentially lower life cycle cost because the fuel will be removed from the site, shipped overseas, processed over there, the waste returned to the United States.

The issues, of course, are public involvement--that's not a very favorable scenario in some circles. The shipping issue is certainly not anything that is not without challenge. Institutional barriers, we currently have a policy against reprocessing fuel in the United States. It could be perceived by taking this off to England or France or wherever where they might process it, as a violation of that policy, and it would then also provide us, with these issues, force us to challenge that 2002 date.

What I'd like to do then is to conclude with where we're going and then what do we need to get there. This is kind of our internal milestones, if you will. We're sitting here in the middle of June. We have a number of--well, let me back up. These are safety questions associated with the facility. There are at least potentially two of those that we're dealing with, looking at solving--going through some analyses and determining whether in fact the facilities can accommodate a seismic event. These three, if you will then, are dealing with the basins as they exist today, because under any scenario, the fuel will be there for probably another two to five years.

We want to understand as quickly as possible what the fuel looks like. We had a program laid out for that with the new direction. We've accelerated that characterization program, doing the chemical analyses, the physical analyses, et cetera. As the project, we're going to be going through systems analysis and planning to ensure that all of this makes sense relative to where we need to go. And at the same time, we're plugging into in a very aggressive way in the national program that's being run out of EM-30.

We're not doing too badly so far. We've got a long way to go. The red dots that you see on here are where we're going to require some action by DOE headquarters to make that happen on time. Here's what those are. We need to reprogram some capital funding because we're a new project, we've just begun to start resolving these, and budgets are not in sync yet, so we need to reprogram some capital funds to get us to the point where we can get this interim facility constructed.

We've got some upgrades that are required to the K-Basins as they exist today. We've got to reprioritize in both '94 and '95 some expense funding. We're going to need help in not--or in streamlining the reviews that take place on NEPA and other sorts of things. We have to get some definition between these entities about our facilities and our future facilities, whether the NRC will license it, whether the DOE will control it, you know, how EPA is involved, et cetera.

In all of this, however, we are, to the maximum extent we can, involving the public in the decisions that we make. And we've had a number of public information meetings that both DOE has led and the project has led on the east side of the state, on this side of the state and in Portland.

DR. VERINK: Any questions? Yes. Would you give you name first, please?

MR. CANTER: Howard Canter. When you say to get the fuel off the river, how far? I mean, what order of magnitude are you talking about?

MR. ETHRIDGE: The K-Basins as they reside now are within about 200 yards of the river. Our strategy is to get them to the 200 Area plateau, which help me here, is a couple miles, five miles from the river.

DR. DI BELLA: Carl DiBella; Staff. It appears to me, I might have missed something, as if in your planning, you're not taking into account at all the ultimate deep geologic disposal of the material and, therefore, it is possible that you come up with a solution for your 30 to 50 years that has to be completely redone. Am I missing something?

MR. ETHRIDGE: No, although we can't wait for that. We can't wait for those criteria to be developed for our fuel types and still meet our TPA milestone. So our strategy is to proceed with where we can now--

DR. DI BELLA: I mean, you're not even guessing at what the criteria may be. You're just ignoring it?

MR. ETHRIDGE: Yes.

DR. DI BELLA: Okay. That's the way I read it, yeah.

DR. REITER: Leon Reiter from the Tech Review Board Staff. I wonder if you've done a risk analysis on this, and what are the means by which the radionuclides are getting to the river? I saw seismic mentioned a few times.

MR. ETHRIDGE: We do have wells situated around the facilities that are showing higher than normal concentrations of tritium. There is tritium in the water in the basin. There's no risk analysis required. Tritium is getting into the sand, into the environment.

Now, it turns out that the site has been--has had a lot of activities occur on the--so the data is not conclusive that the tritium that we're seeing in the wells is coming from our water in the basin, but we do know the basin has leaked, okay, significantly. So it's likely that at least a part of that tritium, the source is the water in the basin now.

DR. REITER: So the main source then is just the ongoing leak rather than a disruptive scenario that might occur?

MR. ETHRIDGE: Right.

DR. REITER: Because you--so you're not too much worried about the seismic scenario?

MR. ETHRIDGE: Yeah, the reason the seismic is an issue is because of the way the facility is constructed, a seismic event is predicted to open up leak paths from the basin to the environment. At this point, the basins are not leaking.

Okay?

DR. REITER: Okay. So where is the--where are you noticing tritium coming out?

MR. ETHRIDGE: The tritium is in the ground water that are under the basins that is there normally.

DR. REITER: So something is coming out. I'm not quite--perhaps you could just clarify it.

MR. ETHRIDGE: There are potentially two sources of tritium in the ground water that's making its way to the river. One are the past practices on the site, whatever those may have been, is one. The other is the basins themselves. The basins have leaked in the past. There is tritium there. It takes "X" number of years for that water to get from the basins to the river, and so any past leaks are most likely a source of tritium in the ground water.

DR. DI BELLA: Carl DiBella again. What's the burnup of this material?

MR. ETHRIDGE: I don't know that number in annum percent, but it's very low. I mean, it was in the reactor to maximize the production of plutonium, and then it was taken out, so it's very low, less than 10 percent for sure.

DR. DI BELLA: What happens to the uranium after reprocessing? Where does it go?

MR. ETHRIDGE: After reprocessing?

DR. DI BELLA: Yeah. The spent fuel hasn't been reprocessed.

MR. ETHRIDGE: Right.

DR. DI BELLA: The fuel that has been reprocessed results in three streams, a plutonium stream, a uranium stream and a waste stream.

MR. ETHRIDGE: Yeah.

DR. DI BELLA: Where does the uranium go?

MR. ETHRIDGE: I don't know. I don't know if that went back into the complex's inventory or where that went. That was part of the PUREX process.

MR. HOLGADO: Just a couple of comments, Jerry. Oscar Holgado with DOE. If the encapsulation does not happen, are we going to miss the milestone in June of this year?

MR. ETHRIDGE: I'm sorry?

MR. HOLGADO: The encapsulation is one of the milestones, it's not going to happen in June?

MR. ETHRIDGE: That's right.

MR. HOLGADO: Okay.

MR. ETHRIDGE: That is not an enforceable milestone, by the way.

MR. HOLGADO: Well, I'm just saying because you showed it in the milestone chart.

Another thing is the fuel is submerged is 16 feet, not 25 feet of water.

MR. ETHRIDGE: Okay. Sorry.

DR. LANGMUIR: Langmuir; Board. Jerry, you mentioned that one of the goals of your program is that there be no discharge into the Columbia River. When you say that, do you mean no discharge that you can measure coming out of the facility itself now or--obviously it's coming out of the sediments that contaminate the areas around it.

MR. ETHRIDGE: Out of the facility now.

DR. LANGMUIR: You can't control that.

MR. ETHRIDGE: Right. It's doing what we can to eliminate additional discharges from the facility.

DR. LANGMUIR: Now, you have, therefore, monitoring equipment?

MR. ETHRIDGE: Yes.

DR. LANGMUIR: To identify it and distinguish it somehow from existing material?

MR. ETHRIDGE: No, where we would be able to confirm that we had it from a water perspective is there are level measurements in the pool. So the water level is not changing, we can conclude then that we're not leaking water out. And that takes into account all the evaporation and the models and so forth take those into account. Now, there's a certain degree of uncertainty with that, of course. But that would be our baseline piece of data we would throw on the table if somebody asked are you leaking today, are you discharging into the environment today, our data says the pool is not leaking today.

DR. LANGMUIR: Okay. But what if it does? Have you got other wells positioned between the river and your plant to identify and follow--

MR. ETHRIDGE: Yes, but there is quite a delay time between the pool and the river and the wells. So we would not see that until months later.

DR. LANGMUIR: What's the ground water level under the plant?

MR. ETHRIDGE: I don't know that.

DR. LANGMUIR: It would be at the river level. So what's the elevation difference?

MR. ETHRIDGE: I would say less than 200 feet.

DR. LANGMUIR: The plant is that much higher than the river elevation?

MR. ETHRIDGE: Yeah.

MR. CAMPBELL: My name is Milt Campbell. And in response to where does the uranium go, you asked the question, it was in Don Wodrich's handout this morning, the uranium from the fuel reprocessing was recovered, converted to the oxide and returned to Fernald to be re-enriched and made again into metal to go into the reactor.

DR. DI BELLA: Thank you. My next question is how many cycles can that be continued? Can that be cycled unlimited times?

MR. CAMPBELL; No. There's too much uranium-236 in it.

DR. DI BELLA: Okay, where is that uranium.

MR. CAMPBELL: The storage of that I think was in Frenald.

DR. DI BELLA: Will that go to a repository?

MR. CAMPBELL: Where it goes, I don't think it's called high-level waste, so it would not go to a repository. It would be a low-level waste.

DR. DI BELLA: A TRU waste.

MR. CAMPBELL: No. It's uranium. Uranium is not a TRU waste.

MR. MC LEOD: I'm Barrie McLeod with the M&O. The uranium goes to Fernald and then goes back into the diffusion plants. So U-236 gets diluted by all of the natural uranium going in there. So it does get substantially diluted. So you can probably do quite a bit more recycling than has been done, however, that's been stopped because reprocessing stopped.

By the way, let me add while I'm here, the burnup of the N Reactor fuel I understand is the order of 1000 megawatts per ton.

MR. CANTER: Howard Canter. In the prior history, we needed uranium-236 because we were producing Neptunium-237, which was used in targets to make plutonium-238. So some of that was diverted in a prior life down to the targets for

Savannah River, but all of that's shut down now, so there's no place to send any of it.

DR. BARNARD: Bill Barnard; Board Staff. Do any foreign countries have fuel similar to this, and what do they do with this?

MR. ETHRIDGE: They reprocess it.

DR. BARNARD: Do they have similar problems with long-term storage?

MR. ETHRIDGE: I found out this morning, to my surprise, that in fact the CANDU reactors have had some starter assemblies that were metal, and they have not resolved what they're doing with those yet, quite frankly. The Britts on the other hand, it's my understanding that their Magnox fuel is a metal, and they have had innumerable problems and have come to us and said here's our problems, here's what we think you ought to do and what you shouldn't do. Okay? So I would say the bulk of the experience lies with the Britts and virtually none with the Canadians.

DR. BARNARD: But they don't have a simple solution, I gather.

MR. ETHRIDGE: They reprocess it.

DR. BARNARD: That's the only solution?

MR. ETHRIDGE: Yeah; right.

DR. VERINK: Any other questions? Any questions from the audience? Thank you.

MR. ETHRIDGE: Thank you.

DR. VERINK: Now, let's see, you have an announcement?

MR. LA MONT: I'm Phil LaMont. I'm with DOE RL, and I just wanted to take a minute to run down the arrangements for the tour tomorrow. A tour has been arranged at the request of the Nuclear Waste Technical Review Board. Board members and other persons who have been identified for the tour are listed at the reception table on the back in case there's any question about that.

The facilities that are going to be toured include the 327 building, that's a radiochemical lab in the 300 Area in which spent fuel, commercial nuclear fuel oxidation experiments are being done, the fast flux test facility reactor, the waste encapsulation and storage facility and the K-West fuel storage basin. The tour will be divided into two groups of approximately twelve people apiece. Each group will leave the Tower Inn by bus in the morning and be returned to the Tower Inn in the afternoon. Group A leaves at 7:15 a.m. and returns at in the neighborhood of 3 o'clock in the afternoon. Group B leaves at 7:45 a.m. and returns at 3:40 in the afternoon.

Each group will be accompanied by an escort. I want to take this opportunity to identify them. Dave Langstaff with DOE RL, if you could stand up, will be escorting Group A. And Milt Campbell from MACTEC Corporation will be escorting Group B. There is a blue information packet like this in the back. It contains an itinerary, a list of attendees and some general information about Hanford, including maps so you can keep yourself oriented.

Lunches will be provided. They're scheduled in the itinerary. I don't know the exact cost. I think they're like $5.00 or $6.00 apiece. It's a nominal cost. And they'll be delivered to the lunch rooms for each group as scheduled on the itinerary. Let's see, I guess about all I can say is casual clothes are appropriate, but these areas I think are fairly clean that you'll be going into and so I don't think you'd need to worry about losing any shoes or suits or anything like that. So if you don't have casual clothes, I think you can still go.

Are there any questions?

MR. PRICE: What were the departure times again?

MR. LA MONT: Yeah, pick up one of these blue packets in the back. For those of you who are going on the tour, the departure time for Group A is 7:15 from the lobby here, and the departure time for Group B is 7:45. The reason we do that is because the first stop is the security facility in the 300 Area where you'll pick up your badges, and it's easier to process people on a staggered basis, so there won't be as much standing around and waiting.

Thank you.

DR. VERINK: Unless there's some other business, we might go ahead and take our break now and reconvene, I guess we're three minutes off from it anyhow, so let's get back at 2:30.

(Whereupon, a recess was taken.)

DR. VERINK: Our next speaker is Dr. Howard Canter.

DR. CANTER: I'll skip through some of this rather rapidly because there's a few things that I want to mention that aren't on these charts and I think you'll find interesting.

Eventually, I'm going to get to the point where I'm going to concentrate with a few view graphs on what extent the disposition of surplus fissile materials, what impact that might have on the repository program. But that's later on.

This little history, most people know this, you know, some rather strange events happened in the last four or five years, starting with the Berlin Wall falling and the plutonium reactors shutdown at Hanford and Savannah River. They didn't shut down because the wall fell, but these events started cascading. In September, 1991, President Bush announced a unilateral arms reduction on the part of the United States, which effectively cut in half the future stockpile of nuclear weapons.

Nunn-Lugar is important because it has to do with what we're doing with the Russian Federation. Nunn-Lugar is a term that refers to some money that has been authorized, it's $400 million a year, by the Congress, and it's put in the hands of the Department of Defense to help the Russians disarm. So it has to be tied to that. The money's predominantly spent in the United States for equipment, for technical assistance and things like that. They've authorized 400 million in fiscal '92, 400 million in '93, 400 million in '94, and the mark that I saw on the appropriations bill for '95 has another 400 million.

Not a lot of it has been spent because it's been very hard to get agreement from the Russians on what to do. They have as big a bureaucracy as we have. But this is very important because it has to do with the non-proliferation.

In the State of the Union message in January, 1992, President Bush announced that he had terminated all warhead production. We still had warheads to produce for the Navy, the W-88's for the Tridents, and that was truncated in midstream and it was never resumed.

Nuclear Testing Moratorium began in 1992. START I was ratified. There was, in early '93, there was a Clinton/Yeltsin summit. There was a Gore/Chernomyrdin--Chernomyrdin is Prime Minister of Russia--and agreement, had some agreements to do with this.

In '92, there was a Bush/Yeltsin agreement which eventually was codified at START II and is now in the hands of the Congress for ratification. The Bush/Yeltsin agreement made a further cut in the forecasted stockpile by about 50 per cent. So there were two 50 per cent cuts which meant that the forecasted stockpile was down to 25 per cent or less than we had when all this started around 1991. Now, that's a lot fewer bombs, which means there's a lot more materials left over, and that's really the story on that.

Last September, President Clinton issued a policy directive and it was--it had to do with non-proliferation, and that's the concern, because with all this excess material, the question is will some of it fall in the wrong hands. Our main concern, in the words of the National Academy of Science, is a clear and present danger of this. Everybody has read in the newspapers how concerned we are over North Korea, and North Koreans may have separated out enough material for a couple of bombs. How would you like enough material for 15 or 20,000, and that's what's going on in Russia. So that is a danger and we're working very hard to do some thing with the Russians.

So the President issued this directive, and it's a comprehensive approach, goes everywhere from export controls to setting up all of our surplus material unilaterally and voluntarily under IAEA inspection on the basis that if we can do it, we can then get the Russians to do it. We're not really worried about ours being stolen. We have pretty good security on it. What we're worried about is the material in Russia. And I explained to somebody before that the old Soviet Union had some very interesting features. It was a devil that you understood. It was very predictable. And they had a terrible material control and accounting system, almost non-existent, but boy they had good security. You move a little material from one room to another, you got a bullet between your eyes. The security is all gone.

Somebody told me they visited a commercial nuclear power plant out there in Russia and the guard went home at 4 o'clock. That's when she went home, and there wasn't any guard all night and the government facilities, the non-commercial facilities, aren't much better. The weapons ones are still pretty good, but some of the research institutions and stuff like that are terrible.

The President tasked an Interagency Working Group to initiate a comprehensive review of long-term options for plutonium disposition. And this interagency working group has been set up. DOE has really the responsibility for the technical side of that because that's our mission. This joint Russian/U. S. Summit Statement that came out of the Clinton/Yeltsin, they're going to work towards an international verifiable ban on the production of fissile materials.

Right now, the Russians are still producing weapons usable fissile materials, and there's some reasons for that. They happen to have three reactors that produce plutonium, but they're dual purposes reactors. They also produce electricity and process steam for heat. They use district heating in places like Tomsk. It's pretty cold there. They need the heat, they need the electricity. We've asked why don't you stop reprocessing the spent fuel. They can't because their fuel, they have about six months storage for spent fuel. The fuel has a very thin aluminum shell. It won't hold up. I think if you think the pictures you saw today were bad, probably that stuff is worse if you left it in water for a long time. So they're continuing.

We are working with the Russians, the Department is, to try to get them an alternate source of power and heat, and they've agreed as soon as they have that, they'll shut those reactors down and stop the reprocessing.

There's some other agreements. One of the things that was agreed to is to set up a joint working group to try to set up some IAEA safeguards on fissionable material, and they task their relative experts to do this joint study on long-term disposition of particularly plutonium.

In recent months, there have been three major studies; the Office of Technology Assessment, which is an arm of Congress, took a look at this issue, particularly the plutonium, the Rand Corporation, and the National Academy of Science. They differ somewhat, and there are some differences here. The OTA looked more at the institutional issues in the United States Government than the other two. The Rand strictly looked at plutonium.

One thing that's very interesting is this line. OTA said we should jointly study disposition options for plutonium with the Russians. The National Academy of Science said it's a clear and present danger. The U. S. should take action on its plutonium to set the model for the world. And Rand says we ought to go buy the Russian plutonium. Rand may be right, except I don't know where we're going to put it. But that's a problem we could worry about if we could actually buy it from them.

And then there's some other differences here. There is another thing that's of great interest, because a lot of people are interested in nuclear power. OTA didn't address this. Rand said plutonium basically doesn't have any value in the United States. The National Academy said it really has negative economic value. And that's really based on the fact that using mixed oxide fuel, once through without reprocessing, is more expensive than using uranium fuel. It's that simple. It's more expensive to fabricate the fuel.

The Secretary, in response to this problem, set up a group of people, of which I'm one, and Bill Danker sitting over here is another member, and this is the charge that we got. It created a project, the project reports to the under-secretary. We're going to direct setting up methods of safe, secure, inspectable storage. We've commissioned a vulnerability study that we're paying for that's similar to the spent fuel vulnerability study that was issued last year. Maybe some of you have seen it. Some of the pictures of the spent fuel that we saw just a little while ago are in color in that vulnerability study and it's rather interesting to look at it.

What we're talking on with that, first is to look at plutonium, and to look at plutonium in every place it's stored. There is plutonium stored at Hanford, Idaho, Lawrence Livermore Laboratory, Los Alamos Laboratory, Savannah River, Rocky Flats, there's even a little bit at Oak Ridge, and it's in various forms. It's in oxide, it's in metal, it's in pits which came from weapons. That's a component of a weapon. It's in scrap, it's in residues. There are some liquids. Some of it's unstable, some of it's very stable.

Plutonium is not like uranium. It's a very reactive metal. Plutonium in contact with air oxidizes very rapidly, and the oxide has a larger volume than the metal, and as a result, I've seen cases of failed containers that were welded shut and were ruptured when the plutonium oxide, there was a pinhole leak and air leaked in, and as the atmospheric pressure changed, it sort of cycled pumped air into the container and then ruptured the container.

Plutonium also hydrides very badly. So if you wrap it up in a plastic and you get some radiolitic decomposition of the plastic and produce some hydrogen, you'll get a rapid hydriding of the plutonium and that's followed by a rapid oxidization and you've got peanut butter basically. So it's a very difficult material, but properly controlled and properly stored, it can be very safe.

We're supposed to promote effective non-proliferation policies and set an example for other nations. We're going to operate in an open and transparent manner and develop consensus. And like I said, the project reports to the under-secretary.

The first thing we have to do is identify what's excess, and we have to confirm the inventory. There was an interesting article in the front page of the New York Times about two or three weeks ago where Tom Cochran, who some of you may know from NRDC, said that we were missing one and a half tons of plutonium. And that can give you quite a headache if you made bombs out of it, and the problem is that the current state of the art inventory systems weren't put in place until the late 1960's. So what went on before them was somewhat approximate.

But there's a lot of work going on to straighten out the inventory of how much plutonium did we make out here and at Savannah River, how much did we acquire by other means. For example, when West Valley was processing commercial spent fuel, the Department took the plutonium from there. It didn't go into the commercial world. So we essentially bought it. And then how much do we have in the inventory and where did the rest go. We blew a lot of it up in the desert, and one thing about the laboratories, they have very good records on how many atoms of plutonium were in each device, so you can add all that up, and that's a few tons. And some ended up, you've heard stories about the plutonium in the ducts at Rocky Flats, and some is in the ducts, there's so many kilograms there, and some ended up in solutions in waste and so forth, and some of that may have to be estimated. But we've got to account for all this.

The next thing we have to do is identify with the Nuclear Weapons Council, and this is based on how many weapons we're going to have and a strategic reserve that we will maintain, how much plutonium will be kept in reserve. For HEU, Naval reactors uses it as fuel, and they're one of the bigger users of highly enriched uranium. So there's Naval reactors requirements. There may be other program requirements.

After we've identified that, everything else is surplus or excess, and that's what we'll be dealing with. Some of the excess may still be in classified shapes, so we're working out methods that could be used for international inspection without revealing the classified information. And if you want to see an interesting session, you ought to see ten laboratory people in a room together, and you've got ten squared ideas on how not to do that.

Now, even some of the material held for future program needs we may put under international safeguards. You know, it's rather interesting with this material; in the 1940's, Bernard Baruch suggested that an international bank be established for plutonium and highly enriched uranium, and nations could deposit their material in it and draw it out when they needed. And you know something? That was a pretty good idea. I don't know where the bank branch would be, but that may be something we get back to. Yes, Switzerland. Put it at Fort Knox.

The transparency is very important. All the agreements in the world aren't going to mean anything if we don't have confidence in those agreements. So transparency, which really means the ability to see what's there, for the Russians to see what we have and for us to see what they have, and maybe expanding that to other nations eventually, is extremely important.

So we are unilaterally, as I said, making some surplus materials available to International Atomic Energy Agency inspection. We're beginning this with Vault 16 at Y-12 down at Oak Ridge, and we're putting some highly enriched uranium in there, and that's supposed to be ready by September. And other sites will follow, like for example there's a vault being looked at out here on the Hanford Reservation for this. And over a period of several years, we will eventually get most of this surplus under international inspection.

Now, the program we've got, I always eventually get to this, and this isn't really as bad as it looks. It's copyrighted, though, because I've sold it to Milton Bradley for a board game. But I want to explain what this program is, and I'll just quickly run through this. We've got a bunch of ongoing activities; there are technical studies, there's criteria development. We've put together a National Environmental Policy Act strategy, and we've got work on non-proliferation.

I mentioned that we're doing a material vulnerability study. The first part is plutonium, and that's supposed to be finished this fall, and then we're going to look at highly enriched uranium, we're going to look at how the uranium-233 is stored, and we have some of that. And by the way, that has a pretty low critical mass; outside of the health physics problems in handling it, it's a weapons usable material. And there are some other cats and dogs, like Neptunium-237 and Americium-241 that we've got.

So we will develop these vulnerability analyses. Out of that will come corrective action. At the same time, we're developing plans for this international control, these inspections. Out of that may come corrective action, because you may have to rearrange materials, you may have to segregate material in a vault or move it around, and that's going to dictate an interim condition, and that's what I call the safe controlled, inspectable interim storage.

At the same time, we're going through a process, both an EIS process and a technical process, to reach decisions on two basic areas; long-term storage beyond the interim of all the material, not just the surplus, and disposition of the surplus. Now, some of it is easy. The easiest thing to do with highly enriched uranium is blend it down to low enriched uranium and then you don't have the proliferation risk, and you can also sell it and that covers at least your cost of doing that. So you get it down below 20 per cent where it's not of concern of proliferation of nuclear weapons, and we could sell it and feed it into the commercial fuel market over a period of time.

By the way, we're also buying 500 tons of Russian HEU that will be blended down over in Russia and brought over here and the Uranium Enrichment Corporation will be selling that for the commercial fuel market. I think it's over about a 10 or 15 year period.

Now, the biggest problem with that deal is working out the details of how do we verify that the stuff they're blending is really the HEU that came from the weapons. That's important because, one, that verifies that they actually dismantled weapons. The other thing is even if it was other HEU, it would be at least reducing their inventory, but we wouldn't be knowing that it came from weapons. They're doing this in a plant where they produce low enriched uranium, and how do you know it isn't just the UF6 coming out of the pipe from the low enriched and they're really in this other room saving the HEU.

So these details are in the process of being worked out; how do you sample, how do you inspect, and this is tough because they don't necessarily want us in all this stuff. But, you know, as part of the deal of buying it, we've got to be able to verify that that's the source of the material.

We are going through some studies and feasibility studies, and we're going to go through a screening process over the next four or five months, and we're going to throw out some of the crazy schemes. We have also started a process to produce a programmatic environmental impact statement on long-term storage of all the materials. It will weigh the alternatives for that from an environmental point of view, and disposition of the surplus. The notice of intent for that PEIS should be in the Federal Register next week. It's all been approved.

We have a series of studies under way and we're starting this PEIS. Ultimately that will lead to a record of decision, which is what ROD stands for, and that's on the long-term disposition options and the long-term storage options. It also may dictate that there's further development needed for some of the long-term elimination options, because most of the things that are available to us today are alternatives or options that don't necessarily get the plutonium off the face of this earth. They may change its form, and from a proliferation point of view, that's a good thing to do, particularly if the form is substantially and inherently more resistant to proliferation or diversion of the material.

We are working, in fact we had a meeting a couple of weeks ago over in Moscow with the Russians, and some of this we're going to study jointly, with the idea of developing some things where we'll have reciprocity. They'll do them and we'll do them. It's going to be difficult because the Russians really want to save all their plutonium and use it in breeder reactors and we don't want to, so we're at different ends of the pole here. So there's a long road ahead, but they agree to at least start investigating this.

The concern in Russia, frankly, is the instability of the nation. There was a recent article, a series of articles in the New York Times on the Russian army, and I don't know what people earlier this year--the Russian army is getting down to like 1.1 million people, 600,000 officers and 500,000 enlisted men. Now, there's a reason for that ratio, and that is that all the enlisted men are draftees, they're all conscripts and in Russia nobody pays attention to the laws, they don't go. And the officers refuse to get out of the army because there's no place for them to live and no jobs for them, so they've got 600,000 people, officers, who have the wherewithal to divert material.

And the author of this article said he visited a base where their crack airborne division was based, I guess the equivalent to our 82nd airborne or the 101st airborne, or something like that, and they had rice gruel for lunch, and they were taking the army vehicles into town and selling fuel out of the tanks so they had enough money for food. So you start to have nightmares about when will some of these people say, hey, I can sell plutonium to Muammar Qaddafi. I can get millions of dollars for it, and that's the scary party of this. So we want to get control of their material. We can't just walk over and take it; we've got to get them to do it.

We are helping them under this Nunn-Lugar and we're setting up material control and accountability systems for them and going to teach them how to do that, and providing equipment for that. We're helping them design a storage facility for highly enriched uranium, in fact, it's now two storage facilities, and plutonium, that they're going to build one in Tomsk and one at Mayak, which is in Chelubinsk area. But it's a real problem. So this is an effort that essentially we have underway.

The scope of the disposition options, and I'm talking about plutonium now, I mentioned that uranium is a lot easier, is first of all storage. We're looking at a no action alternative. We have to. And that's where it just stays where it is for long-term, upgrade in place, and those upgrades would really be to improve the ES&H capabilities of the storage. Some of the storage facilities around the complex you can't upgrade them to meet today's standards; they can't meet the seismic, for example. You'd have to build new.

Now, the National Academy of Science has an excellent report and I recommend it to people, and they established a standard; Meet the Spent Fuel Standard for plutonium. And that's because 80 per cent of the world's plutonium is in spent fuel, so the separated stuff is only about 20 per cent. And there are three areas that we're looking at on meeting the spent fuel standard, one is actually using it as mixed oxide fuel in reactors, another is immobilization, and the other is deep geologic, like deep borehole disposal, and then there's some things beyond the spent fuel standard.

I want to talk a little bit about this because this affects--could affect the repository. If we were to select a reactor based technology, the spent fuel from those reactors would have slightly different characteristics than uranium spent fuel. So we're going to fund some studies on the part of the Civilian Radioactive Waste Program to identify what the repository impacts would be of using plutonium as mixed oxide fuel in reactors. And our preference is to use existing reactors, so it would be replacement spent fuel, not additional spent fuel. If we can't find any existing ones, then there may be new reactors.

The same thing with immobilization; that's vitrification in glass or in a ceramic or something like that, what's the waste form and what would be the impact on the repository, whatever repository. So we're going to work with the Civilian Radioactive Waste Program to do that.

The deep geologic disposal, the deep borehole, is being studied. The Academy said they didn't know much about it, but it ought to be looked at, so we're looking at that.

Beyond the spent fuel standard is basically alternatives where you almost completely either fission or destroy the material and leave a very small amount of residual in the waste form. But the interesting thing is no matter what we do with it, there's a waste form and eventually that waste form has to go somewhere. So I think it will all be studied for what happens to it in the repository.

Like I said, I skipped over some things. If there are any questions, I'll be happy to answer them, unless you want me to hold that for later.

DR. VERINK: Are you ready for a couple questions?

DR. CANTER: Sure.

DR. VERINK: Are there any questions?

DR. LANGMUIR: Langmuir; Board. I understood that the Nuclear Energy Agency was being funded and was concerned about reactor safety and operation and payment of reactor employees, that sort of thing, in the USSR. Is this something that we are working on? How are we dealing with this? Is your group at all involved with that?

DR. CANTER: No, our group isn't involved in it, but the Department is. And there's several initiatives to help the Russians with the safety of their reactors. One's called the Lisbon Initiative, and it's actually managed under the Nuclear Energy part of the Department, and Brookhaven Laboratory has the lead on that, and it's trying to--and there's a number of U. S. firms involved to design safety improvements to the reactors. The RMBKs, which are like the

Chernobyl reactor, there's a tentative agreement on the part of the Russians to shut them down eventually. We don't have dates. So they're not going to do much with them. But like the VVR 1000s, which are PWRs, they're not bad reactors, they need some substantial improvements.

There is one glitch in that. If you do work and you design something in the United States for a reactor, your liability is limited under Price-Anderson. If you do work in other nations, they have something similar in the Western world. The Russians don't have any such thing, and they also don't have a treasury, so nobody would believe it anyway. So the U. S. firms that have been involved with this have all stopped work because something has to be done, because if you have an accident in Russia like Chernobyl, which was in-- which is now the Ukraine, but you know that was picked up in Denmark and your third party liabilities could be extensive, they could be infinite and, you know, companies like Bechtel and others, they've got assets and they don't want to lose them. So the government is working on trying to set something up to underwrite this so they can get on with this work.

DR. DI BELLA: Carl DiBella. Is there a time table for the government making a decision on what the preferred way of disposing of plutonium will be?

DR. CANTER: Yes. Let me run quickly through the time table. Like I said, the notice of intent for this programmatic environmental impact statement will be published in the Federal Register next week. We're going to have a four month public scoping period and solicit from the public what alternatives should be examined and what are the issues, like is usually done on these things. That will close about the middle of October.

In the meantime, we're starting to gather the data. We have some technical studies underway to provide information, and we'll be shooting for publishing the draft programmatic environmental impact statement for public comment next summer. We will identify in that draft the preferred alternatives. There will be a public comment period on that, with the objective of finalizing that PEIS by March of '96, with the record of decision in April, 1996. So we're talking about the spring of '96.

Now, if we can figure out ways to do it quicker, we'll try to do it quicker. But those of you that have been through a NEPA process, you know that that has a life of its own. And we want to do it right. The decision maker may not be the Secretary of Energy. The Secretary of Energy may just make recommendations. The decision maker on this may be the President.

DR. VERINK: One more question before we go to the last speaker?

DR. LANGMUIR: You mentioned and we're all aware that 80 per cent of the plutonium is in spent fuel. It's obvious we want to protect ourselves from proliferation with plutonium that's already plutonium as such. But the technology for getting that plutonium out of spent fuel is not very complex, is it? Wouldn't it be--isn't there just substantial risk in spent fuel as a potential source of plutonium for proliferation?

DR. CANTER: Yes, there is. The policy statement from the President has some language about this. It basically says we will not encourage reprocessing of spent fuel. But then it recognizes that some of our trading partners, like the United Kingdom, France and Japan, are either reprocessing spent fuel or planning to reprocess spent fuel. And so it's somewhat almost an internal conflict in the policy statement.

The United States has had a policy since 1977 for not reprocessing spent fuel. An effort was made in the early Eighties to get that reversed and it was slam dunked pretty hard. Getting the Japanese not to reprocess spent fuel, or the French, is a monumental task. But the one thing we can say is that the United Kingdom and the French and the Japanese have good safeguards on it and they do have inspection and they do have controls over the material and they do have good accountability. So you don't have to sit up at night and lose a lot of sleep on it. It is a concern.

We are not proposing any option to get rid of plutonium that will involve reprocessing of spent fuel, because it's not our policy. Now, putting the plutonium in spent fuel, if the Russians would do that, still requires some safeguards to make sure that in the dead of night, they're not taking the spent fuel and running it through their reprocessing plants. And they have extensive reprocessing plants, far more than we have, so it still requires some institutional barriers in the form of safeguards or IAEA inspections to make sure they're not doing that.

DR. VERINK: Thank you very much. Dr. Sareen?

DR. SAREEN: My name is Sareen and I work for the M&O, and what I'd like to talk to you about today is the RW proposal for studying the feasibility of taking converted plutonium and final disposition in the geologic mined repository.

As Howard showed in one of his diagrams, the total system essentially looks like dismantling of the plutonium, interim storage for a period of about ten to twenty years, conversion of the plutonium by one of several methods, the reactor method and the immobilization that Howard talked about, and there is some talk about using accelerators, although that's not very high on the priority list, and then final disposition either through a geologic--in the geologic media like the mined repository, or the deep borehole disposal.

We have, in order to accomplish our job, we have several interfaces with some of the other components of the entire system. We have some physical interfaces that relate to the waste form characteristics that have to come in either through the reactor burnup or through the immobilization form. We need to know the isotopic composition, the physical and chemical characteristics. We need to understand the mode of transportation that the fuel is going to come in in, know what the containers are going to look like, and this is both the cask as well as the containers. And we also need to know the quantity, the rate and the schedule at which all of these things are likely to show up.

We have certain administrative interfaces that are related to the materials control and accountability and safeguards and security that we have to worry about from a plant design point of view. And, clearly, the regulatory/statutory issues associated with handling plutonium, and I'm going to talk about that more in a second.

The interface philosophy that has been established on this project, which is the Nuclear Materials Disposition Project, is that there will be certain requirements that will be imposed upon the geologic disposal component sub-system of the total system. However, there will be certain requirements that the geologic disposal will levy back onto the front end of the system, and this will be an iterative process to ensure that both the front end and the back end are compatible and are in a workable situation.

From an organizational point of view, the nuclear materials project has assigned Sandia the lead for the technical integration on this whole project for them. They are producing an interface control document and our requirements are feeding into the ICD, and Sandia will facilitate the technical interchanges between the various facilities.

The work as we see it is primarily driven by the PEIS and the record of decision, which is to occur in April, 1996, with the initial data flow for the PEIS starting around the end of this year, November, December, January time frame.

We have several tasks that we have identified that we believe are necessary to support this record of decision and the PEIS. One is essentially a systems engineering task which looks at all of the alternatives and things of that nature, to develop the issues and assess the impacts, develop some of the interface requirements, perform some sub-system, that is the geologic repository being a sub-system, level analyses, and integrate all of our other functions.

The message in this task on the regulatory task is essentially what are the current statutes and regulations, and do they have any special issues associated with the disposal of plutonium. If they do, we need to identify them and recommend some mitigating measures.

Second, look at other regulations that are specific to handling of plutonium and see what additional requirements they levy onto the system. And the NWPA esse••••••••••••••••ke sure that the Nuclear Waste Policy Act permits the disposal of plutonium in a geologic repository.

The design and operations task essentially is based on evaluating the impacts of the waste forms. And criticality is really one of the biggest issues that we have to look at. We have to look at--we will compare all of these designs against the existing designs, some baseline design for the repository right now, establish cost and schedule impacts, and generate the data that will be needed for the performance assessments.

The performance assessments will be done and conducted in two categories; one is the long-term prediction of the waste package, much like we're doing right now, and the other one would be the total system, that is, the repository as a whole, based on the new waste forms.

And the comparison will be, for lack of anything better right now, against Table I, or 40 CFR 191, and any other plutonium release limits that EPA and other regulations might impose.

That's essentially the scope of the work that we will be performing in support of Howard Canter's efforts.

DR. VERINK: Any questions or comments from the Board?

DR. DI BELLA: Carl DiBella. I've got a question about criticality. Do you expect if you, in analyzing the MOX option, that the criticality concerns are going to be significantly different than normal spent fuel concerns?

DR. SAREEN: That's one thing, Carl, we have to look at. The increase in plutonium probably in order of about 6 per cent or so probably in the MOX fuel versus about 1 per cent, and to tell whether or not that causes a problem (a) during the design of the waste package. Second, and more important one is, what happens with time. And this becomes perhaps an issue if we have vitrified logs, the glass logs. If there is leaching of the glass and there is a concentration of plutonium, we would need to know that up front.

DR. CANTER: I want to add to that. Howard Canter. I want to add to that a little bit because the vitrification option has to be studied and some experimental work will have to be done. The vitrification work that's been done by the Department is pretty much to vitrify wastes.

For example, we do not know exactly how much plutonium we could dissolve in the matrix of glass, and it hasn't been experimented on this, and to what form we have to convert. We have plutonium in metal, the bulk of it is in metal, and you just can't throw that in a pie. Some people think it will be very easy to just go vitrify it down at Savannah River, but the melter down there is too big. We would turn it into a reactor. So we have to go to a much smaller melter for criticality control. We don't know what the integrity of the glass form would be and what weight percentage of plutonium we could add to glass and still have it good. There's a lot of work has to be done with this, and that will lead to providing information to look at what happens in the repository.

I think with regard to the spent fuel from MOX, if I take the nominal 4 per cent as plutonium oxide in place of the essentially the 4 per cent enrichment of U-235 oxide, and you can make some assumptions on the per cent burnup, but what you'll have is maybe half of that left in spent fuel. You'll still get production of plutonium in the U-238 component, so as I said, we're not necessarily getting rid of the plutonium by doing that. We're changing its form.

And the other interesting thing with that is that we're adding--that form will have an inherent level of radioactivity, which is a barrier to diversion of the material. In the vitrification option, we would get the radioactive material that we'd want to mix it from from the high-level waste that we've got. But one of the problems is that high-level waste is getting old. Some of the stuff at

Savannah River, by the time we're doing this, will be 65 or 70 years old. We've gone through two half lives of cesium. So we may have a shortage of good clean high-level waste to do that, but that's the kind of thing, and when they talk about systems analysis, you really have to look at it as an entire system when you're looking at these kinds of options, because it's not quite as simple as a lot of people think.

DR. REITER: Leon Reiter; Staff. Sareen, both you and Howard mentioned the idea of deep borehole disposal as opposed to geologic disposal. Could you give us some idea of what is meant by this, who proposed it, what the rationale was?

DR. SAREEN: I'm not the right person to talk about borehole disposal. Perhaps Howard can address that. The rationale I believe is, as Howard pointed out earlier, that it was almost like an after thought in the NAS report that said oh, but maybe you ought to also look at the deep borehole disposal.

DR. CANTER: The description by the Academy of deep borehole disposal is where you put the plutonium, and you don't convert it to a glass form or something like that, but you put it in some suitable canister in a deep borehole that may be four to six kilometers deep. And this has been looked at in Europe, by the way, and so we're not the first ones. But the Academy are the ones who recommended that we examine this. We're taking a look at it. We're using the laboratories in the same manner that they were used on this program; I think Livermore looking at the engineered barrier and Los Alamos looking at the far field, and to try to see whether this is worthwhile investigating further. This may not go beyond our initial screening process.

DR. LANGMUIR: Langmuir; Board. I read some ten years ago in the Russian literature that they were proposing, since they're the masters of deep holes in the crust, of putting their nuclear wastes down at 30 to 40,000 feet and pouring lead in the hole afterwards as a way of getting rid of it. It's a fairly expensive approach, but I don't know whether they did any work on it.

DR. CANTER: I don't know. That will probably be one of the things we find out in dealing with the Russians, how far they've gone, and we may learn a lot from them.

DR. VERINK: Any other questions from the Board? Staff? Anybody in the audience? Yes. Give your name, please.

MR. BARNARD: I'm Ralston Barnard from Sandia Labs in Albuquerque. This may be a stupid question, but I'll ask it anyway. With regard to the reactor conversion, I'll say, or treatment of the plutonium, do you envision some type of refabrication process which takes all these different shapes and physical forms and stuff like that, and somehow subjects this plutonium to reactor or radiation and then it is available in its irradiated form for disposal in a mined geologic repository or elsewhere?

DR. CANTER: The reactor option, obviously in looking at that option, it's not just the reactor end of it. It's using the plutonium as mixed oxide fuel in reactors, and since most of our plutonium is in metal shapes, we'd have to have the capability of converting it to oxide that meets the fuel spec. We have to have the fuel fabrication facility, and I found it very interesting that Jerry Ethridge is looking at the FMEF to store spent fuel in, because we were thinking of looking at the FMEF, which has a fuel safeline, which is a fuel fabrication capability. I think it needs a lot of work, but that's okay. I guess the first one who gets there can have it.

But there are commercial interests who, if they're assured of a long-term contract, would build fuel fabrication. But in looking at it again, you have to use a systems approach and take a look at it from beginning to end, and the back end is what do you do with the spent fuel, and the spent fuel is part of the spent fuel to go to a repository. But even the front end is substantial.

DR. VERINK: I'm going to make a firing line change on the schedule. I'm going to suggest that we defer the break and do the comments from the audience now. And then we'd take--do this for a half an hour and then take the break. It will allow us to rearrange the auditorium for the closing round-table discussion. Is that all right?

MR. HONEKAMP: John Honekamp with SAIC. I just have kind of a followup comment to the response on the question of criticality on MOX fuel. I've been involved in the studies Howard mentioned on using MOX fuels in existing reactors, and to a first approximation, most of those studies are looking at taking the fuel to the same burnup you do now. And at that point when it's discharged, you're usually getting about 60 per cent of your fissions from plutonium, because the uranium has been converted. So that's in a normal uranium fuel cycle.

Under those conditions, when you discharge that fuel, it will not look much different from a criticality standpoint than the normal fuel that you're getting, either isotopically or total fissile content. So, I mean, it's not a totally definitive, but it's been looked at and it is essentially the same, and it gets rid of--that process gets rid of, as Howard said, not all the plutonium, but it gets rid of about 40 per cent of what you net, net reduction in plutonium. So you're still left with about something like 60 per cent.

MR. JOHNSON: Carl Johnson with the State of Nevada.

I'm going to follow up a little bit on I think it was a question that Bob Cook from the Yakima Nation asked this morning, and I'm going to come at it from a little bit different perspective.

In the opening remarks that the chairman made this morning, he asked one question that's also contained in the announcement for the meeting, and that is how could surplus weapons plutonium potentially affect plans for high-level waste repositories. Well, he went on to say that there is only one high-level waste repository under consideration, and that's Yucca Mountain. Yet in the two presentations, we heard nothing that referred directly to Yucca Mountain. But I'm going to say that from the State's perspective we do have concern about plutonium as well as other materials as they might affect a repository.

We have access to plans from both Rocky Flats and from PANTEX that specifically identify the Nevada test site as the location for disposal of their plutonium. That has really caused the State some concern as to what type of geologic disposal is this going to be. Is this going to be part of Yucca Mountain or is it going to be disposed somewhere else on the Nevada test site, such as deep boreholes which we just heard about?

That has led to our governor communicating with the Secretary of Energy as to what is going on here relative to geologic disposal. Are we looking at possibly two geologic disposal sites on the Nevada test site, or are we just heaping more into Yucca Mountain? And that kind of leads to what the governor has asked for, and that is that we need an overall programmatic EIS document that describes all of the disposal activities that are going to take place on the Nevada test site.

And, of course, then that brings in what Bob Cook says that we need a more coordinated set of EISs that also bring in what Hanford is doing, what Savannah River is doing, and all these various other things, because they all fit together into a very coordinated or at least into an overall picture which seems to be emerging, and what I think my comment is that I would encourage the Board to continue to pursue and investigate this because this is quite a web that I think we're just trying to at this point get kind of a taste for from this meeting.

I thank you.

MR. PENBERTHY: Good afternoon. My name is Larry Penberthy, Penberthy Electromelt. We're long-term developers of vitrification, that is, glass melting, and our processes are now producing 16 million tons of glass a year. That's commercial glass bottles, plate and the like. So when you talk about the vitrification problems at Hanford, we total that up and it's only about 400,000 tons. That's an interesting quantity to a glass maker, but it's certainly not impressive, and so therefore, what I'm saying is let industry get in on this.

Now, it's related to Yucca Mountain in this way. The present plan in which we are now getting involved, we have one of the awards for the evaluation of our process for the liquids, that is, the sodium nitrate to be converted into glass. The plan now is to take the cesium out at considerable expense, really expensive. Just the plan alone is estimated $258 million, just for design. I do not know the numbers on that, but it gets way up into big bucks to get the cesium out, because cesium is not easy to get out. A lot of it has been complexed and the chemistry is not really well established or known.

What we can do, however, when we're making glass out of the sodium nitrate, we reduce the nitrate to the oxide, and then it makes a good glass. Here's a piece of glass that is about two-tenths of a percent cesium. The point is that we can use the cesium, which is one of the alkalis, to make glass just as well as we can use soda or lithia or potassia, all over in Group I, and they are all alkalis for making glass.

Ordinary glass like this, tableware, plate glass, has 15 per cent soda, and our task is to increase the soda and still not get too much solubility in this assignment that we're just starting now for Westinghouse Hanford.

But what I'm getting at is that we can work glass furnaces very well remotely and, therefore, we don't need to wait for a cesium removal plant and all its uncertainties. We can start end processing the glass with the cesium content already in it and leave it in the glass.

Now, cesium has been misunderstood. Sure, it's a high-level, it's .66 MEV, and there's a lot of it, but that doesn't mean that it's a long life. Cesium has about 30 year half life, and the age of the United States, 220 years, you're dealing with something like seven half lives of cesium, and you start multiplying half, half, half out seven times, there's not a lot of cesium left.

So what I'm proposing to you that the space, the volume in Yucca Mountain is far too costly and far too valuable to consider putting cesium in it, if that's the only thing. Cesium should be left right in the plateau at Hanford, and then it can be made into excellent glass. We can make glass a thousand times better than borosilicate glass, and then put it into metal boxes like cast iron boxes, which are really very good when buried, and they would then be stored in what are now the grout vaults, or they would become glass vaults. And then leave them, you put on, after you've filled it up, you put in your heat pipes to remove the heat, and then cover it over with slabs, concrete slabs, resting on columns, and then you would cover that with 10 to 15 feet of soil, and the final layer of rock and some concrete slab if you wanted, perfectly secure for all time.

It wouldn't matter if the whole Columbia River flowed across the good glass that we can make, you've seen pop bottles in the ditch, they haven't dissolved, and we can make glass which is much better, a thousand times better than the Macedonians made, the Mesopotamians made back 4,000 years ago, and yet their glasses have survived.

So what I'm saying is for the general protection of the United States Treasury and the taxpayers, we need to get off the idea of removing the cesium. It has no value, no function at all for the benefit of the disposal of hazardous waste. It will be a little different when we get down to the transuranics, which are in the sludge, but we're talking right now about the first phase, which is the sodium nitrate salts with the accompanying cesium.

Thank you.

DR. VERINK: Any further questions or comments?

MR. PENBERTHY: I have some copies of this one page write-up on cesium over here at the desk, and I have them at the front desk as well. Were there any questions for me?

Thank you.

DR. VERINK: Does this mean everybody agrees?

Hearing no questions or no comments, we'll adjourn now for 15 minutes to get set up for the round-table.

(Whereupon, a recess was taken.)

DR. VERINK: This will be a free for all event. We'll kick it off with the people at the table, and then be prepared to get into the discussion, and in doing so, use the microphones, identify yourself so that the record will show who was here, your name and your association, and we'll take it from there. Who's got the first question?

DR. LANGMUIR: Langmuir; Board. It's clear to me from what we've heard today that there are potentially a great many kinds of materials that need to go to waste disposal, and one of the first things--you know, until I came here today, my sense was that, well, it's going to go to borosilicate glass and it will be fairly routine in the sense that we can probably predict what its compositions will be. But I'm not so optimistic that we can predict what those compositions will be, and my sense is I'm not sure that you folks can either. But I'd be curious what your thoughts are on being able to guarantee some compositions for the waste materials that might go to a repository.

MR. RANDKLEV: I'll take some crack at that, given that Steve Schaus isn't here to help with that one. Certainly for Hanford and the new TPA agreement which makes the commitment to look at the composite of single-shell and double-shell in terms of an integrated program of disposal, in all likelihood that's going to involve a certain amount of or certain fraction of blending of some of those wastes, and that selection of waste feeds, if you will, that will come to eventually high-level is, in terms of timing, going to be somewhat influenced by the concern over certain safety issues with regard to existing tanks. But beyond that, it will get down to this topic of what I would refer to as waste feed/product types.

Savannah River, for instance, I'll try to make this short, but Savannah River has for years forecasted that they're only going to make four waste types. It's all going to go into borosilicate glass, but they had projected-- they're blending their wastes and they have projected these particular waste feed types, and they turn out to be really very similar. They don't have nearly the number of tanks Hanford does, and they didn't have this split, if you will, between a big inventory of material that wasn't even thought of as being part of the initial vitrification program like Hanford's was, which was only dealing with double-shell initially.

So what Hanford is starting to do now collectively between the elements of the TWRS, its pretreatment characterization and the vitrification folks, is to start to design a process, you know, definition of the overall processing that starts to take a look at how many of these waste feed and product types would we propose trying to make in order to accommodate certain known restrictions, mostly chemical solubility restrictions having to do with what it is you can get into a borosilicate glass or some other glass compositions.

So what I'm saying is that the problem you're mentioning is one that will be addressed and is being addressed as a general topic by simply getting at this question of how is it we're going to stage the remediation and disposal of these, you know, this waste inventory out there. Beyond the split now of low-level to high-level, you're going to end up with high-level with stuff coming in from all of these various tanks, and they're not all going to be dealt with in one big, you know, grand blending event. But it's not clear at this point just how many of those waste feed types you might try to deal with from an optimization standpoint. And right now, what's being looked at is merely the technical featuring of that and what has to occur beyond that is the process or the step of looking at an actual optimization of that topic in terms of both technical featuring and the costing.

So it won't be that long in the future before Hanford would have some more detailed perspective. There are some things already on the books just for purposes of being able to proceed with the problem, and one of them is the matter of having just come up with a master blend that represents what would happen if you blended the high-level waste, as it's understood to be there, from all of the tanks together, what would you end up with. And so there are some things that just hypothetically are already down on paper in the last few months.

DR. LANGMUIR: My sense is it would be fairly easy, easier perhaps to simply be taking waste materials as they become available, and they're not going to become available all at the same time in your process here, and put them in the repository. And my concern in part is that when you start putting different materials in different parts of the repository of defense nature, maybe the thermal effect is fairly generally the same among those things, and they're not that important relative to the fuel, but the chemical consequences to the environment could be extremely different, depending on what you put down there, and may locally be an issue that you've got high--potentially coming out. Admittedly that's a short half life, and maybe it's Neptunium in some other part of the repository you have to worry about as a potential leachate. So you make the environmental difficulties of predicting consequences of a breach a little more complex, if you mix your fuels and mix your materials. If you can blend them, which I'm kind of doubting--

MR. RANDKLEV: I mean, they're blending them at Savannah River and we, in all likelihood, are going to do some blending. We have waste types even among double-shells that were always perceived as being best dealt with by blending them.

DR. LANGMUIR: But your blend and Savannah River's blend aren't going to be the same blend.

MR. RANDKLEV: No. And some of the constituents that you're referring to, transuranics, there's not going to be a whole lot of difference between even blends of some of these tanks. What's different and has to be dealt with, you know, from a pretreatment consideration is the concerns over the fact that we have some tanks that have high concentrations of phosphates, it had to do with bismuth phosphate processing technology. There's limited solubility unless you make a particular glass that precipitates an apatite, mineral, you know, that contains high amounts of phosphate, you end up with a limited capability to incorporate chemical compound constituents like phosphate into a borosilicate glass, as an example. And it would be the same for some other glasses. So that's, in part, what some of this blending is about, considerations over chrome, any number of other constituents for which the solubility level, as an example, in borosilicate glass is relatively low.

DR. LANGMUIR: I suppose you're kind of wedded to having one or two kinds of glass hosts for your products. But in a sense, this bothered me because, for example, apatite, you described the phosphates, among the least soluble forms of minerals out there, and you can in phosphate apatite structures, they're less soluble than the glass. If you're trying to get rid of chromium, you could put it in a mineral structure, and that's less soluble than anything else you could put chrome in. So if you're struck with glass as a potential host, you're going to have problems with a lot of elements that you don't necessarily have to have.

MR. RANDKLEV: But glasses in general are--that's the reason they're looked at as a matrix material for high-level waste, that when you compare them to mineral assemblages, as had been done back during some of the early development work in the late Seventies on up into the early Eighties for crystalline, you know, tailored crystalline waste forms, glass has an ability to accommodate a much broader range of constituents to at least some degree of solubility than, you know, does one's ability to tailor a whole set of compounds that would actually incorporate those elements in a bound condition. It's really a challenge in that regard.

But it's certainly possible that Hanford might come to the conclusion then and propose conceptually several different reference product compositions in order to efficiently get rid of certain inventories of material, and that will just come down to choices at the local level as well as at the higher system level involving RW and EM as to whether it makes sense to, you know, do it one way versus another. And the repository hopefully would be, you know, working with us, the program, would be working with EM then to provide that technical perspective on those things that border on essentials relative to a repository licensing performance assessment type issue versus those things that are desirable from, you know, more of an economic driver or something like that.

MR. GOMBERG: I know this won't answer your question. I was going to point out that one of the requirements we put on all the producers is for them to report the total and canister specific inventories of radionuclides greater than .05 per cent of the total radionuclide inventory. That allows us the ability at least within our own system to find high concentration localities, things along that line, and ensure that the glass will perform in a repository.

DR. DI BELLA: Carl DiBella. This morning, Steve told us about the waste acceptance standards that I guess are mandatory for Savannah River and West Valley and are sort of being used as a benchmark for the planning process going on right now at Hanford. Some of those standards and specifications are establishing a design, a geometric design envelope. Others have to do, I would suppose, with performance of the glass at the repository, and I'd like to know what sort of linkage actually is there between those standards and the repository performance of the glass. And the next question I'm going to be asking is the performance allocation between the glass and the shell, the waste package, the overpacks in the repository.

MR. GOMBERG: I can make a real simple answer to the first question, but I think it will be wrong. My simple answer is probably none, but that's not entirely true. We were talking about the product consistency test earlier during a break, and there's an example of something that has been interpreted to be some sort of surrogate to long-term performance in a repository, and that's not the case. It's meant to provide a short-term producer based index durability of the glass as far as the overall adequacy of the glass production process.

One of the points that we've tried to make repeatedly, and I think the performance allocation that was in the site characterization plan that applies to the engineered barrier system and the accessible environment is still pretty much the goals that we've established. There is a contribution or some part of an allocation that the waste form is given credit for. But in general, the performance of the system elements against the NRC performance objectives and the EPA accessible environment system objective is on the accessible environment, the engineered barrier system or the waste package.

Why we require this information of the producers is to get the data, the envelope that we need to be able to demonstrate performance of those sub-systems or total system, but we don't necessarily put any direct performance on the glass other than those that we can specifically allocate, things such as solid form requirements, consolidation, things along that line are the kind of things that we can allocate directly to the glass and that we do.

By the way, Gomberg, RW. So I don't know if that answers your question, but that's the way we've developed these requirements. That's the way we've used them. We have been--it's been suggested by NRC, for example, that we do more to design the waste form, and I guess we don't feel right now that that's appropriate, that we will design a system that will meet the performance objectives and all the regulatory requirements.

DR. DI BELLA: I guess what I'm getting at--Carl DiBella again--is how Hanford can use what they have here in their planning process to figure out what sort of waste form they're going to make. Ed was just mentioning solubility limits in the glass. So if you don't know what performance you have for the glass, what difference does it make if you've exceeded the solubility limit, for example?

MR. GOMBERG: Well, you know, an example would be we have a requirement to meet one part in ten to the fifth for releases greater--after 1000 years. We know that the glass has certain characteristics and that we can pretty much demonstrate that under the repository specific conditions, that there will be certain related solubilities. The goal of the repository system designers would then be to develop a package and an EBS that with the waste form as a source term and whatever contribution we can take credit for, would meet for example the one part in ten to the fifth requirement.

So we're trying to get the maximum allocation we can to the glass without specifically coming back and putting all the reliance on the glass, because we don't think that's appropriate. That's not the intent of the requirements as we see them.

DR. BARNARD: Bill Barnard; Board Staff. I think it's been obvious to everybody that, you know, we're going to be disposing of spent fuel and high-level waste in the repository. There's been some discussion this afternoon of disposing of plutonium, too.

As I recall the NRC and the Office of Technology Assessment, both looked at greater than Class C waste and assumed that perhaps geologic disposal would be the best way for dealing with that in the long term.

Steve, has DOE decided what they want to do with commercial greater than Class C and defense, there must be some defense greater than Class C waste, too.

MR. GOMBERG: I can tell you what I know and it's not much, and then I would volunteer for anybody else who knows more, please go ahead and feel free.

The Department is responsible for ultimately taking title to commercial and defense greater than Class C waste. My understanding is there is a significant amount of commercial and also a significant amount of DOE owned greater than Class C waste. Maybe it's more the way I interpret it as a nuance in the regulations, but what the NRC did when they revised Part 61, which is the low-level waste requirements, is they basically said that in lieu of some other DOE facility, that geologic disposal was the only accepted form of disposal.

Under Part 60 in the Nuclear Waste Policy Act, however, the NRC did not specifically come out and say that this waste fits within the definition of any other waste determined by the NRC to require disposal. Now, I have to admit that's about where my knowledge ends, and I can't really say what's going on in the Department right now to develop an intermediate facility. I know there's been some work going on to characterize the inventory and the characteristics of greater than Class C waste and there's been some--but I don't know the status of the work as of this year or what not. Most of the work that I know about is maybe two years old.

DR. BARNARD: Is there anybody else here that might know about some of the work that's being conducted? I think it's at INEL, isn't it?

MR. GOMBERG: A key part of it is going on at INEL. I'm sorry I don't know more, or else I would tell you.

DR. VERINK: I for one, and I think there are others in here who would welcome a little further comment from you, Howard, on some of the things that you skipped over in the abbreviated thing that you gave today. If you would feel kindly towards that, I think we'd enjoy hearing about it.

DR. CANTER: Howard Canter. I mentioned sort of a glancing blow at the question of vitrification, and the option of possibly going to the vitrification or some other form of immobilization of plutonium would not make sense unless we did mix it with something like high-level waste so that we would get the inherent radiation barrier.

One of the difficulties is that barrier doesn't last forever, and even in the spent fuel option where you go through a reactor and you create spent fuel, as people here know, that the radiation barrier decays with time, and fortunately a spent fuel element from a commercial power reactor is rather large and it's a little hard, even if somebody--even if the radiation level had decayed, for somebody to just throw it in the back of a pickup truck. But they would have to be obviously on whatever storage facility or repository, there would have to be some degree of safeguards to make sure that the material wasn't falling into the wrong hands.

But we are probably going to very rapidly rule out the idea of vitrifying plutonium without high-level waste, because basically what that creates is a nice source of plutonium for the future, which can be done--which you can extract the plutonium chemically very easily with acid basically to dissolve the glass, and then you've got some chemical processes and you don't need shielded facilities or anything else.

There are a number of other things that we're going to rule out, I believe, that people have suggested, and that's part of the screening process like, you know, an ideal thing to do with plutonium is launch it towards the sun. But if you look at a safety analysis report that was done some number of years ago on some power sources for the space program which used plutonium-238, and you find out that it was a relatively small quantity of plutonium that was considered an acceptable risk, and that's the risk of failure on the launch pad or the risk of not reaching escape velocity, you would find out that it would probably take 1000 rockets, large rockets, to get 50 tons of plutonium off the earth. So I think that's another one that we could rule out.

There are a number of others that have been suggested by people, ocean dilution is one. We signed a treaty last year that prohibits disposal of radioactive material in the ocean, and I don't believe we're going to go out and violate that treaty. There's a deep sea bed disposal method that I think also when you take a look at that, it's not going to be a reasonable option and we'll discard it.

So we're going to get probably down to what can we do in a reasonable amount of time at reasonable cost to place the plutonium in a condition that's substantially more proliferation resistent and inherently more, and that gets down, probably down to the reactor option and a vitrification option, or some form of immobilization. It will be very difficult to reach decisions on this because our government isn't very efficient at that, and when you start dealing with decisions that take several decades to implement, as you know in this program, 20 years is ten Congresses, and it's five administrations. So even if you can reach a decision, can the decision hold up? And that's really probably the greatest risk of all, and we don't know what the Russians are going to cooperate with. We'd like to do some things in concert with them and we just don't know. We've just started the dialogue with them on this subject.

DR. VERINK: Thank you. Yes.

DR. DI BELLA: Pursuing the same. Carl DiBella pursuing the same thing. As you mentioned, there's going to be a difference between the waste form for the vitrification option and the reactor option. The vitrification option has less long-term protection, longer than 300 years, because high-level waste has very little in the way of long-term radionuclides. And furthermore, the vitrification option will result in essentially weapons grade plutonium, whereas the reactor option would result in longer protection because of its actinides and other long lived nuclides, and also will be reactor grade plutonium, which is dangerous but perhaps not as much so.

My question is really this, I know you know this, is there--is the metric you're going to use for your systems analysis going to be that fine to distinguish between those waste forms?

DR. CANTER: I think the answer is yes. One of the things that we're doing as one of the early steps is developing criteria for deciding which options to select, and that will include a lot of details. And, in fact, one of the criteria has to do with the degree to which the process is reversible, and there will be many, there's oh, maybe 20 or 30 categories in this criteria. I felt that we should have the criteria up front before we do all the studies so that the studies are really to fill in the blanks.

What we intend to do is when we get this criteria in a form that doesn't embarrass us, is to get a rather wide distribution of it and get input from the public and interested parties and various stakeholders on the criteria, and to even get input on how important different things are. You know, to some people, the cost may be very important. To others, the cost may be secondary, and the degree of proliferation resistance much greater. The waste people may be concerned about the waste disposal form, so to try to get some kind of consensus. But the very things you're talking about will be evaluated in this kind of criteria.

DR. VERINK: Are there any in the audience who have a particular burning question they'd like to throw up for discussion? Yes.

MR. DUFFY: My name is Mike Duffy. I'm with Battelle out of Columbus, Ohio, not PNL. And this morning, Don Wodrich put up a chart that showed that approximately 100,000 MTUs of spent fuel have been reprocessed up here. Then Steve Schaus put up a chart that said there was about an equivalent of 2600 MTHM of high-level waste here.

Now, the question I've got really is that--I know the current repository design is constrained to 70,000 MTUs of spent fuel, until which time a second repository is under operation. Also, 10 per cent of that is being allocated to the defense high-level waste. Now, I know that there are a couple of studies done in the middle Eighties that came up with this conversion I guess of the 100,000 MTUs to the 2600 equivalent metric tons. But I've got here a copy of the

Nuclear Waste Policy Act as amended, and it doesn't talk about equivalency. It basically says, and I quote, "Prohibit the emplacement in the first repository of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent fuel."

So my question is if I'm the State of Nevada, am I going to allow you to put all 2600 metric tons of the defense high-level waste from Hanford in the Yucca Mountain repository, assuming for the moment that we forget all the other potential sources of defense high-level waste, or am I going to say you can't bring any more than 7 per cent of the waste up here at Hanford down there. I don't know who has the answer, but I'd be interested from both these folks here as well as the Board, as well as I know some of the folks in the audience might have an opinion on this.

MR. GOMBERG: Reluctantly, Gomberg, RW. Actually, I'm going to put the burden on Barrie McLeod for a second after I break it up into two issues. Barrie is the guy who does this kind of stuff so he can say it more eloquently than I can.

Two aspects that we look at; one is to establish fees, because we need some basis to establish some comparable--we need a comparable basis to establish fees, the utilities and the producers to put funds into the Nuclear

Waste Fund for the ultimate disposal of the waste. The other is against the 70,000 metric ton limit. I guess I never really quite, when I look at the wording, sometimes I say is that 7,000 initial metric tons or is that 7,000 metric tons from some larger number of initial metric tons. I don't know, but let me just put it in the perspective and then I'll turn it over to Barrie if he doesn't mind.

For planning purposes, we have said that we would put, in order to total the 70,000 metric ton limit, we would put 63,000 metric tons of commercial spent fuel and 7,000 metric tons equivalent of defense high-level waste. That's the basis that Mike was using for the numbers.

As far as the fee goes, I'll let Barrie deal with that, if you don't mind, Barrie. It's Barrie McLeod, M&O, by the way.

MR. MC LEOD: Thanks, Steve. Well, dealing first with the point brought up by Mike with regard to the 100,000 tons of actual physical material, I think we heard today that the average burnup was something in the order of 2,000 megawatt days per metric ton. The spent nuclear fuel that we're dealing with is the--the mean is somewhere between 35 and 40,000 megawatt days per metric ton. So let's just say there's a factor of 20 difference in the amount of energy and products that came out of those. So the defense people of course recognized this and came up with the concept of equivalency, and I believe it's a gamma equivalency. I was not involved in it. Maybe there are some PNL people here. Pardon?

Okay, curie equivalence. So it's very close to an energy equivalent, in other words, with some allowance for decay. So I think that explains why they converted a large physical amount of tons into an equivalent amount of metric tons.

Now, with regard to the costing and the fee, once you come up with that amount of money--sorry--once you come up with the equivalency and the amount of tons that you're going to put in and convert that to number of waste packages, the agreement that has been reached for allocating cost is a purely parametric one. The repository people literally cost out what it costs to emplace a large waste package, to handle one waste package or the area it needs, and they compare that with the same calculations for spent fuel emplacement. And when you look at the costs that can be assigned parametrically, they come up with a number approximately 15 per cent of the cost can be assigned parametrically to the defense program.

Now, the part of the defense program--sorry--the part of the total repository costs that can be assigned parametrically are only about one-quarter to one-fifth of the total costs, because there's such a huge fixed cost, you know, 8 to $10 billion of the program is fixed before you start putting any waste in there. So the net result of this is that they have also decided that then when you've carved up the parametrically assigned costs as to the amount of 15 per cent, you're going to use that same 15 per cent to assign the fixed costs against the two components.

Now, I think that explains how the costs are assigned one you've got an equivalency. The key thing that-- the key impact that this has, however, is that when you optimize or when you try to minimize the total system cost and the total disposal of the high-level waste by doing preprocessing, how much preprocessing do you do, every dollar that you save in disposal cost by doing this preprocessing is in fact multiplied by three or four because of this fixed cost component on top of the direct disposal cost component. So you have to be sure in your cost calculations when you do your optimizations that that fixed component is in there as well as just the direct parametrically assigned disposal cost.

Are there any questions on that? I'd be glad to discuss that in person with anyone that wants to talk about it. I hope that the record might show that it was a clear discussion.

MR. DUFFY: It was an interesting discussion, Barrie, but it doesn't really answer the question that I had. And I understand, you know, all the kind of systems analysis work that needs to be done in order to figure out the cost fee and the work that was done to come up with the equivalency, but I guess maybe it needs a legal interpretation, and the question remains can you say that this 2600 is less than the 7000 that would be allowed to go to the repository based on what is stated explicitly in the Act, and that's the question.

MR. GEER: If you don't mind, Steve, I'm Tom Geer; I'm with the M&O in Las Vegas. I'm systems engineering manager. I'm going to try to say this in a way that's--to Carl Johnson's concerns, I'm sure. But I want to clarify something Mike said about the Nuclear Waste Policy Act and the 70,000 metric ton limit that's in there is actually a hold point on the first repository. The Act itself requires the NRC to impose a license condition on the first repository's license that caps the capacity at 70,000 until another repository is in operation. At that point, the NRC would be free to lift the license condition and the ultimate capacity of the first repository is not limited to 70,000 MTU. So I guess in whatever event we calculate the equivalency, and that's beyond me because I'm just a nuclear engineer, all we have to do to take care of all of the Hanford problems is get that second repository in operation.

DR. VERINK: Anybody else have a question?

MR. WALTON: My name is Ray Walton. I'm retired from the Department of Energy. I currently work for Argonne National Laboratory. Section 8 of the Nuclear Waste Policy Act required a determination as to whether defense waste would be put in the repository or whether a separate repository would be made for defense waste. The 70,000 metric tons was determined originally for commercial waste. When it came time after the study on the Section 8 was made, it recommended that defense waste be put into the same repository as the commercial waste. This study was recommended by the Department of Energy to the President, who approved it.

After that, then it came time to decide the equivalency of defense waste to commercial waste, and if you really know the history of waste from Hanford, some of the original fuel that was processed was only irradiated to 100 megawatt days per metric ton compared to 30,000 megawatt days per metric ton, and the initial waste processing was very inefficient and some of the very early batches had up to 10,000 gallons of waste per metric ton. So the defense waste has been very dilute, even the very latest waste is about 10,000 megawatt days per metric ton as a maximum.

So, again, this curie equivalent was the basis that was determined to come up with what is called equivalent metric tons of heavy metal.

MR. SPRECKER: Bill Sprecker, DOE. The report that Ray was referring to was published in November, 1984 and it's the basis of that Section 8 requirement. If you look at the table on equivalency, he's correct, it was a curie content. But the interesting point is that that two to one ratio or one-half, however you want to put it, was on the basis of commercial reprocessed waste, and defense reprocessed waste. The curie content of intact spent fuel is an order of magnitude difference.

Now, we've been using the comparison of the commercial reprocessed, this was back in '84, with the defense reprocessed waste with a two to one conversion, or one-half. But, in fact, we're putting, or intending to put intact spent fuel in the repository, and that curie content is an order of magnitude higher. So there's something we have maybe to look into a little bit deeper. But in those days that we had a different view of what the repository was going to be.

MR. GOMBERG: Just an additional point I guess. When we wrote the Waste Acceptance System requirements document, we went and we looked for all the information we could find on some sort of equivalent. What we used in that document for commercial high-level waste, i.e. West Valley, I think was 2.3 metric tons per canister. For defense high-level waste, we used half a metric ton per canister, just as a data point. If anybody has any better data out there, we'd love to get it so we can get this document better in the next revision. But that's the basis that we used, just to add another set of data points to the equation here.

DR. VERINK: I don't see any great abundance of people showing hands. I want to express the appreciation of the Board to the speakers, to the audience. I think this has been a splendid presentation and I really thank you all for the special efforts that you've made on behalf of the Board.

I guess we're adjourned.

(Whereupon, at 5:40 p.m., the meeting was adjourned.)