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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

SUBCOMMITTEE ON REACTOR RADIOLOGICAL
EFFECTS AND WASTE MANAGEMENT

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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AND WASTE MANAGEMENT

Nuclear Regulatory Commission
Room 1046
1717 H Street, N.W.
Washington, D. C.

Saturday, December 1, 1984

The subcommittee meeting was reconvened at 8:30 a.m., Dade Moeller, chairman of the subcommittee, presiding.

PRESENT:

JESSE C. EBERSOLE
CARSON MARK
DADE MOELLER

OWEN S. MERRILL, Assigned ACRS Staff Member

P R O C E E D I N G S

MR. MOELLER: The meeting will now come to order. This is a continuation of the subcommittee meeting that began yesterday morning of the ACRS Subcommittee on Reactor Radiological Effects and Waste Management, and today we will be concentrating on the subject of waste management. I'm Dave Moeller, chairman of the two subcommittees and the other subcommittees members of Jesse Ebersole and Carson Mark. We also have in attendance a team of consultants to support the subcommittee in its work, and these consist of Melvin First, Donald Orth, and Jacob Shapiro.

Owen Merrill, normally seated on my right is the ACRS staff member for this meeting. A transcript is being kept and will be available as stated in the Federal Register notice, and it's requested that everyone speak loudly and clearly so that they can be heard.

We have received no written comments from members of the public and we've received no requests for time to make oral statements from members of the public.

As I mentioned, today we will be concentrating on waste management. Initially this morning we will be hearing a report on high-level and low-level waste management, led by Bob Browning of the division of waste management and then later this morning we will be hearing about the same

subject through the representatives of the Office of Nuclear Regulatory Research.

Following the two sessions this morning, the subcommittee will go into executive session, still open to the public but not recorded, in which we will be formulating our written recommendations to be submitted to the full committee so that they can be considered for inclusion in our annual report to the U.S. Congress, commenting on research activities within the Nuclear Regulatory Commission.

Although today's meeting will be, for the most part, open to the public, we may desire to close briefly certain portions of the meeting so that we can go over budgetary matters, and these portions of the meeting would be closed as required for the discussion of privileged information under exemption 9(b).

So, having said that, let me also comment to the subcommittee that the results of the executive session we had last evening are being typed and they will be ready in time -- by the time we finish this morning, so that we can go over the written text and comment and polish it to get it ready for the full committee.

Do you have any questions or comments before we begin this morning?

Okay. There being none, then we'll call on Bob

Browning to begin the discussion.

Bob?

MR. BROWNING: Thank you. I would like to start off, if you don't mind, just giving a brief overview of our perception --

MR. MOELLER: You have to hook those up pretty close. Yes, that's good.

MR. BROWNING: -- our perception of what's going on in the two program areas that you are discussing today, in terms of the real events.

I would like to start off first with low-level waste disposal.

As you are probably aware, the Low-Level Waste Policy Act of 1980 made it a state responsibility to deal with disposal of low-level waste.

Since that time, the states have been grouping together, trying to form what they referred to as compacts, in other words, groups of states that would come together for the purposes of locating a low-level waste disposal within that compact to handle the waste that originates within the states that are in that compact. So it has been mostly a political process up until this point in time, and that process is still going on.

Prior to that time we had -- we have issued our regulations for licensing of low-level waste disposal

sites.

At the time we developed the regulation, we assumed that the primary disposal method of choice would be shallow land burial, along the lines that it has been practiced to date in the United States. So the regulation has focused primarily on near surface disposal using shallow land burial techniques factoring in all the lessons learned from the experience of the existing low-level waste disposal sites.

In terms of what's actually been going on in the licensing arenas, we have essentially issued the regulation, we have been waiting for someone to get to the point where they come in with a license application for low-level waste disposal.

So, in the area of technical assistance and licensing activity, on low-level waste, it has been at a rather low level.

We have the staff and the capability to deal with any license application for shallow land burial, if one were to come in. And the one area that seems to be closest to coming in with a shallow land burial site similar to what's been practiced to date is Texas, which has elected to go it alone.

They plan to just go on a single state basis rather than a group of states.

MR. MOELLER: Question on that, Bob. Yesterday in our discussion of other research, the question came up, which it always does, on how do we finance this research and who should be doing what? What should the NRC be doing and what should other federal agencies, as well as state agencies, be doing? And what came up was whether any of the states, either in a compact or going it alone, are initiating research activities? In our sort of a grandiose point of view, we could see a state university, you know, in state X, and state X is going to have this low-level burial site, or they are part of the compact and they are going to have it, and it has specific, site-specific questions that need answers. So the state appropriates some money, the state university gets busy and does some research and helps them answer those questions.

Is that a dream? Or are you seeing any possibility of that approach?

MR. BROWNING: That may happen but I have not seen any sign of it happening to date, because the process up till now has been primarily a political process; people trying to come together, forming compacts, as opposed to focusing on trying to find a site or trying to find -- apply a particular disposal technology.

Let me clarify a little bit exactly what the status is.

In Texas, at the stage where they are actually looking for sites, at this point --

MR. MOELLER: They are actually looking at four sites or looking for sites?

MR. BROWNING: No, looking for a site. They have screened the state using the approaches specified in our regulation plus some additional conservatisms that they introduced, and are attempting to focus down on, I believe at least two real sites.

So, they are at the point where they are actually looking for sites and their initial approach was to use the low-level waste regulation and shallow land burial as covered in our regulation.

Our regulation does offer the approach of some alternative means, but the alternative means were not studied because no such alternative means existed at the time we were developing the regulation. So it doesn't preclude alternative disposal approaches to shallow land burial.

In parallel with the Texas move, the state of California was also moving to develop a particular site and a particular technology. And, in that process, one of the bidders, specifically Westinghouse, came in with a concept which was different than shallow land burial as practiced today. I think the trade name is the "surepack"

concept.

Basically it's large, cement, reinforced cement containers. So that the entire waste going in the disposal site would, in effect, be encapsulated in cement containers.

Yes, sir?

MR. MARK: You mentioned Texas having added a few conservatisms which they think necessary and you think not. What's the nature of those?

MR. BROWNING: The conservatism they added was that they would not locate it above a major aquifer.

MR. MARK: Is that all?

MR. BROWNING: That was the only additional conservatism.

MR. EBERSOLE: In this connection, isn't it a root characteristic of low-level sites that you have privilege -- after you decide what you want to do, you monitor the performance and you can go in and fix it if you've made a mistake?

MR. BROWNING: Unfortunately, fixing it would be rather difficult with the shallow land burial approach.

MR. EBERSOLE: You do monitor what has happened?

MR. BROWNING: Oh, absolutely. The existing sites are being monitored to see if the radionuclides are monitoring from the sites.

MR. EBERSOLE: You are not absolutely precluded from fixing it if your expectations were not attained; right?

MR. BROWNING: That's right. It would require digging it up, which is something you would avoid.

MR. EBERSOLE: With respect to the high-level wastes that's an irrevocable decision for the next 10,000 years; isn't that right? Well, we'll get to that later.

MR. BROWNING: In our high-level thing, we have inherent in our regulation a requirement that you be able to recover up to about 50 years after completion of emplacing the waste, to decide to take it back out again.

MR. EBERSOLE: 50 years?

MR. MOELLER: And I notice, and you'll tell us, too, that I believe Ben Rushi, in that interview in Nuclear News, said they were aiming for 100 years retrievability.

MR. EBERSOLE: I guess I have been harping on this.

MR. MOELLER: Back to the California thing, it would be just enormous concrete boxes, in other words?

MR. BROWNING: The concrete boxes are roughly 7 feet by 7 feet. I'll show you a picture of them.

I've got some brochures here if you are interested.

MR. EBERSOLE: Sounds like caskets.

MR. MOELLER: Like burial vaults.

MR. BROWNING: That's what it would look like.

MR. FIRST: Is the material put into an empty box or is the material put in the concrete also encased in concrete as a matrix?

MR. BROWNING: Not necessarily. The facility that they envision would take wastes such as wafers that would come in a 55-gallon drum, would compress the drum and its contents and then stack those inside the concrete. You could also power concrete inside, I guess.

MR. EBERSOLE: Is it all dry?

MR. BROWNING: Yes. There are no liquids.

MR. MOELLER: These are not shipped to the reducer and hauled by truck. You don't put it in at the production site? You put it in --

MR. BROWNING: Not necessarily. Their concept is they'd have a facility at the site that would take waste -- for example if a waste generator just had the existing capacity of putting stuff in 55-gallon drums, he would continue doing that and at the disposal site they would compress that drum and put it inside these containers.

Basically the concept is to have an extremely stable waste form so there would be no delay or corrosion of the containers, and then have the collapse of the site and

then the intrusion of water.

MR. MOELLER: No biological decay.

MR. BROWNING: The California state has the option of finding a dry site and they were moving in that direction. And they picked this choice as the primary choice.

Now, they are going back and re bidding it because originally they had requested people propose, based on 10 CFR61, shallow land burial, and all the other people did that.

Westinghouse was, I understand, the only one that came in with an alternative concept. And what they are trying to do is to get equivalent inputs from several people before they make their decision.

But given that sequence of events, a lot of people think that in order to sell low-level waste disposal politically, that the states will have to go to something better than shallow land burial as currently practiced, even with the lessons learned, factored in, that we factored in our existing regulation. Even though technically you could conclude you don't need to do it, they are concluding, tending to conclude that in order to sell the thing politically they are going to have to do something better.

It's important that you have that concept because some

of our technical work and research work is going, of necessity, going to focus on these approaches of something that's better. Because, in terms of our role in this thing, I think our role ought to be to make sure that it really is better before people go too far down that line, and to be asking the kind of questions, that -- will phenomena that you didn't see before because of the way you were disposing of waste, if you do this in a highly compressed concreted manner, is that in fact going to be better? Or will we be moving into some other phenomena that people haven't thought about before?

So I think, when you hear the research program presented, there will be discussion about looking at other -- other alternatives. But we'll probably be focusing them on alternatives that the states and the companies that want to get into this kind of business would be proposing.

So, it's more focused than just worrying about something better, in general.

For example, concrete, we'll have to make sure we know a great deal about the properties of concrete over the long term.

MR. MOELLER: Would those be single-story? Or could they be multiple-story?

MR. BROWNING: Their concept, I think, is to stack them in a hexagonal array. That's another one of

their sales brochures.

It's a variation of shallow land burial. You'd build the trench, but then instead of putting in carbon steel drums which decay with time and people are concerned about when they decay will the trench slump, and we'll have a maintenance associated with it. This is perceived to be a way of doing it so that you get long-term stability.

MR. SHAPIRO: In time would you expect the concrete to crack and water to seep in as any long-term --

MR. BROWNING: Oh, sure. Eventually all things decay but the dry one will be slower.

Low-level waste covers a broad spectrum of radionuclide and concentrations. Within the categories that we've got covered now in our regulation, there still would be hazards 500 years after you disposed of the thing. But, within the regulatory framework we've got, there are barriers to the kinds of concerns you'd run into, namely intruders getting into it, not realizing it is there and intruders inadvertently getting into it.

MR. MARK: You say there would be hazards 500 years later. There will certainly be radioactive decay going on. What do you call a hazard? I mean, what's the threshold for saying it's a hazard or not?

MR. BROWNING: Well, the threshold is 500 millirem to an inadvertent intruder when he gets to the

waste.

MR. MARK: Okay, he gets into one of these concrete boxes he'd get 500 millirem.

MR. BROWNING: That's the limit.

MR. EBERSOLE: What does he do, sit in there?

MR. BROWNING: The way we framed our regulations is you can't put anything in the site where that threat would be exceeded.

MR. EBERSOLE: What does he have to do, stay there for X hours or minutes? What's the dose's basis?

MR. BROWNING: I think that's an annual dose.

MR. MARK: Doesn't have to eat the contents?

MR. BROWNING: Doesn't have to eat it.

MR. EBERSOLE: He's going to get rather intimate with it, though.

MR. BROWNING: The point is, it's a rather conservative limit and therefore we think our regulation that covers shallow land burial is sufficient. We are not proposing that it is necessary, technically necessary to go to these steps. There's nothing in our regulation that would force this kind of an approach. It's an approach being taken to satisfy political concerns and the concerns of the public, that the political forces have to satisfy before they can bring additional low-level waste disposal site on the land.

Now, the other concept that's inherent in this particular approach is that if you conclude that you've done it wrong, or you want to undo it, it is undoable. You can pick these individual pieces up and move them again. As opposed to the French concept, as being practiced today, which really ends up having a huge solid monolithic hunk of cement, where the whole site is one huge hunk of cement. Here's a brochure representing some pictures, things, of the French approach.

The reasonable I'm emphasizing this is because I think it should give you some perspective of why we may have to be doing some research work and technical assistance work in areas that we hadn't anticipated before, because of the way the states are reacting to their Congressional mandate to deal with this problem.

One other move in the low-level waste area, which affects our technical assistance and research work, is the increasing concern about nonradioactive hazards associated with the low-level waste.

This is coming about as a result of the resource conservation recovery act, and the EPA's regulations and rules to implement that act.

We have some technical assistance work underway now to confirm our current understanding of the nonradioactive hazards associated with low-level waste. And, as we get

into that more, that may very well also dictate some additional work to understand how to better control those hazards.

For example, one of the low-level wastes that get disposed of in shallow land burial sites are liquid scintillation vials. They are used in the medical world and university worlds. Those have toluene and xylene associated with them. So in addition to the radioactive concern there's the concern about the nonradioactive hazard associated with that and its impact on the ground word.

MR. MARK: You can't separate that and hand the toluene to EPA and say: You fix it.

MR. BROWNING: The degree that we have been able to do that is that at the very low end of the radioactive hazard we have gone through a rulemaking which indicated that certain liquid scintillation vial materials have a low enough radioactive content that they are below regulatory concern, from our standpoint, and therefore could be handled in an EPA hazardous waste site.

Above that threshold, we have been approaching it from the standpoint of: We will handle the total hazard. We will not just look at the radioactive hazard and ignore the chemical hazard. We'll work closely with EPA to ensure the way we are doing that satisfies their technical

knowledge about the effects of those things.

MR. MARK: Unfortunately that makes sense, even if it complicates the business.

MR. BROWNING: It does complicate it and that's not completely resolved now. We are still working with EPA with the ultimate goal of avoiding duplicate regulation at low-level waste sites.

MR. SHAPIRO: Hasn't your incineration approach to toluene taken care of much of that problem? Hopefully we don't bury toluene; we burn it.

MR. BROWNING: That's right. That would be the preferable way to deal with it.

MR. SHAPIRO: Maybe industry is responding. Packard is advertising something that you can throw down the drain when you are done counting it, providing your municipality allows you to do it.

MR. BROWNING: That would be the other option, to see if you can't eliminate the hazardous component, come up with some other component that does not create the problem. Go back to the original source to avoid the problem in the first place -- cut through the Gordian knot.

I think that may be enough, unless you have some questions about the low-level waste disposal, I think that might be enough overall perfective.

MR. MOELLER: Mel?

MR. FIRST: Is anyone thinking about or doing anything about volume reduction by way of incineration? Or is that now a dead issue?

MR. BROWNING: No, it's not a dead issue. We, of course have issued, the commission has issued a policy statement saying we support volume reduction. Which is, I guess, about as far as we can go to promoting something.

When people come in with proposals we attempt to move as quickly as we can to do whatever we can, what we have to do with regard to the licensing of the facility.

People are attempting to bring facilities on the line, but, again, they engender a great deal of local opposition. You know, that's something that entrepreneurs and people that want to put those things on the line have to deal with.

To the extent we can make sure that facts are available and the correct perceptions are abroad as to the health effects of that, we'll attempt to do that. But we are not really in a position to try to promote it, per se.

MR. FIRST: Do you know whether volume reduction by incineration is being conducted at any of the national laboratories or any of the DOE sites?

MR. BROWNING: Los Alamos had been doing quite a bit of work on volume reduction by incineration, to develop the technology so that other people could mix it

up. That's the one that I'm most familiar with.

MR. MARK: They have been operating a incinerator, and apparently with fair success, for meeting the technical specs.

Is that purely experimental, or are they now turned loose to go ahead and use it for practical use?

MR. BROWNING: My understanding is they published all their information so it's available, primarily the reactor plant people. Whether it's being used at the other DOE facilities, I'm not sure.

MR. MARK: Is it being used locally to throw in the lab coats and other stuff --

MR. BROWNING: You mean at Los Alamos?

MR. MARK: Yes.

MR. BROWNING: I don't know.

MR. MOELLER: Is any commission or utility using incineration? We only heard or read about them planning to. But are any of them doing it?

MR. BROWNING: No. Some of the universities are -- for example, the University of Maryland was doing some work under contract with DOE to do some work on incineration.

DOE has been trying to, you know, provide the technology, develop the technology and make the technology available for expanded application. I think the major

hurdle is trying to get through the permitting process, local --

MR. SHAPIRO: If you had done it years ago like we did, we are in great shape. Our problem is our incinerator, they say our incinerator will not burn glass. That's the only reason why we are still shipping to Hanford, is that we can't burn the glass.

If we had been able to do that in the old days we would be in great shape.

But what I would like to do is I would like to rephrase a question I asked yesterday.

The main problem I think we have, and we, really, have a lot of problems, I think. Everyone involved in low-level waste in Massachusetts is very depressed. It has become completely politicized.

The main problem we feel we have is in getting the people who have to make the decisions to understand what's going on when you put something in the ground. The whole problem of transport and eventual exposure of the population; we pointed out yesterday that with incineration or with meteorology it's no real problem. People can appreciate what happens when you put something in the air and where it goes. But when you put something in the ground it seems very hard for people to conceive and to accept what you are doing.

What I would like to ask is that if technical people who are interested would like to take on the job, as we feel we have to in Massachusetts, of talking to our politicians and talking to the public and so forth -- do you feel you have done all the research you need to do? You have done a lot of it, obviously, through your codes and everything else, do you feel you have done enough research so you can give the appropriate technical material to technical people in Massachusetts who, in turn, then, will be the middle man to get that over to the public? Do you have codes that are readily usable? Do you have analyses that have been made? We have talked about the natural analogs. Do you have information so we can tell the people in New Hampshire, look, you have got all this uranium in the ground and it's not going anywhere?

Have you given this enough thought in your research so we can use your results?

MR. BROWNING: I have concluded we do need to do more of what you are talking about, to put our technical work in such a form that it can be digested by the public. I think, if you went and looked at our reports, I have been told by people like the League of Women Voters, who are quite interested in this subject, that we either send them reports that thick which they can't understand or digest, or it's in technical jargon, and they can't

understand it. Which is one of our problems. We don't know how to speak English.

For example, we go out and talk about waste streams and the public is sitting there thinking that there's a stream of water coming out of the site when we are talking about carbon steel drums full of dried material. So it's a matter of presenting your information in a form that it's understandable, and, hopefully, believable.

MR. SHAPIRO: I proposed that yesterday but we said perhaps that's not research and we shouldn't talk about that so much. Then I thought the other way. We have plenty of people in Massachusetts who could do that job, the academicians, faculty, people who like to write books, whatever. Plenty of people.

The point is, is that information now readily available and from your point of view, is it sufficient in terms of the research you have done, so that you can then -- you have actually set the ground, set the stage, so the rest of us now can do this sort of thing and get it over to the League of Women Voters, get it over to the Sierra Club, but more important get it over to the other scientists and engineers who the League of Women Voters turn to.

MR. BROWNING: I believe so.

MR. SHAPIRO: Natural analogs and things like that, who we we contact to sort of be a lead on that?

MR. BROWNING: Contact me. Maybe I could sort of use you as a judge, in effect; hey, is it in a form that is understandable? We are also trying to do that with the League of Women Voters, because they have a very active group. I spoke to them recently, they had represents from all the states coming in and they have put out -- they have put out some information which, I think, has been helpful in trying to put the whole thing in its proper perspective.

MR. SHAPIRO: They have been very responsible, in Massachusetts.

What you answer is you do feel that you have enough -- enough research has been done, so that it's applicable and can be used by people in Massachusetts?

MR. BROWNING: Let me put it this way. I think we could put together the body of information that we have developed. Whether it's sufficient or not, I don't know. And the big question mark is -- two things.

One, at the existing sites, they have only been operating -- in terms of they have only been closed, some of the sites have been closed and operating for on the order of 20 years. They have to operate for hundreds of years.

So I think people will always say, no matter what we think our predictive capability is, they will always be in

a position to say: Well, you haven't demonstrated it yet for the long period of time you have to demonstrate it. Therefore the jury is still out.

That's why Mr. Ebersole's question about, are we monitoring the sites, is so important. We have to keep monitoring the sites. Comparing the monitoring results to our predictive results, and to demonstrate over the long term that we can in fact predict how they are going to perform.

MR. SHAPIRO: What about the natural analogs, as we said before, that have been in operation for millions of years? Have you done much in this area?

MR. BROWNING: Well, the confounding -- maybe I better turn to our research folks.

In the low-level waste area they have had some studies where there have been cases where radionuclide have been migrating, so some work has been done.

MR. MILLER: Waste disposal issues are very, very site-specific, many of them. And while I think there is a lot of research that is available to talk about what can be done, you've still got to go to a specific site. And if you are to convince the public you have got to do a good job of characterizing that specific site. So I'm not sure if you are talking about waste disposal technologies or whether you are talking about waste disposal at a given

site. There's a big difference. And the research has to be site-specific before you can go do it at any one site.

MR. SHAPIRO: The question is, can I talk to the Massachusetts people without having to go through a million dollar site-specific analysis? Is there enough analysis and enough tools available so that I can use my PC, or whatever I need to use, and talk about what might happen in western Massachusetts; or what might happen given the general geology for a region?

MR. MILLER: Let me give you an example of the kind of issue that gets raised.

If you know the general situation of the geology, you can make certain statements. But there will always be the question about, well, what about the fractures at that site? And what about a buried channel, if you are talking about alluvial deposits for newer surface disposal? There are always those kinds of questions which you have to deal with. And you can only go so far in generic kinds of studies.

Do you see what I'm saying?

MR. SHAPIRO: Yes, but that doesn't help me. I have to be able to answer the fracture question by saying, well, I won't let the rain water get to the fracture, maybe. I don't know --

MR. BROWNING: I think maybe, instead of taking

more time at this session to get into that, I would like to volunteer to talk with you more on this subject, on the details. Because it's a question of great importance, I think, to make sure that our technical work is getting disseminated in a way that it's understandable and usable by people other than just the scientific community.

MR. MOELLER: Don Orth?

MR. ORTH: Going back over a little bit of the previous conversation, understanding that, yes, site-specific work, like for Texas or disposal-specific work, like the Surepack, needs to be done when people come in with them what do you see as right now you should be doing to either prepare for that? Or what are you doing? Just holding water and waiting?

MR. BROWNING: No. No. Let me make sure you understand one other thing that's going on.

Since we issued or regulations at the existing burial sites, they have been upgrading to meet our new requirements for waste form. Okay?

Topical reports have been coming in from the companies that are producing higher integrity containers and new solidification techniques. So the licensing staff is in the process of reviewing those reports.

One of our attempts to encourage that was to get approval to perform those reviews and do topical report

approvals, without charging for it. In other words, there's no licensing fee charged to the companies that have come in with those things.

That's a fairly large effort on our part. That is an effort that's going on that will have an impact on improving the performance of the existing disposal sites that are currently receiving waste from people.

The kinds of things we are talking about here, the Surepack, et cetera, that's something that would come on the line at new sites. It probably will not impact the existing sites.

In terms of the research program, the research people will talk about the kinds of things they are thinking about doing to address the very question you are talking about. In our topical report reviews, as we find questions in reviewing a particular material -- for example, one of the high integrity containers is high density polyethylene.

If questions arise as a result of those reviews, we feed that information to the research people so they can make sure their research programs are addressing it.

The main thrust is that we are trying to put the burden on the companies that are proposing these things, to do the kind of work necessary to demonstrate their performance.

We do not want to get in the business of providing the data that people will use to sell their particular product.

It's a balance between those two concerns. And we have a very active interface with our research folks to make sure that, as we get these applications and as we see the potential for new applications, we are feeding that information to them so they can factor that into their longer range research programs.

Most of the questions would be related to the long-term performance of these materials. Because most of the people can only get short-term data and then extrapolate its performance out to the long term. I think most of the research questions that will have to be addressed is, how do you confirm over the long term the performance of these engineered materials that people are bringing along the line to improve the capability of the disposal sites to retain the radionuclide? So the kind of questions you are trying to address are of secondary concern. The primary concern is convincing people that you know how to predict the performance of that package once it is buried in the ground, and you've got confidence that the radionuclide are not going to make grade out very quickly and that's going to be stable with time. It's not going to collapse on you.

MR. MOELLER: Okay, let's move on, then, to

high-level.

MR. BROWNING: And just as an aside, the vast majority of our technical assistance work is oriented towards waste form and package behavior, because we think that's a very important part. It's important that you put your money where you are convinced you know how the source term is going to behave so when you get into these predictive model situations, you have a very accurate and well defined source term to deal with.

MR. SHAPIRO: Yes -- I don't want to take the time, Dave -- but in the end when you are talking to the public you might as well forget about all that. They want to know if this stuff is leaking out and what's going to happen once it starts leaking out.

MR. BROWNING: We have two populations.. One is the existing sites which are leaking and the other is the existing sites in which people are moving in the direction that make sure they won't leak.

MR. SHAPIRO: But they will leak in time.

MR. BROWNING: They will leak in time. You are exactly right. They have to be careful that they don't oversell that they won't leak with time.

In the high-level waste area, the Department of Energy is in high gear, investigating sites to narrow down to three sites to characterize for the potential first

repository.

In December of this year we expect to get nine environmental assessments, which will be evaluating the nine --

MR. MARK: Did you say December of this year?

MR. BROWNING: Yes, sir.

MR. MARK: The next four weeks?

MR. BROWNING: December 20th in particular. That will be our Christmas present from DOE.

MR. MARK: Christmas present.

MR. BROWNING: The vast majority of our technical assistance work in the high-level area has been keeping up to speed with the DOE program so we can review those documents as quickly as possible and with as much technical knowledge as we can get.

Our whole interface with the Department of Energy is oriented with the desire to make sure we are familiar enough with their programs so that issues, if there are issues, and questions that need to be addressed are addressed as early in the process as possible. And get resolved as early as possible in the process. And we think -- and Mr. Miller will get the specifics on that but we think we have been fairly successful in that regard.

Mr. Rushi, who has taken over the Office of Civilian Waste, has been applying some of his own thinking in terms

of how to make this whole high-level waste management thing make sense from the overall system standpoint. He addressed the commission recently, giving his latest thinking.

One of the concepts that embedded in the High-level Waste Policy Act is the concept of a monitored retrievable storage facility. In the act it's conceived of as an option. I think originally, DOE was looking at as, in the event the repository didn't come on line in time to take water in 1998, the monitored retrievable storage facility would be an option to allow more time for the repository to come on the line. Mr. Rushi's thinking, as I understand it, is that it's an integral part of the overall high-level waste management approach, and would probably end up being more than just a temporary storage facility -- like a warehouse where the stuff comes in, sits for a while, and then comes back out; but would be a facility that would take the waste and have the capability of putting it in whatever packaging is required to be compatible with whatever repository ends upcoming on the line.

So, it's sort of an expanded, more complex facility, than what a lot of people had in mind when they had in mind a monitored retrievable storage facility. So that's a new concept that's coming on, on the line. And Hub can

talk about that a little bit.

It is going to be a very important concept as he conceives of it.

MR. MOELLER: I think we should hear something about that.

MR. EBERSOLE: I'm wondering why that can't be the end of the line for a long time.

MR. MOELLER: Let's hear about it.

MR. MILLER: Well, I thought about, as a backdrop to the discussion on the research in the high-level waste area, we would again review some things we have reviewed with you before. We'll do it briefly. And in this package in front of you, there are a number of charts. I won't talk about all of them but I included a number, just in case in the question and answer there's a need to.

The first chart shows the overall schedule for the high-level waste repository which, as Bob said, is the prime part of the Nuclear Waste Policy Act. The Nuclear Waste Policy Act does call for development of two repositories, and the law laid out a multistep licensing process which would lead to operation of the repository in 1998.

Before that, there would be, of course, the authorization to construct the repository, which is a

formal licensing action by the Commission; and prior to that time would be the process of characterizing at least three sites before one is selected for actual development of the repository.

Backing up, before that, in this coming year the department will be making a selection of those three sites from the nine sites that they are now considering for the first repository and have been investigating.

Mr. Rushi's concept of the MRS as a facility that would do more than just store is something that is very recent. And I don't think that there's been anything published formally. In fact there has been nothing formally published by the DOE.

But, given the slips in DOE's schedule that have occurred over the past year or so in establishing the siting guidelines which the law calls for, for them to develop to guide this whole process of site selection; and then, in turn, the process of issuing the environmental assessments, so-called, which the law calls for them to issue to document how they decide -- they make those site screening decisions, the repository program is slipping a year or to here at the front end.

And I think it's -- you consider that, and you also consider the fact that the department has firm commitments, legal commitments with utilities to take waste by 1998, it

appears certain that some form of MRS will be needed to be able to meet that commitment of taking waste. And I don't know that there's a whole lot to add to what Bob said about DOE's plans for this MRS, other than some of the concepts that we have seen involve taking spent fuel and actually cutting the fuel to be able to consolidate fuel inside packages, but beyond that I don't know that there's a whole lot we can say.

MR. FIRST: Question --

MR. MILLER: Maybe sometime in the future we can go into some detail on it. But DOE has just offered more preliminary thoughts than anything else.

MR. FIRST: What is the situation with regard to siting these monitored retrievable storage? Is this going to be a problem, similar to the permanent sites? Or has something already been done to assure that such sites will be available when they are needed?

MR. MILLER: I'm certain that they will have to encounter much of the same sort of problems that the repository in the site selection process has encountered.

So far, the MRS has been, as Bob said, a backup. And all that's been done is the engineering work and conceptual design work.

MR. BROWNING: It has been done generically, not site-specifically.

MR. FIRST: No sites have been tentatively selected --

MR. BROWNING: The Act says the monitored retrievable site could not be in the same state as the repository. If you don't want a repository, you might volunteer for an MRS.

MR. EBERSOLE: It's been said this process has been highly politicized and the reason for that is who in the world thinks that we can make 10,000-year decisions, that we are that smart, that we can invoke nonreversibility? I see in that a root basis for all sorts of political, public unrest.

As I see it, the public rightfully says: How the hell are you so smart to see ahead 10,000 years? I think that's a keystone.

MR. BROWNING: Except the public has spoken through Congress and said this is what we want done. And until Congress changes the law --

MR. MILLER: But to deal with that, I think the regulatory approach we have taken is sound. And that is, multiple barriers.

You are right. You cannot go to the public and have them have the feeling that you are just getting by by the skin of your teeth. It's got to be through arguments such as: We found sites which are stable, there is no water;

and you've got to have good programs to demonstrate that. And, moreover, we've got waste packages which add another barrier. There is no way --

MR. EBERSOLE: I hear you. Behind all of it, though, is irrevocability, which is the roots.

MR. MILLER: The other thing we do, though, is in doing the analyses of projecting out 10,000 years, we do an exhaustive study of what can go wrong. And of course that will be the test.

MR. EBERSOLE: I can find a new ice age, I reckon, that far down the road.

MR. MOELLER: Yes, you can. But that has been considered.

MR. MILLER: To get to the timeline here, and on one of your questions of MRS, the Department of Energy, by the way, under the law is to issue a mission plan, so-called, which lays out their program. They issued a draft of that this past year and they are now revising that. And we expect that that document will, in fact, lay out in some detail what their plan is with respect to this integrated system. And that should be sometime this coming year.

MR. EBERSOLE: Would it be wrong of me to say that maybe the public has built a monster by requiring irrevocability of storage? An unmanageable monster? And

that somebody should say something about the unreality of it?

MR. MILLER: We have a requirement for retrievability.

MR. EBERSOLE: In the short term.

MR. MILLER: Short term. And, frankly, you can't get mining engineers to say that a whole lot more than 50 to 100 years is -- for a whole lot longer than that, you can be able to go in and retrieve the waste. You might be able to, might be able to --

MR. EBERSOLE: Oh, I'm talking about one designed for that purpose.

MR. MARK: The rocks will crack and sink.

MR. MILLER: If you go to the next chart, the chart that looks like this -- I should have had this numbered -- but this focuses on the period prior to licensing. And it's a bit busy. But it shows, if you look at, on the top schedule, on the top line which shows DOE's schedule, that in this coming year, as Bob says, we will be reviewing these environmental assessments. And those environmental assessments are essentially going to be very detailed technical documents, laying out all of the information that is known at each of those sites.

The department has gone to the printer on Monday, and having seen the preliminary drafts -- they are about that

thick, with many, many references, and essentially what they will be doing there is making interpretations on the data so far, saying what they think these sites are worth, each one of them; and ranking those sites so that the Secretary can recommend to the President the three for detailed site characterization.

We will be reviewing those documents at the NRC staff. We will be reviewing them for the purpose of determining whether we agree with those data interpretations or not.

There is an element of the EA that involves ranking the sites. And because that gets into a lot of very highly judgmental and subjective issues, such as prime farmland in Texas ought to be weighted more heavily than beautiful sunsets over the national parks in Utah, we are not going to get in the middle of comparing among the sites. But we will look at the factual basis upon which those kinds of judgments will be made.

So that's the biggest chunk of work this coming year will be our review of those documents.

Now, following that, after the President recommends three sites, the department has to submit to us detailed plans for characterization of those sites. And, within the coming year, if time -- if the hurdles are cleared for site selection, we will be receiving site characterization plans which are essentially scoping documents for their

license application.

Here are the specific issues we've got to resolve at each of these sites and here are detailed test plans for doing that.

This is an important point, I think, an important point to make here when we are talking about NRC research, is that the law calls for DOE to gather all of the data required to go through the hearing process. And one might wonder: Why are we doing research when DOE is required to do that?

Our view of research is to allow us to be in a position to be smart enough to make sure that the issues have been raised, to do a little bit of probing around in the same areas that DOE is probing around in, or is doing work in, so that we can confirm the results that they are gathering. But it is not at all to substitute for, or to relieve DOE of any burden as far as having data, collecting data that would address the issues that we are going to have to address in the licensing hearing room. It's similar to what Bob talked about before with respect to low-level, and not relieving the industry of that burden.

MR. BROWNING: One of your comments on our overall technical program is that we ought not be getting involved in every area that DOE gets involved in. I think that, just to clarify something that Mr. Miller said, we don't

plan to get involved in all the areas. We are going to make sure we know enough to pick the first order concerns and do enough there, that we are on good ground. There's no way we can, in our limited -- with our limited resources, match all the things that DOE is going to have to get into. It will only be those things related to the long-term safety questions.

MR. MILLER: Yes. Much of what DOE will have to do, that of course we couldn't duplicate. As it shows on this chart here, a major part of site characterization will be actually constructing shafts that get down to the level, down to the geologic horizon that they will be wanting to put waste into, and do detailed studies. That's something we wouldn't attempt to duplicate.

If I can go to the next couple of charts --

MR. MARK: Excuse me, you said part of the site characterization will be sinking shafts. They have had that wonderful drill sitting for the last year not sinking any shaft at all out at Hanford.

I see the site characterization is a matter of about 10 months in this graph. It takes longer than that to even sink a shaft and it takes another two years to decide what they are looking at.

MR. MILLER: The first question about that drill rig, the law prohibits DOE from starting construction of a

shaft until after they have cleared the site selection hurdle and have issued their site characterization plans.

MR. MARK: The shaft has nothing to do with the site characterization plan?

MR. MILLER: It does. They are going to have to sit on that out there until they've issued these plans. But they will use it, if, in fact, Hanford is selected as one of the sites for detailed site characterization.

They got caught up in the middle here, of --

MR. MARK: Look, I'm vaguely aware of some of that. But my point was the site characterization, if it depends upon what you learn after you have drilled, can't possibly be coming in sight for three years now, anywhere, if it requires a shaft.

MR. BROWNING: The site characterization is on an 11-month timeframe.

MR. MILLER: That's after they selected three sites for detailed work and it shows on this chart, from 1985, if DOE sticks to its schedules, out through the time they submit a license application to us in 1990. So we are talking about a five-year period of site characterization.

MR. MARK: I saw the ends of the arrows here in '85 and '86.

MR. MILLER: The ends of the arrows are the

period of time over which they will be submitting SCPs to us, the period of time over which they will be starting to sink the shafts.

MR. MARK: Excuse me, I put the emphasis wrong. It's the plan that's cooked up in 11 months.

MR. BROWNING: Only one element of the plan is sinking the exploratory shaft. There's a lot of other investigations that are going on also.

MR. MARK: Oh, yes.

MR. BROWNING: I think what this chart is intended to show is our present understanding. They are not going to wait until the site characterization plan is completely finished and everybody is agreed necessarily in order to start sinking the shaft. There may very well be a need, and the capability of starting the shaft relatively early in that process, because it is important to get down to depth to see what's going on.

MR. MILLER: The long haul intent is the construction of the shaft and completion of the testing of the bottom of the shaft. The hydrologic testing and bore holes around the site and chemistry work and other things done at laboratories, we can do on parallel, not on critical path. They are very eager to start that.

MR. MOELLER: We have a comment. Carl?

MR. GOLLER: Carl Goller, Office of Research. I

would like to amplify on something that was said about research and the NRC's activity in that area. I think he gave a very good explanation of why we do research, why we have to do research, the kind of research we do.

There's another aspect of this you should be sensitive to, and I think it relates to the use of this word "research." DOE has gone on record to say that they essentially do not have to do any research for their high-level waste repository. This has given us some problems in some circles, particularly in budgetary matters, as to why NRC must then do research. There's a lot can be said about this, but I personally think this is largely a matter of semantics, as to what someone interprets as research. And I think building on what Hub said, we are doing essentially similar work to what DOE is doing. They don't call it research. We do.

MR. MOELLER: Thank you.

On this discussion that just took place, looking at the chart that you passed out, it clearly shows that you will be sinking the shafts while the site characterization is being developed and completed.

MR. MILLER: Let me explain that. That's causing too many questions.

That, DOE will be submitting three sites or will be characterizing three sites. Depending upon which sites

are selected, there are -- they are far enough along on some that they could submit the SCPs much earlier than they could on others.

In the SALT program, however, they have done no -- very little, I shouldn't say no -- they have done very little, actually speaking, actual site investigation. They are further behind in terms of actually developing detailed plans, because unlike Hanford, Nevada, where they know exactly where the site is going to be, they have seven plans. If BWIP and Hanford, Nevada were selected, they would be admitted very early in this process, SALT much later. And you can imagine in the left hand side of those brackets, NTS, and BWIP, and the right side, SALT. But the sequence will always be SCP, and then shaft.

The other point is we are already taking up many of the issues that relate to the shaft, many of the potential licensing issues like how you seal the shaft and how you will be testing as you construct the shaft, because the lead times for procurement of shaft equipment and getting contracts in place is so long that, in this process, all along, we are trying to take up -- be sensitive to what's on critical path and take it up on a timely basis.

What you were pointing out is it looks like it's academic, to be taking up an SCP when the shafts are being constructed at the same time.

The next charts are in here just to review with you what the sites are that DOE is looking at for the first repository. Of course, Hanford, in a bay assault formation; and then bedded salt formations in Utah and Texas, and Gulf -- and salt domes in the Gulf Coast region.

In the next chart, briefly it shows the formations that DOE is looking at for the second repository, and these are all crystalline rock formations, granite primarily.

Now, during this whole prelicensing period, our objective is to try to get agreement on, A, what the issues are that are going to have to be addressed for licensing; and, secondly, what constitutes an acceptable methodology, if you will, for data gathering and analysis. So that when we get to the hearing room we are not quibbling over that.

And the process involves extensive interaction, even before we receive these site characterization plans and EAs. We have been interacting with DOE at each of the sites, taking up these questions.

We are, through a number of means, documenting our staff positions on what are the issues, and what information is needed to resolve those; and making those available to the public for comment. Our objective, here, and to take them to other groups, to knowledgeable technical groups -- the objective here is to build as much

consensus as possible on what is -- what are the issues and what constitutes adequate resolution, because this is a first of a kind thing. There are no standards that you can conveniently pull off the shelf for much of the data gathering that's being done. And so we feel that consensus is an extremely important thing; to get that technical consensus that will allow us to go to the public and say: We've got confidence.

Part of that also is peer review, review with the ACRS and others, and that's being done. And we hope on many other occasions, very important issues, selected issues, if we -- we feel if we can develop enough consensus to take those to rulemaking and actually eliminate them as issues in the hearing room, that's our plan during this site characterization -- or during this prelicensing period.

The next couple of charts are really just expansion on the point that I just made. If you wanted to we could go into it, but it's basically pointing out that there are a number of different vehicles we feel we have for documenting our staff positions.

Our analyses of the environmental assessments, for example, are a form of that. We are issuing technical positions, such as this one -- such as a series of positions we issued for each of the sites recently,

documenting what we thought the questions were at each site; and other positions such as position we issued on the Hanford site relating to what we thought was an acceptable program of hydrologic testing.

Similar technical positions are under development for virtually each of the areas that are of concern in high-level, and another form -- if you go to the chart that shows the -- looks like this, it's titled "Technical Reviews and Workshops" -- the form of documenting our guidance on staff positions is through a process of technical interaction and meetings that we have been having with the Department of Energy, that is face-to-face consultation with the DOE; and we document those meetings, our conclusions and our positions on the things that come up in those meetings.

These are all open meetings. They are open to the states, and in fact the states and tribes are invited to participate. We have tried, in fact, to take positive steps to assure that that happens so that they are raising their issues at the same time we are raising ours, and hopefully create a situation where the issues are going to be raised early. Not just ours, but those of other people who can have strong say on whether the sites get licensed or not, to involve -- to, through this means of interaction, get to the real heart of the matter.

When we sit back in the office and we deal in the abstract, we can go but only so far; and you've got to get out to where the data is being collected, out to the people formulating the plans, and have these kinds of interactions. And we have had 350 or so meetings over the past several years with DOE, all of them documented, and with the idea of, again, trying to establish licensing information needs.

Finally, if I could come to the chart, next chart, which characterizes the nature of our technical assistance just for a moment? One of the comments you had last time was that we ought not to try to build a complete in-house capability, technical capability, that we ought to not try to cover every possible issue there is, and in fact we do have a fairly substantial technical assistance contracting program where we are obtaining assistance and expertise in documenting these -- our positions on what's needed for licensing and giving assistance in the acquisition of a licensing capability, modeling capability of the staff.

Much of the issues are very site-specific and you've got to -- and the investigations are exploratory in nature, so you've got to develop the guidance in a step-by-step fashion, so we have expertise. We hire hydrology expertise, geochemistry expertise, and so on.

MR. BROWNING: By the way, we are fully staffed

at this point in time. Our problem will be retaining the highly qualified staff we've hired because they are in great demand in other areas. As we train them and give them experience, other people hire them away from me. It's going to be a continuing challenge.

MR. MILLER: This past year we prepared a so-called "user need letter" a statement of what we in the licensing office feel we need in the way of supporting confirmatory research. I think you have a copy of it. But basically, after having sat down and, through exercises where we systematically consider the regulation and all the findings that we have to make for licensing and the specific information needed to make those findings, and you have turned to DOE and told them: Here is what your program is going to have to produce, through such documents as these -- we then sat down and looked at, now: Where is there large uncertainty? Where are we dealing with phenomena that are highly uncertain, such as in the near field of the waste, where there's a lot of heat generated, and you couple the heat with radiation effects, and so on; where are there areas where we ought to be doing some of this probing around, as I described before? And we identified a selected number of areas. The key word is "selected" number of areas, where we thought, at least, NRC should be doing confirmatory research.

In the charts that follow, I won't go into these -- I think Frank, I'm sure, will cover these when he talks about the research program. But we identify, we highlight some of the kinds of issues that were identified in our user need letter to the Office of Research.

It's hard to do a quick review of what those issues are. I wouldn't propose to do that here unless you'd like to go into any of this. But we think we've done a pretty good job of laying out what our needs are and we have been working with the Office of Research to put in place specific programs which meet those needs.

Now, we intend to continue to update this letter, partly based upon our experience in dealing with DOE, and also partly based upon the results of the research itself.

I hope that what I've done here is just give you a background on the program and the high-level waste repository program in general, and a little bit about what our approach has been in trying to prepare for licensing.

So, with that, unless you've got some more questions --

MR. MARK: You weren't going into this diagram which shows the accessible environment boundaries?

MR. MILLER: I wasn't.

MR. MARK: I wanted to ask, merely, it was that, what seemed to me at the time, pretty arbitrary condition -- I guess it's in 60 -- 10 to the minus 5th of the 1000-year

inventory per year limit on leaching.

Now, I see the release rate limit applies here on this drag, namely that's at the end of the disturbed zone, I take it? No it isn't quite, the edge of something else --

MR. MILLER: Edge of the engineered barrier system; not at the waste package but -- not at the cannister --

MR. MARK: As originally written, it was at the outside of a can. I'm relieved. I think that's getting better.

MR. MILLER: One of the comments that we got --

MR. MARK: If it were at the environmental accessible boundary, I'd be even happier.

MR. BROWNING: There's a lot of confusion on that, but the rule as promulgated is, as you show it on this little cartoon, it's not on the edge of the can itself.

MR. MILLER: I might just make one point on this chart and that is that the EPA standards of course are the things that dictate -- establish the overall release limits for the repository. And those, the EPA has not yet finalized their standard.

MR. MARK: Will that happen by 1998?

MR. MILLER: They are scheduled to finalize it this coming year, early in the year. But one of the key

issues, in fact, is where should the accessible environment be? They have always talked about that being at some distance away from the repository, and I think that's the way it will still be. Whether it's a mile or 10 kilometers is an open question. But one of the new wrinkles in the EPA standard is that they have a very stringent groundwater protection standard that is being -- that has been incorporated in one of the most recent working drafts, largely at the insistence of the states and also from the people in EPA who are responsible for groundwater protection. And the effect of that, as we interpret it, might be to make it almost moot the release limits to the accessible environment for some sites, because it calls for protecting drink -- protecting groundwater, very stringent standards within the controlled zone, and that the definition of what's an "aquifer" and what is "groundwater" to be protected involves relatively small amounts of water. So we are still following along with EPA as they finalize this standard. But it could put even much -- put much greater emphasis on the need for engineered barriers than before.

I just mentioned that just so you got the sense of the status of our -- of the overall regulatory framework. Our regulations are in place and -- but they -- they have a little opening there for the EPA standard when that's

promulgated, and our regulations are based upon the standard that has been circulated for the past two or three years, but there's a little uncertainty creeping in now as to just exactly the nature of that final standard.

MR. MARK: There's no way to reach those people and get them to take reasonable views?

MR. MILLER: We are in constant contact with the EPA.

MR. MARK: I had an end to that phrase -- you can get in contact. But you've never -- it never seemed that you could penetrate through the skin?

MR. BROWNING: There is a certain sense of frustration on our part in those interfaces but we keep up the interface, anyway, keep the dialogue going.

MR. MARK: How many people in EPA should one think of here? Are there five who are deciding this?

MR. BROWNING: I don't know how many people are deciding. There have been basically two groups that are involved. I'm not sure I've got the titles correct but there's the office that deals with radiation protection and then there's the office that deals with groundwater. And therefore lies some of the problem: You can't deal with just one office; there's two offices.

MR. MILLER: The states are also applying tremendous pressure on this question. So it's not like

it's just us and DOE --

MR. MOELLER: Thank you. Any other questions? Okay.

Are you going to cover the rest of the charts, Bob? The rest of these?

MR. BROWNING: I think the rest of those are really just for your background information.

MR. MOELLER: Fine.

MR. BROWNING: We could get involved in any degree of specificity you want. I thought maybe the best thing to do is give you an overview of our perception of what's going on so you can try to put that in reference when you hear the research people talk about the research programs.

MR. MOELLER: Sure.

MR. MILLER: Those are the charts we talked through last time with you.

MR. MOELLER: Fine.

MR. MILLER: We could come back to those if there's questions.

MR. BROWNING: The programs haven't really changed since we talked with you in May. Basically it's a continuation of the same thing, except as these new things come on, the non-radioactive hazardous portion, that may dictate some additional changes to our program. We have

to have a very close and constant interface with research to make sure that as these -- as the targets change or move, that our programs adjust accordingly.

We don't want to be continuing to do research on shallow land burial if the whole world is moving off in an entirely different direction. We want to do enough that we can deal with the existing sites and if a new site does come on the line; but we also need to get prepared for what the real world may present to us. That's the message I wanted to get across.

MR. SHAPIRO: Again, how is this, your problems, different from the general problem of disposing of very hazardous wastes in the ground like VFI or FVA? Some of the people who used Niagara Falls, who have developed these enormous pits, plastic lining -- instead of trying to keep away the water, I mean they try to do that but they also have a way of pumping these things out constantly so it's drier.

MR. BROWNING: The difference in philosophy behind our regulatory approach is we want to do it in such a way that you don't have to have perpetual maintenance.

MR. SHAPIRO: Their hazardous waste will last forever, too, obviously.

MR. BROWNING: They have built in perpetual maintenance.

MR. MOELLER: At least in my impression of the toxic chemical waste disposal systems, is that they leave a lot to be desired. I think they could learn a lot from the radioactive waste people. At least that's my personal opinion.

All right. Well, thank you very much. We'll take a 15-minute break and then resume.

(Recess.)

MR. MOELLER: The meeting will resume and we will now hear from the Office of Nuclear Regulatory Research, with their report on their activities related to high and low-level waste management. We have with us Frank Constanzi, who will be leading that discussion.

MR. CONSTANZI: I would just like to run through these charts that explain what our basic assumptions and directions are in the high-level waste, and then the low-level waste research program in the Office of Research.

To begin with, what provides our context, of course, is what DOE must do, namely that they must demonstrate that they have achieved the performance required by the regulation, 10 CFR part 60, meet the containment period requirement, the controlled release requirement, the groundwater travel time, and of course the EPA standard as it is proposed now as the 10,000-year release limit standard.

NRC, of course, to do its job of licensing geologic repository, must be assured that the application and the repository itself is complete; that is to say that all the significant performance factors have been identified, everything that needs to be examined has been brought to the fore.

Those things which will affect the performance of the repository have been understood and modeled, where DOE has done modeling to project the long-term performance, that the systems themselves that are going to provide the performance, the isolation of the waste from the environment having adequately characterized, and that the tests and experiments which have been done by DOE to make -- to collect the data and to analyze the data for making these long-term projections have been done in acceptable and meaningful ways; the tests are relevant to the case which DOE is making.

NRC research is to assist the licensing staff in doing this, and our job is to provide the results of research on the various technical areas to the licensing staff for their use in these prelicensing NRC/DOE interface meetings; guidance on the review of the DOE licensing submittals, both providing guidance to DOE, and what to say, and what points to cover and what is adequate coverage, and also to help the licensing staff review DOE submittals. That

leads, of course, to the conduct of the licensing review itself to help support the technical base for the licensing assessment, and also to assist the licensing staff in closing out issues through rulemaking.

Many times in the past, the results of research in other areas have allowed NRC to close out licensing issues through the rulemaking process, reactor regulations -- we expect, as time goes on with the characterization of sites for repositories and licensing of repositories, that the same sort of opportunity will present itself in waste management.

As mentioned earlier, there was a user need letter written in July from John Davis, outlining the kinds of research that the Office of Nuclear Materials, safeguards Division, waste management, would like research to do to help them do their job. And basically the research was of two types: All dealing with the capabilities and limitations and uncertainties, in particular for the methods for identifying and quantifying failure modes; that is, what can go wrong and how, and methods for extrapolating the short-term laboratory and field tests over the very long periods of time which the DOE will have to do its demonstration for, and for which the repository will have to operate.

Our research program, in order to remain relevant and

useful, has to track the DOE program because DOE is making decisions on sites and design of materials, and of course DOE waste management is also making decisions on what sorts of areas they want to probe very deeply into, what are the areas in which they are not going to probe quite so deeply.

As said earlier, none of us have the resources to duplicate and check at the same level everything that DOE is doing, so we have to pick and choose carefully. And of course we need to follow the strategy that waste management proceeds with.

The rest of this chart gives us an idea of what are the highlights of the issues that we are focusing on: Containment, controlled release, groundwater travel time, favorable and unfavorable conditions, and of course the EPA standard; and what are the main questions involved in these areas.

MR. MOELLER: In terms of the previous chart where you were talking about the user need expression, I gather NMSS writes -- in this case wrote to RES, and told them what, or told you, the research group, what they believed they needed to know in order to do their job.

MR. CONSTANZI: That's correct.

MR. MOELLER: Do you automatically do what they say? Or do you ever question whether they --

MR. CONSTANZI: Oh, well, yes. The user need letter is the basis for a dialogue.

MR. MOELLER: Okay.

MR. CONSTANZI: As well as provides a request of things they want done and we respond to the user need letter and have, very explicitly, in fact, for FY '85 and '86, as to what programs we are carrying out which we believe are responsive to the user need. And also we have some room for carrying out programs which we feel are necessary which they have not explicitly identified, but we feel are necessary either to making sure that our own program is coherent and complete, or that we feel are areas which still need to be explored because we are not really sure whether they are going to become major issues or not and we feel that we need to know more about them to lay them to rest.

Carl?

MR. GOLLER: I would like to contribute to that, Mr. Chairman. The user need letter is certainly not a unique feature. This is a very common --

MR. MOELLER: Yes.

MR. GOLLER: -- part of the Office of Research's activity, to solicit this kind of input from other components of the NRC that are the ultimate users of these research results. And, in many cases -- and it's

certainly true of this case, I'm sure Mr. Browning would confirm, that this user need letter was the result of a dialogue; not only is it the basis for a continuing dialogue, as Mr. Constanzi has indicated, but that the Office of Research had a considerable input into its development.

MR. MARK: You helped formulate questions as to what would be needed and also modified with what you thought could be achieved?

MR. GOLLER: Yes, sir. And suggestions on how to satisfy the needs.

MR. MARK: I have a question, out of great ignorance. On the first page it points out a possible source for rulemaking.

MR. CONSTANZI: Yes.

MR. MARK: Who actually does the grimy work of formulating, particularly the background statements for a rule? Is that done by NMSS in this case? Or is it done by RES?

MR. CONSTANZI: The Office of Research has the responsibility for the Commission's rulemaking in general. But the rulemaking is a cooperative effort between the two offices --

MR. MARK: Yes.

MR. CONSTANZI: -- and I would guess the details

of the procedures and the administrative portion is certainly handled, always within the Office of Research. But the construction of the rule, the policy position, of course, comes from the policy office. Construction of the rule, putting it together -- the technical positions are a joint effort.

MR. MARK: Well, there's usually a background statement which contains a fair amount of, hopefully fairly hard --

MR. CONSTANZI: You mean supplementary information in the Federal Register notice?

MR. MARK: Sometimes it contains a fairly decent discussion of hard data. Is that an RES undertaking, generally?

MR. GOLLER: Is your question specific, Dr. Mark, to waste management or is it more general?

MR. MARK: Not really, but it would include that and you can use that as a case.

For instance, supposing one has got some data on 1000-year performance extrapolations and stuff, and you are going to make a rule. You would be involved in the writing of the background, supplementary information package, to go with such rule.

Would that be something you would ask Brookhaven or somebodypto spend time on? Or is it done in-house?

MR. GOLLER: Since you asked the question in more general terms, let me answer it generally.

MR. MARK: Fine.

MR. GOLLER: The recent survey indicated that about half of the current ongoing rulemaking within the Nuclear Regulatory Commission, the lead on this is within the Office of Nuclear Regulatory Research. About half of it is distributed throughout other offices within the NRC.

MR. MARK: Fine.

MR. GOLLER: As to the coordination, the cooperation input on all of those, that varies from one extreme to the other as you described.

In the particular case of waste management, I think the two offices are particularly closely coordinated. And I believe in all cases the Office of Research has the lead on the administrative details and preparation of the documentation for the rulemaking. But in all cases we arrange for and have the ongoing cooperation and input from the division of waste management, NMSS.

MR. MARK: Now, does such an activity in a case like this or in some other case result in the need of your spending what we think of here as research funds? We don't think of the money you waste on your own time as being research funds. But if you take an FIN contract, then it is.

MR. GOLLER: Yes, it can. If the funds were specifically intended for that purpose, then if one really had a reason for doing so, you would identify that as tech assistance funding. The Office of Nuclear Regulatory Research also serves the function of standards development research. As you recall, there was once an Office of Standards Development that was subsumed into the Office of Nuclear Regulatory Research. That function still resides within that office.

MR. MARK: Yes.

MR. GOLLER: With that merger, what were previously identified as technical assistance funding was transferred to the Office of Nuclear Regulatory Research. There is not, on a routine basis, a distinction made in our office between that funding, that is between technical assistance and nuclear regulatory research.

If you recall yesterday, in some of the presentations, and particularly in the health effects area, Dr. Miller made a distinction in some of the programmatic efforts, most of which were identified as research, but there was one grouping identified as technical assistance. That technical assistance effort was aimed at the development of regulations and guidance.

MR. MARK: And was not part of the money that Congress tags as research funds?

MR. GOLLER: Yes. I'm afraid it is. Within our office, as I say, that distinction is not made.

MR. MARK: Oh, is it?

MR. MOELLER: Are you saying to us that the Office of Research has technical assistance programs?

MR. GOLLER: Yes, it does.

MR. MARK: But they will be subtracted from the total that Congress allows for research in the agency?

MR. GOLLER: Not within the Office of Nuclear Regulatory Research; the funds are commingled.

MR. MARK: Well, when I say it's subtracted from the total, I will mean when you spent that money you spent that much of your allocation.

MR. MOELLER: Your research money. Okay.

MR. GOLLER: Yes.

MR. FIRST: About what fraction?

MR. MARK: But if NMSS asks for technical assistance, that is not part of the same basket?

MR. GOLLER: NMSS has its own budgeted technical assistance funding.

MR. MARK: Right. And that is not what Congress specifies, when it says "only so much for research"?

MR. GOLLER: That is correct.

MR. MOELLER: Mel.

MR. FIRST: I just wanted to get a round number

as to what fraction of your research budget goes into technical assistance.

MR. GOLLER: As I already indicated, in many cases it's very difficult to make a clear distinction between the two. In some cases, for some projects the distinction is there and is obvious.

In many cases it's not, but I think, by anyone's separation of the two, the fraction of technical assistance projects within the Office of Nuclear Regulatory Research, dollar-wise, is small compared to the research funding. And I would guesstimate at this point it's somewhere in the 10 percent category.

MR. FIRST: Thank you.

MR. MOELLER: Bob Browning?

MR. BROWNING: I think it's fair to say that in the waste management area, in the rulemaking piece of research which is being referred to as technical assistance, that the resource that the research people expend on the rulemaking is entirely within the research staff here. It's not subcontracted out to someone else.

If there's any subcontracting out from the technical input behind the rule, beyond whatever research was done as research, we would do it.

As a case in mind, I think in the high-level waste rulemaking, if I recall correctly -- maybe you can correct

me -- when we were doing that we had under our technical assistance, some work at Sandia, to do some modeling exercises for us about the release rates and the 10 to the minus 5 number, but that was technical assistance work. The work that research did in framing the rule was entirely within their staff years, which doesn't show up in the dollars that they spend with the research.

MR. MARK: That's what I was asking, whether any of the money that we comment on which is not their in-house dollars but is only their out-house expenses, whether any of that is specifically chargeable to rulemaking? And you are telling me, not really?

MR. BROWNING: Not in the area of waste management. I think it would be pretty close to zero if not -- I think when Carl was talking he was talking about overall.

MR. MARK: Yes.

MR. BROWNING: All the research work that has been done, of course, phased into those rulemakings.

MR. MARK: True.

MR. BROWNING: But I think it's very rare, if at all that I'm aware of, that any contract is let to specifically support a rulemaking in the area of waste management.

MR. MARK: Fine.

MR. MILLER: When you consider the rulemaking that Frank was talking about and I was talking about before in the high-level waste area, at least, our thinking is to take these areas that have only the weight of the MSS or staff talking, in the rulemaking area, to take those with the same technical rationale developed for that, make that a rulemaking without a lot of rewrite, so that the purpose of going to rulemaking is simply to legally exclude from the hearing those issues. But the work, the drafting and the technical rationale that you are referring to, is being developed through this process that I talked about. So there's not a lot of --

MR. MARK: Develop their own technical positions?

MR. MILLER: Yes. They don't conceive -- it's not, I guess, right to conceive of another group or lab or somebody spending a lot of time drafting a rationale. It will have already been developed and then there's the administrative part that Carl talked about, but that's done in-house.

MR. MARK: Sorry.

MR. MOELLER: No thank you. Go ahead, Frank.

MR. CONSTANZI: As I said, the last time we were here, I guess it was in May, our research program is divided into three areas: Materials and engineering, hydrology and geochemistry, and assessment and modeling,

which will assist us in administering the program. The concerns of the techniques in the research within those categories are fairly similar, and allows us to better administrate the research programs conducted.

I would like to begin with the materials and engineering program, on high-level waste research. We have three objectives, program goals that we are trying to achieve here.

First to do with the assessment of the waste package failure mechanism, how the waste package fails, what are the consequences of it? That is to say, what does that particular mode of failure mean with regard to the performance of the repository.

The question of extrapolation of the short-term test to the containment period, 300 to 1000 years, which is currently in the regulation. And, lastly, the stability of the areas in which the waste packages are going to be in place, because obviously if those change, it will change the conclusions reached about performance of the waste package.

The next chart gives a bit more about what we are trying to accomplish in each of those areas, and the titles of the projects which we would plan to fund in FY '86. I have indicated where some projects are new, that is to say they will begin -- they are planned to begin in

FY '86. The others are ongoing programs.

Perhaps you could indicate to me what level of detail you want me to go in?

MR. MOELLER: I think for this first, for this morning, just do what you are doing, about that level.

MR. MARK: How large an item is that first one? How large an item is it in 1985? That number I believe you can mention here.

MR. CONSTANZI: Yes. The FY -- that's the effects of manufacturing?

MR. MARK: No, your package failure mechanism.

MR. MOELLER: The total?

MR. CONSTANZI: The whole thing? That's about $400,000 in FY '85.

MR. MOELLER: And take the middle and last, give us each one roughly for FY '85.

MR. MARK: Are they comparable? They are new starts.

MR. CONSTANZI: Well, for the short term tests, that's about $1 million in '85; and the stability of the emplacement areas is about 7 -- about $500,000.

MR. MOELLER: Okay.

MR. SHAPIRO: What are these electrochemical predictive techniques?

MR. CONSTANZI: Some of our research has

indicated that the onset of pitting corrosion, which we think is very likely the mechanism for waste package failure, could be latent; it could be a long latent period where there would be nothing observed and then pitting corrosion could begin very rapidly and proceed to fail the waste package in a relatively short period of time.

There seems to be some evidence that by monitoring the -- essentially noises, an electrical noise level on the surface of the containers, one might be able to detect, early on, the onset of this latent pitting.

This would be -- you know, DOE is under obligation, under part 60, to have an in situ monitoring program in the repository during the operational stage. This is a possible technique for looking at the performance of waste packages during that period.

MR. SHAPIRO: Is this a stainless steel surface you are looking at or what?

MR. CONSTANZI: This is a low carbon steel.

MR. SHAPIRO: Drum?

MR. CONSTANZI: This would be the waste cannister.

MR. MOELLER: Fine. Go ahead.

MR. CONSTANZI: In the area of hydrology and geochemistry, we are trying to achieve an understanding of the interaction of the waste form and the waste package

with the groundwater. This obviously is the groundwater chemistry which is going to be controlling the reactions, both of the corrosion and failure of the waste cannister and ultimately the leaching of the waste. The behavior of the radionuclides themselves in the disturbed area, in the fields, both thermally and mechanically disturbed by the operations of construction and waste emplacement; and, lastly, to understand the mechanisms, the physics, if you will, of groundwater flow in the unsaturated zone.

Ultimately in that project we would hope to be able to have a quantitative model of flow in the unsaturated zone.

The next chart is specifics projects.

MR. MOELLER: Again, can you give us a ballpark of what sort of levels for '85, in each of the three areas?

MR. CONSTANZI: Yes. It's about, for the waste form/waste package interaction it's about $600,000; for the near-field it is about $900,000 and in the unsaturated zone it's about $300,000.

Incidentally, the project -- climate -- it was mentioned this morning, the possibility of climatic change, ice age was mentioned, particularly. This is a project which we are participating in with a number of other agencies, including the National Science Foundation, looking at past climates to try and get some feeling of how one ought to predict what future climates might be.

And, by that, by what sort of climatic change a repository site might undergo and what would be the effect of that on the assumptions under which the repository was sited and designed.

MR. MARK: When you assess or make dose estimate assessments, you assume a population density. What do you assume, in the case of an ice age?

MR. CONSTANZI: Assume for what purpose? You mean population?

MR. MARK: The population density as the base for your dose estimate.

MR. CONSTANZI: Let me make a remark about that. The EPA standard is a release standard. It is not a dose standard. And the EPA has taken the responsibility for saying that the released quantities under that standard are safe. And the analysis which, the demonstration which DOE must perform and the analysis which we must do over the long term is relative to those release limits. So we will not be considering population or dose in our licensing of a repository.

The question of climate is not so much as to what will be delivered dose, it's the question that we are looking at is the mechanistic one, as to how does this change --

MR. MARK: Whether glaciers scour it out --

MR. CONSTANZI: Scour it out, change the

hydrology, change the chemistry of the ground water, all of which affect the chemistry and release.

MR. ORTH: Is this a continuation of a discussion we had on this at some previous meeting?

MR. CONSTANZI: I'm not sure.

MR. ORTH: We did have -- I forget who it was that came in, but we had several speakers discussing the effects of the glacier, the depression, and all the rest of these things.

MR. CONSTANZI: The purpose of this contract is to be able to make us smart enough to be able to assess that and to know how DOE should take that into account in its performance demonstration.

MR. EBERSOLE: I can't help notice, it's rather fantastic to note the extremes. On the one side we are at the ragged edge of thermonuclear war and on the far edge we are into this business.

MR. SHAPIRO: As you go deeper into the ground your geology changes, your chemical composition changes. Is there any way on a specific site, as you go deep into the ground and notice changes in chemical composition, to be able to get some estimate of transport from deeper regions to upper regions?

MR. CONSTANZI: Oh, yes.

MR. SHAPIRO: Is that just a naive question?

MR. CONSTANZI: No. There are a number of ways of coming at that. Of course it depends on what the specific site is. But looking at the chemical composition of the groundwaters as they change with depth, the isotopic mixes of certain isotopes, for example carbon 14, also gives an indication of whether they are mixing -- there's mixing of groundwaters between levels, between aquifers.

There are also specific hydrologic -- hydrogeologic tests which can be made, packing tests and pump test, which would give an idea of the communication between various aquifers and hydroscopic units. So there are tests which are currently available to be conducted --

MR. SHAPIRO: The water tests. But in terms of just taking samples and then you would analyze the chemical composition, you see what effect the upper layer is reflected in the transport of the lower level.

I'm trying to think again of natural analogs. Do you have lots of data there on what sort of intermixing you may have, say between something that may be 500 feet down and something that is 100 feet down?

MR. CONSTANZI: That is a very site-specific question.

MR. SHAPIRO: But do you have data that a person like myself could reach into?

MR. CONSTANZI: DOE, for example at the Hanford

site, is developing such data. They are under obligation to do that, of course. We -- our research programs -- we do have research programs that look at ways of analyzing such data to try and interpret that, to see whether there is mixing --

MR. SHAPIRO: For how many sites would you say, or areas, or general geographic locations, is such data available? How many places have been analyzed that way?

MR. CONSTANZI: I'm not sure I can answer that question. DOE is doing that at the Hanford site.

MR. SHAPIRO: That's one site. Yes.

MR. CONSTANZI: The Nevada test site, of course, that site is in the unsaturate zone, so that doesn't apply.

MR. SHAPIRO: You haven't done any of this?

MR. CONSTANZI: We have not analyzed any specific sites in that sense. We have field tests under our hydrology programs, and we are looking at the migration of radionuclide around ore bodies, which gives us some historical perspective of how radionuclides behave over the long term in the so-called far field, but we haven't tried to analyze a specific site.

MR. SHAPIRO: You haven't given any contracts to anybody to give you just general information, possibly model validation, things like this, to use on the site -- there's nothing in this area?

MR. CONSTANZI: Not that I'm aware of. Information of course exists for specific sites and specific areas of the -- there's data on hydrothermal sites that the Department of Energy and the USGS have developed for other purposes, the hydrothermal -- for example.

We have availed ourselves of that data in our research programs and are continuing to do so to help us understand what techniques of data gathering and analysis are appropriate under what conditions, and which aren't. But we are not trying to analyze or characterize sites, to say that, you know, this kind of a site with this feature has this kind of specific behavior. If that's the sort of thing you are getting at?

MR. SHAPIRO: What what about, say, a specific type of geology. For example, Massachusetts has a specific type of geology. Would there be data available to say, for example, if you took a core sample from 500 feet down and one from 100 feet down to see to what extent -- thinking in terms of body compartments -- to see to what extent the 500-foot-down compartment is being affected -- at all -- the 100-foot-down compartment? Or is there complete isolation or some kind of transfer rate coefficient between the two?

MR. CONSTANZI: I think the data you are talking

about would have to be taken at that site. You'd have also to do hydroscopic data, some core analysis --

MR. SHAPIRO: But is there not data for a specific area someplace to give me a feel for the whole problem, is what I'm trying to say.

MR. CONSTANZI: USGS might have that data.

MR. SHAPIRO: Who might?

MR. CONSTANZI: USGS. I don't know that.

MR. MARK: You spoke of ore body exploration study.

MR. CONSTANZI: Yes.

MR. MARK: Do you have all the data, then, that has been collected in the mine in French Africa? The Gabon?

MR. CONSTANZI: We have been using that data in our research programs.

MR. MARK: A classical example of nonmigration.

MR. CONSTANZI: Yes. You know, the difficulty we have is that nonmigration, unfortunately, doesn't tell us as much as migration.

MR. MARK: No. I realize --

MR. CONSTANZI: Because the real problem that we have is to try and project, understand what will happen over the long time.

MR. MARK: When you have water-saturated clay.

MR. CONSTANZI: We have a program that is ongoing with the Australian Atomic Energy Commission, which looks at some rare ore bodies, I guess, in the northern territory of Australia.

MR. MARK: Okay.

MR. CONSTANZI: In which radionuclides have migrated under a variety of conditions. And we have been trying, over a number of years, with a good deal of success, of correlating what has been observed with the kind of test one makes in a laboratory --

MR. MARK: Okay.

MR. CONSTANZI: -- to predict --

MR. MARK: You had picked up that kind of stuff. It had crossed my mind to go -- it might have been fun to go up to Great Bear Lake, in the summer, to see how far that might have migrated, if at all.

MR. CONSTANZI: That particular subject is the one titled on this sheet "Radionuclide Migration."

MR. SHAPIRO: Can I ask you again a simplistic question? Again, I suppose. The ore body problem is almost a point source problem, I suppose. Over a large region, you have an ore body and you try to see how it has migrated out from an identified source?

MR. CONSTANZI: Well, the source is large. It's fairly distributed, and it goes through a number of

stratographic units.

MR. SHAPIRO: So it's multiple point sources?

MR. CONSTANZI: It's multiple point sources and it's going through multiple geologic environments, both geologic and hydrologic environments. So, with this work we are able to get an idea of the kind of conditions under which the radionuclide migrate and the change in rate they migrate under varying conditions.

MR. SHAPIRO: It's like shielding problems, in a way. In contrast to the multiple point source of a distributed ore body, what about the -- again to get back to my previous question, I looked at that as possibly a distributed volume source, if you have different strata, and then you are looking at interactions between the two.

What I'm trying to say, is it possible to almost get as much information from looking at distributed volume sources in general, anywhere, in contrast to looking at the more point source-type system that you get when you look for particular ore bodies? Can one mine this data, just in our own environment, is what I'm trying to say, to determine transfer coefficients between different compartments, different altitudes, and different depths, and that sort of thing?

MR. CONSTANZI: If you are dealing with a fairly monolithic system like pluton, or something of that sort,

which doesn't change very much -- it's homogeneous -- then I'd say the chance is very good.

On the other hand, if you are dealing, like we have in many of the sites, where even in the case of Hanford, the flows were laid down at different times and they have slightly different, certainly physical properties but also different chemical properties, it becomes a much more difficult problem and I don't think you can make that kind of ready extrapolation.

MR. SHAPIRO: You can't learn from what you have got about what you might have in the future?

MR. CONSTANZI: Oh, no. If you are talking about can you learn, by looking at what's there now and the processes which are going on at this time and have gone on in the past, the geologic processes and the hydrology --

MR. SHAPIRO: Not that, but looking at the chemical composition up and down.

MR. CONSTANZI: Looking at the chemical composition, yes, you can make some extrapolations and we will be -- DOE will be doing this about what they expect the environment to be in the future, certainly. What they expect the chemistry to be, the hydrology to be. One has to do that, or DOE has to do that, specific to each stratographic unit as well as to the whole system. You

need to look at it piece by piece, very carefully; and also look at the interfaces between the two. It's not an easy task. It's not a simple task. The more complex the geology, the more complex the task.

I hope that answers your --

MR. SHAPIRO: I'm trying to answer that to doing an internal dosimetry problem, where you have so much stuff in the liver, so much in the heart, so much in the kidney. I'm looking at rate constants.

To some extent one doesn't have to know the exact physics of a membrane -- of a transport between organs to know there's some sort of a steady state situation and perhaps have rate constants between the different organs. So what I'm trying to say is without necessarily knowing the whole -- going through the whole groundwater analysis and everything else, just by looking at the distribution of components in different volumetric regions, which we come up to some sort of a rate constant situation?

MR. CONSTANZI: I think certainly you can always do that as a first approximation, but I'm not sure how good that would be. Because, remember, the carrier of the radionuclide is going to be the groundwater system. That's the mechanism for the radionuclide to leave the underground deposit. And how the water goes through the various geologic units and how the chemistry of the water

changes as it goes through the units is going to depend --

MR. SHAPIRO: But that's going to depend on everything else, also, in the past.

MR. CONSTANZI: That's right.

Lastly is the compliance assessment modeling in which we are looking specifically at how to write conclusions on the environment, at which the repository is going to be sited and the engineering is going to be comprised which is going to remain stable; how the radionuclides themselves are going to transport over the long periods of time; and what are the limitations in materials of the uncertainties associated with demonstrations of compliance, the uncertainties in the data, the uncertainties in analyzing the data, the uncertainties in making measurements, and of course the uncertainties in the models themselves. That is to say, the kind of approximations to nature that modelers are forced to make to be able to have practical models.

In the first area, in FY '85, our level of funding is about $250,000. Radionuclide transport, it's about $400,000. And the limitations question, it's about $500,000.

The last chart, the high-level waste just indicates how the results of this research will be used.

Our goal in transferring the results and, in fact, the mechanism by which we transfer the results of our research,

try to key on these things to make them useful to the licensing people.

We have initiated, not quite a year ago, the practice of having research summaries attached to the topical reports from our research, which give the regulatory context. You know, what is the issue, the regulatory issue we are trying to solve with this research? What the results are? What the researchers have found out? And what we think this means, or how this could be used by the licensing staff in doing their job.

If there are no further questions on the high-level waste, I would like to turn to the low-level waste program.

MR. MOELLER: I have one on the high-level. The NCRP, the National Council on Radiation Protection and measurements, the president recently sent a letter to EPA, DOE, and NRC, saying that the need for a definition of what is high-level waste was a crucial item in terms of where we go.

Who, within NRC, is responding on that?

MR. CONSTANZI: Well, I think Mr. Browning would respond best to that.

MR. MOELLER: Could you just tell us briefly, Bob, where that letter goes and what's being done?

MR. BROWNING: Is this on?

MR. MOELLER: Yes.

MR. BROWNING: We are preparing a reply back to the National Counsil. We agree with what they are talking about. That in fact is what we are doing.

Under the Nuclear Waste Policy Act, NRC has the responsibility of defining those wastes that are -- should be considered to be high-level wastes for purposes of disposal.

Here's a case where research is for the rulemaking, but we are working very closely together in coming up with what that ought to look like. And I think we are tentatively scheduled to brief you on that process sometime in December.

MR. MOELLER: Okay. That's adequate.

MR. BROWNING: We can get into that a little later, if you would like, after he finishes his presentation.

MR. MOELLER: The main thing was I wanted to be sure that something was being done.

MR. BROWNING: Yes. Their major thrust was government agencies involved in this ought to be working closely together, and we are; and that it ought to be subject to a lot of scientific scrutiny.

We intend to not only go through a rulemaking but to go to the various groups that can bring the kind of scientific perspective to bear, in parallel with the

rulemaking, to make sure we've gotten all the good ideas we could possibly get.

MR. MOELLER: In a similar manner, the Conference of Radiation Control Program Directors, the chairman and president -- or president, whatever he or she is called -- wrote to the chairman of the NRC, outlining what the state viewed as the technical questions pertaining to low-level wastes -- or was it surface storage of spent fuel? I have a copy of the letter. I can look it up. Are you familiar with the letter and are you responding to it?

MR. BROWNING: Is that a recent letter?

MR. MOELLER: It's not the last month or so, it's probably six months old. Show it to Bob, and let's just see who is handling that.

What is the date on that?

MR. BROWNING: June 15, 1984. Yes, we've answer it. Fortunately we have answered the June 15th letter.

MR. MOELLER: June 15th of '84. What was the general response?

MR. BROWNING: We worked closely with them in answering those questions.

MR. MOELLER: Fine. Okay. That's good to know. Well, go ahead then with low-level --

MR. MARK: Well --

MR. MOELLER: Yes?

MR. MARK: One terribly vague remark. It just came to mind in reading what you have here, radionuclide migration over a long time --

MR. CONSTANZI: Yes?

MR. MARK: I understand that you are really concerned only with the transport of radioactive radionuclides?

MR. CONSTANZI: Yes.

MR. MARK: On the other hand, in talking about this to anyone, I think one might carry in mind a little concern, or caution. Radionuclide don't migrate in any different way than other substances, because when they are migrating they haven't expressed themselves yet. It's cesium that's migrating, not radiocesium. Once it explodes radioactively, we become interested. It would be worth some care, it seems to me, to see if we are talking about the transport of radioactive materials. They are transported just like they have been, in the plutons or whatever. People think it's only the radioactive stuff that moves and jumps around and that the old geologic evidence isn't specifically relevant because it wasn't radioactive strontium. It's just a very vague feeling that one could get into a trap by letting people think that the radioactive materials transport differently, that

it's new and unknown.

MR. CONSTANZI: Well, you know, of course much of our research is, in the laboratory --

MR. MARK: I'm just talking about the public relations area. Not what you do in research.

MR. MOELLER: Go ahead with the low-level, then.

MR. CONSTANZI: What sets the stage for our low-level waste program is that concerns, or events -- of course the Low-Level Waste Policy Act, the forming of the the state compacts, there is, I think, a bit of a time crunch coming because the compacts may be able to restrict waste getting into low-level waste sites -- the compact states -- to only waste-generated within the compacts after January '86.

The agreement states we will still be in the licensing business. The shallow land burial compacts themselves will operate the low-level waste sites within the compacts.

There's been an interest, as Mr. Browning mentioned this morning, in alternatives to shallow land burial, and we view that at the beginning of '86 a need to begin assisting states in a number of technical areas with license reviews, demonstration of compliance, operating design criteria, site selection and screening and again alternatives to shallow land burial.

Let me mention at this point that our program in

dealing with alternatives to shallow land burial were not out to design nor demonstrate an alternative, or even a number of alternatives. Our focus is simply to understand what the properties, the characteristics of alternatives to shallow land burial which may be used, what these may be, what the safety considerations are, what the hazards are, what can go wrong, what is necessary to make them work.

We are not in the business of providing a design or providing selected alternatives or preferable alternatives to the states or anyone else. We are simply evaluating what the safety concerns are, what the important features are, what the assumptions are.

MR. MOELLER: Well, the DOE recently, certainly within the last six months or so, released a report in which they covered the range of alternatives to shallow land burial.

I'm interested in what you are saying this morning because, when we discussed this at one point with the NRC staff, the alternative to shallow land burial -- and I don't remember who it was, but the person we were talking to said that you weren't evaluating it because no real viable alternatives had been proposed, or that you didn't know about any viable alternatives.

So, when we saw the DOE report, we said to ourselves:

Well, there are viable alternatives and they looked at them.

Now, what you've just said is that the reason you are not evaluating alternatives is that they haven't been proposed. And until someone proposes them for licensing --

MR. CONSTANZI: No. I'm sorry.

MR. MOELLER: What are you saying?

MR. CONSTANZI: I did not mean to say that. I'm saying that we are not trying to select an alternative. We are not trying to say: This is an alternative which the states ought to go to. What we are trying to do is, looking at a range of alternatives, try to understand what the safety features are in those alternatives, what the design assumptions are, what things need to work for them to safely isolate the low-level wastes, and what the hazards are if things should fail.

MR. MOELLER: What you are saying to me is you do look at alternatives and you do try to weigh the pros and cons, or problems of each, but you are not out to recommend a specific alternative.

MR. CONSTANZI: We are not out to recommend or even say this alternative is better than that alternative. Simply, these are the assumptions and these are the problems with this alternatives and these are the assumptions and problems with that alternative.

MR. BROWNING: Apparently there's a misunderstanding because in one of our technical assistance contracts we do have a contract with the Army Corps of Engineers to look at alternative disposal concepts for low- level wastes. It was a follow onto our rulemaking when our rulemaking, as I indicated earlier, we addressed shallow land burial as practiced to date, factoring in the lessons learned from that experience. In the regulation and statement of consideration, we said: This doesn't preclude other alternatives." And we had a study underway to look at them, and I can go through the alternatives that we specifically looked at as specific, concrete alternatives, that would sort of bracket what we at least at that point in time thought people might be interested in.

MR. MOELLER: Good.

MR. BROWNING: One was below-ground vaults. The other was above-ground vaults. Earth mounted and concrete bunkers -- that would approximate the French facility, for example. Mined cavity disposal -- in other words, existing mines, using an existing mine to dispose of all of the waste. And augured holes, which is a concept in which the Department of Energy was and is running some experiments at the Nevada test site.

The reason for that study was to take a look, given

those alternatives, what, if anything, would we have to change or modify in our regulation for low-level waste disposal if someone were to come in with something approximating one of those approaches as opposed to shallow land burial?

We were, in fact, trying to get ready for what in fact is happening, where people, particularly in the eastern states, the humid states, are considering going towards something that is more engineered than shallow land burial.

MR. SHAPIRO: What's the earth mounted?

MR. BROWNING: Earth mounted concrete bunkers. That's like the French concept where they have a concrete pad and concrete piled up on the surface and you pile it over us, so you end up with a tumulus, which will be of great interest to future archeologists, I expect.

MR. MOELLER: This is helpful because I had the wrong impression of what you were doing. So I'm straight. Thank you.

MR. BROWNING: What the research people were saying, given those concepts, are there other uncertainties that ought to be addressed?

MR. MOELLER: Right.

MR. BROWNING: If you are going to other approaches, are there new questions that ought to be put to bed before people go too far down those lines?

MR. CONSTANZI: The next slide just gives the -- what technical information that we are focusing on, trying to provide in our program: What the characteristics of the wasting, what the radionuclide released from the waste is, the source term problem; movement through the soils on-site -- that's where we disturb things -- in the case of shallow land burial and even some of these other engineered concepts; the transport off-site; monitoring of performance, and of course the alternatives.

The next slide just provides -- is provided to give some perspective, to show that the NRC is not alone in the low-level waste business. There are other people who are actively doing things, studying the topics. But I think I should point out that most of what is being done is quite specific to sites, especially by DOE, in terms of their own operations. And that in terms of doing generic sorts of studies which would be widely applicable, NRC is pretty much the show.

MR. MOELLER: Now, you do meet -- at least Bob Browning talked about his interfaces with EPA, and the difficulties there. You obviously all are interfacing with DOE. What is the name of your interface, then, with USGS and EPRI?

MR. CONSTANZI: The annual DOE low-level waste meeting is perhaps a primary formal interaction. And the

staff, technical staff interacts quite frequently on an informal basis, just as professional to professional, with these people in the various organizations, to keep abreast of what they are doing.

We also, of course, receive reports of their work as they are released.

MR. MOELLER: But do you formally go to California, on a periodic basis, and sit down with EPRI?

MR. CONSTANZI: I wouldn't say on a periodic basis. We have done that. We talked with them quite frequently. At least the fellow who is in charge of our low-level waste, what we call our area leader, who kind of coordinates all our little research programs, talks to his contact in EPRI pretty often.

I can't recall the fellow's name offhand, the EPRI fellow. But he talks with him pretty frequently, has correspondence with them.

MR. MOELLER: And you receive their reports?

MR. CONSTANZI: Yes, we receive their reports.

MR. MOELLER: You are trying to keep up?

MR. CONSTANZI: Yes.

MR. MOELLER: You have contacts with them. How do you influence their research or how do they influence your research?

MR. CONSTANZI: Well, their research is very

developmental and it's pretty much aimed at helping their constituency, which is basically utilities.

Our research of course is not developmental, but while they were -- for example -- perhaps a good idea of how it went, EPRI had been doing some work on incineration. We had, in the past, done some research on incineration.

We were looking at the techniques that were being suggested for incineration of low-level waste as a volume reduction, and to try and determine what kind of properties of the waste form that would result in. So we were tracking what research which was being done by them in terms of methods of doing it; by doing research in terms of what do you have as a result? What do you get in terms of the chemical and physical properties, primarily the leachability of the waste form -- of the volume reduced waste, of the incinerated wastes.

One of the programs which we are doing now at INEL is characteristics of rad wastes in plant solidification of rad wastes. That is a developmental project that is being -- which we are tracking very closely, looking at what kind of characteristics that sort of solidified waste would have, and its leach properties, its physical properties for holding up over long periods of time physically, to judge what that is going to effect it in terms of a source for low-level waste.

MR. MOELLER: You got to a specific. Now, yesterday in our review of the research program, we heard from the chemical engineering branch, Keith Steyer, and he told us about two areas of waste research they were doing.

MR. CONSTANZI: Yes.

MR. MOELLER: How do you -- what is the nature of the decontamination waste, the chelating agents in them --

MR. CONSTANZI: Yes.

MR. MOELLER: -- and what impact would those chelating agents have not only on the migration of the waste from the waste package but on the soil through which they move.

Now, at the same time that he presented that to us we had a letter from Dr. Christopher Wood, at EPRI, outlining what they were doing. And it included a project on these chelating decontamination wastes, which sounded almost identical to the project that Keith Steyer reviewed.

So, I have two questions. One is, how does Keith Steyer's work relate to RES, and your work on low-level waste; and, number two, if you are familiar with what EPRI was doing, why did there appear to be this overlap between what Keith Steyer is doing and what EPRI is doing?

MR. CONSTANZI: My understanding of the work that Keith Steyer is doing, is carrying out, is that they are looking at the mix, the soup, that results from

decontamination incidentally. Their primary concern is looking at the methods for decontamination.

We are working with them on that project, to then look at the implications of that soup for low-level waste disposal.

I believe that the EPRI -- the work Steyer is supporting, and the work that we are supporting, will all end together. EPRI is developmental: How you do it? How do you decontaminate, because that's a real problem now. In the next couple of years all the BWRs are going to have to go through a decontamination, I think. That's my understanding; a number of them, anyway.

Keith's group is looking at the effectiveness of those procedures for decontamination, and we are looking at the question of, okay, what does that do to low-level waste? What class of low-level waste is that? Are they going to reduce that? Is that going to still maintain them in class C or is it going to shove them above class C? What stability of the waste form are you talking about? Things relating to disposal.

Now, I think the three areas are pretty much coordinated and the overlap, I believe, is only apparent --

MR. MOELLER: Okay, in looking at Dr. Wood's letter, I would agree that they are mainly looking at the use of the process as a removal of contamination and as a

control of occupational doses. So you are correct there. And that's good clarification.

But, now, why is that particular aspect of radioactive waste research within NRC being done over in chem engineering?

MR. CONSTANZI: Again, I think the chem engineering group is looking at what the effect of the decontamination is, and what's coming out of the decontamination process. Then they are passing it on to us. We are working closely with them. They are passing that information on to us and we are looking at how that affects the low-level waste.

MR. MOELLER: Oh, and he is not.

MR. CONSTANZI: He is not.

MR. MOELLER: Okay. Maybe I misinterpreted what he told us. We could look it up. But I could have sworn that he said they were looking at how to dispose of that as a waste.

MR. CONSTANZI: I think that "research" is looking at how to dispose of it as a waste; yes, definitely.

MR. MOELLER: You are?

MR. CONSTANZI: Yes.

MR. MOELLER: Okay. So you are assuring us that it's well-coordinated?

MR. CONSTANZI: Oh, yes. Definitely.

MR. MOELLER: Okay.

MR. GOLLER: Furthermore, I think you could generalize that even more. My understanding is that the research that EPRI is doing in this area is at least primarily, if not entirely, focused on the waste generators' problems, which is, after all, the folks that they represent. So they would be concerned about things like volume reduction, temporary storage, packaging, transportation. To my knowledge they are not doing anything in the area of waste disposal.

MR. MOELLER: On disposal.

MR. GOLLER: In the area of waste disposal research.

MR. MOELLER: Fine. Thank you.

MR. CONSTANZI: The next chart is just for background to show who is doing what in the world with disposal of low-level waste.

"Surface facility" is kind of a misnomer on that chart. It really is anything which is an alternative to conventional shallow land burial, as we know it.

We are, of course, keeping abreast of what other people are doing. And, in fact, the Office of Research has been actively pursuing research exchange agreements with other countries, that covers both high-level waste and low-level

waste, to make more efficient use of our research dollars to make sure that we get the benefit of related problems that other countries are actively researching so that we don't have to duplicate that research, and also that provides us with greater insights into the sorts of things that we ought to be doing.

Now I would like to talk specifically about our research program in low-level waste. Again like the high-level waste it's broken into three broad areas: materials and engineering, hydrology and geochemistry, and compliance assessment and modeling.

There is a parallelism also in terms of the kinds of objectives we are trying to achieve because low-level waste and high-level waste, many of the problems are very similar. The major difference, in terms of the science, is the fact that the high-level wastes are thermally hot. You don't have that problem with the low-level waste. And the geologic disposal is a lot deeper. And that does have a perturbation on the way you approach things. But basically you still have the same materials kinds of problems, still have the same hydrology kinds of problems, still have the same geochemistry kinds of problems.

Within our research program, we don't make an administrative distinction between high-level and low-level, and that has allowed us to take the results to

take the results of a lot of these programs under high-level and low-level and cross-pollinate the programs.

Much of our, for example, unsaturated zone work in low-level waste is applicable to disposal of high-level waste in the unsaturated zone. I might talk a little bit more about that as we go through it.

Okay, beginning with our materials and engineering, establish the properties of stable wastes and waste containers; assess methods for inhibiting water infiltration, in humid climates -- this is a particular problem with shallow land burial; investigate alternatives to shallow land burial.

The first area, properties of waste containers, our FY '85 funding was about $400,000.

The next area, assess methods for inhibiting water infiltration, was about $200,000 in FY '85. And what this project consists of is a demonstration of some things that we learned when we were doing some very site-specific low-level waste research. We found that by means of vegetation, particularly creating an environment, artificially, where the vegetation is stressed, hungry for water, that one could, through evaporation, control the water infiltrating through a trench cap. And this project is essentially a full-scale demonstration. It's being conducted out here in Beltsville, where, at the USGS --

U.S. Department of Agriculture, agricultural experimental station, where we have made some full-scale trenches that would be like those for low-level waste burial, putting a cap in there, putting vegetation on top, a particular variety, and monitoring water influx through the cap.

The last project, which is alternatives to shallow land burial, this is the engineering alternative. We are planning to begin that project in FY '86. The FY '85 project and alternatives, which we have going on now, which appears last on in these charts, is looking at the hazards. This is looking at the engineered features, what are the safety features, what are the suppositions.

The project that we have now is what can go wrong, and if it does, what are the consequences, that kind of project. We thought we'd start with that first.

Hydrology and geochemistry, we are looking at the effects of chemical complexants/enhanced mobility, both the naturally occurring ones found in soils plus the chelating agents, for example used in decontamination; assessing the contribution of the low-level source term to shallow land burial performance -- this is a project which we have a goal -- I don't know if we'll attain it or not -- but however close we come to that goal I think we'll be successful, and that is to developing a source term for use in assessing performance of low-level waste disposal

systems, and that would apply to alternatives as well as shallow land burial.

It's a complicated task because of the great variety of chemical, biological and radiological forms that go into low-level wastes, but we think we have observed enough from watching the way radionuclide behave in shallow land burial trenches and within the first few matters beyond the trench, that we can develop an effective source term. We'll try, anyway.

MR. ORTH: Can you give me an example of what you mean by "scurce term"?

MR. CONSTANZI: It would be related to the class of waste and it would be essentially a radionuclide, Curie per volume and species, sort of source, that would plug into an assessment model. That would be the ideal. How close we'll come to that I don't know, and we are working on that, but as close as we can do that, we will have been successful, I think.

It will at least make the job of doing performance assessment for low-level waste disposal a lot easier because they'll be able to make meaningful calculations instead of just guesses as to what's actually being disposed of.

The last one is the -- an assessment of what -- how good you have to model the sites in order to have

confidence in the performance assessments of low-level waste disposal.

On the chemical complexants/mobility, our FY '85 budget is about $100,000. The source term in FY '85 is about $200,000 -- is that's just starting up, and in the hydrologic and geochemical modelability, that's about $250,000.

The stochastic analysis of groundwater system is one example of a low- level waste water project which has applications in assessing disposal of high-level waste as well, especially in the unsaturated zone. And the Chalk River experiment, as that's termed, is looking at where the major uncertainties lie. Trying to partition how much uncertainty in demonstrating or inspect expected performance of a shallow land site is based on uncertainties in the hydrology, uncertainties in the source term, and uncertainties in the geochemistry.

That particular site, as I mentioned last time I was here, is ideal because the source term is very well known. The Canadians kept very good records of what they put into the site. The hydrology and geology are very well known.

They are very simple, first of all, but also very well characterized. So this allows us to essentially do an experiment and the Canadians have provided an experimental apparutus and we are just going in there and taking the

data. We expect to find some very good information from that, to allow us to better focus or confirm our focus on what we are doing.

Compliance assessment modeling, the two areas are establishing methods for field validating shallow land burial hydrologic models -- again, because of the nature of things, even if we are talking about some sort of engineered alternative to shallow land burial, we expect these sorts of results to be applicable because eventually the engineering will break down, things will leak out, and people will still want to know: Well, what happens then? And of course, the second item is identify the source of design failures and operationally produced failures for alternatives. This is a hazard analysis to the alternatives to shallow land burial.

Funding in each of those areas for FY '85 is about $150,000. The first one, low-level waste shallow land burial field validation, is a test, essentially a field test which we are going to be conducting of the stochastic analysis techniques that were developed under another contract that's listed under the hydrology and geochemistry, stochastic hydrology project.

MR. SHAPIRO: Where are you doing these validation tests?

MR. CONSTANZI: This particular validation test

is going to be done at the University of New Mexico, in our field site out there. It is a joint project with Pacific Northwest Labs and the University of New Mexico.

The last slide is how the low-level waste results will be used. And, again, like high-level wastes, it's ultimately in the licensing. In this particular case it's -- we have another customer, and that is the states. Through the Office of State Programs, we are providing the results of our research to the states to help them do their job.

MR. MOELLER: All right. Do we have other questions now? Yes, Don Orth?

MR. ORTH: One point of clarification, I would like. Do you have any document at all, or anything that documents the source of all that data you had on what all the alternatives were around the world?

MR. CONSTANZI: There are -- a major source is -- I can't recall the name of that document.

I'm Enrico Constanzi, research. Was your question with regard to the key on research techniques? I believe that came from a compendium that Kent Harmon advised DOE, it's called something like the International Source Book or something like that. It's a three- or four- volume looseleaf document that he keeps updating, tracking, both for -- at least in a summary fashion, fuel cycle activities focusing on waste management.

On that same chart, Frank Arsenault was good enough to point out to me that perhaps I should point out for ocean dumping for Switzerland and Great Britain, perhaps put a question mark next to that.

Switzerland was sending their low-level waste to be dumped out to sea but that has become very controversial and of late Switzerland is talking about placing both low and intermediate level waste in some form of geologic disposal, not as deep as high-level waste. I am not sure what Great Britain is doing.

MR. MOELLER: Other questions?

Well, I want to compliment both groups this morning on the presentation, particularly in terms of having it organized so that it, rather than giving us details, you have given us a big broad perspective which is what most positively we need. Undoubtedly we will have some questions, but we do have the opportunity to -- we have the opportunity to meet with you again through the full committee, the subcommittee meetings that are held the Wednesday before the full committee meeting for each of the next several months. And we will be, then, this morning, trying to put down on paper some of our initial thoughts. And, as I say, if we find, in trying to do that, that we encounter problems, we can always get back to you to fill in the voids.

Unless there are additional questions, I think what I'll do -- and I don't believe we need the '86 budget information, again, at this point. Because that will be changing and it will be refined over the next several months as our report is prepared. We can pick it up as needed at that time. Carl?

MR. GOLLER: If I can make a comment on that? You expressed an interest in some of the breakdown, the details of the '85 budget. The information which you already have, but it's provided to you more conveniently, currently, total fiscal year '85 budgeted research funds are $5 million for high-level waste, and $1.6 million for low-level waste.

I want to note that I said "current." We are still early in the fiscal year and if the past is any indication, it's not necessarily so that we will get to expend all of those funds during this fiscal year, if other financial problems and difficulties come up.

As you can undoubtedly deduce from the information we gave you, the considerable number of new starts that we indicated, we have requested a substantially higher amount for fiscal year '86. But, as you know, we are not at liberty to discuss that at this open meeting.

MR. MOELLER: Right.

MR. GOLLER: But we will be discussing that with

another ACRS subcommittee on December 12, at which we can go into details on that.

MR. MOELLER: Right. That will probably be an all- day closed meeting.

MR. GOLLER: It's my understanding that is so.

MR. MOELLER: We will be covering it at that time.

MR. GOLLER: Fine.

MR. MOELLER: We'll prepare our initial drafts today and match them over the next week and have them on the table, at least for that subcommittee, on December 12th. So we do have ample opportunity to, because we are getting this early start, to, hopefully, have a report that's, you know, well done.

Well, thank you.

Bob, could you give me the same numbers? Or give me the '85 research effort within the division of waste management?

MR. BROWNING: Yes, but the division of waste management for fiscal year '85, the dollar values for high-level wastes would be $6.57; and low-level waste, $1.4; and total waste management is $10 million.

MR. MOELLER: Well, I think it's important for the subcommittee to hear those numbers, because it shows that, in terms of waste management, that there's an

equivalent activity in each of these groups within NRC.

All right. Well, thank you again, then. And, with that, I believe we'll wrap up the formal subcommittee meeting and we will immediately go into executive session and probably go from there to a lunch break and then come back and work on our draft to get it completed in time. In fact, we are supposed to submit it to the subcommittee on Monday, to the subcommittee that's meeting on December the 12th.

So, thank you to all of our NRC staff members, particularly for coming out here on a Saturday morning. It is convenient for us as a subcommittee, but I know it's quite an added imposition on you and we very much appreciate your sharing your valuable time with us.

Thank you very much.

(Whereupon, at 11:40 a.m., the meeting was concluded.)

CERTIFICATE OF OFFICIAL REPORTER

This is to certify that the attached proceedings before the UNITED STATES NUCLEAR REGULATORY COMMISSION in the matter of:

NAME OF PROCEEDING: ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE ON REACTOR RADIOLOGICAL
EFFECTS AND WASTE MANAGEMENT

DOCKET NO.:

PLACE: WASHINGTON, D. C.

DATE: SATURDAY, DECEMBER 1, 1984

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission.

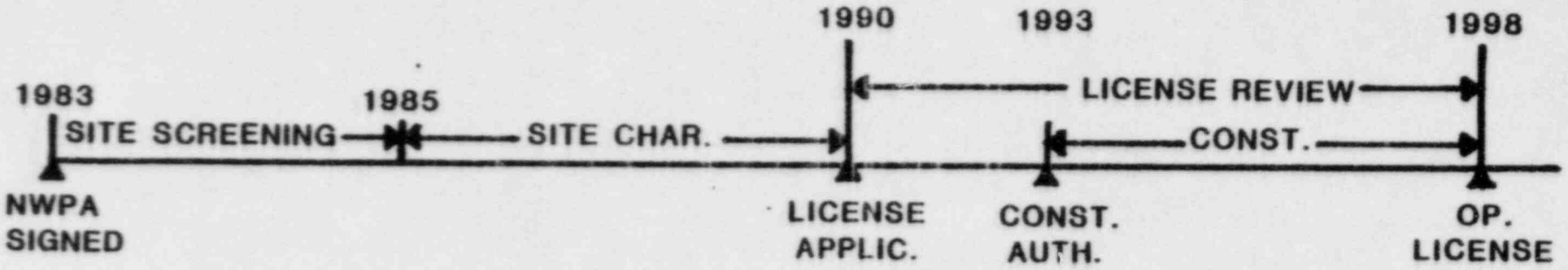
(sigt) Joel Breitner

(TYPED)
JOEL BREITNER
Official Reporter
ACE-FEDERAL REPORTERS, INC.
Reporter's Affiliation

HIGH LEVEL WASTE
LICENSING PROGRAM
AND TECHNICAL ASSISTANCE

R. E. BROWNING
H. J. MILLER

DECEMBER 1, 1984



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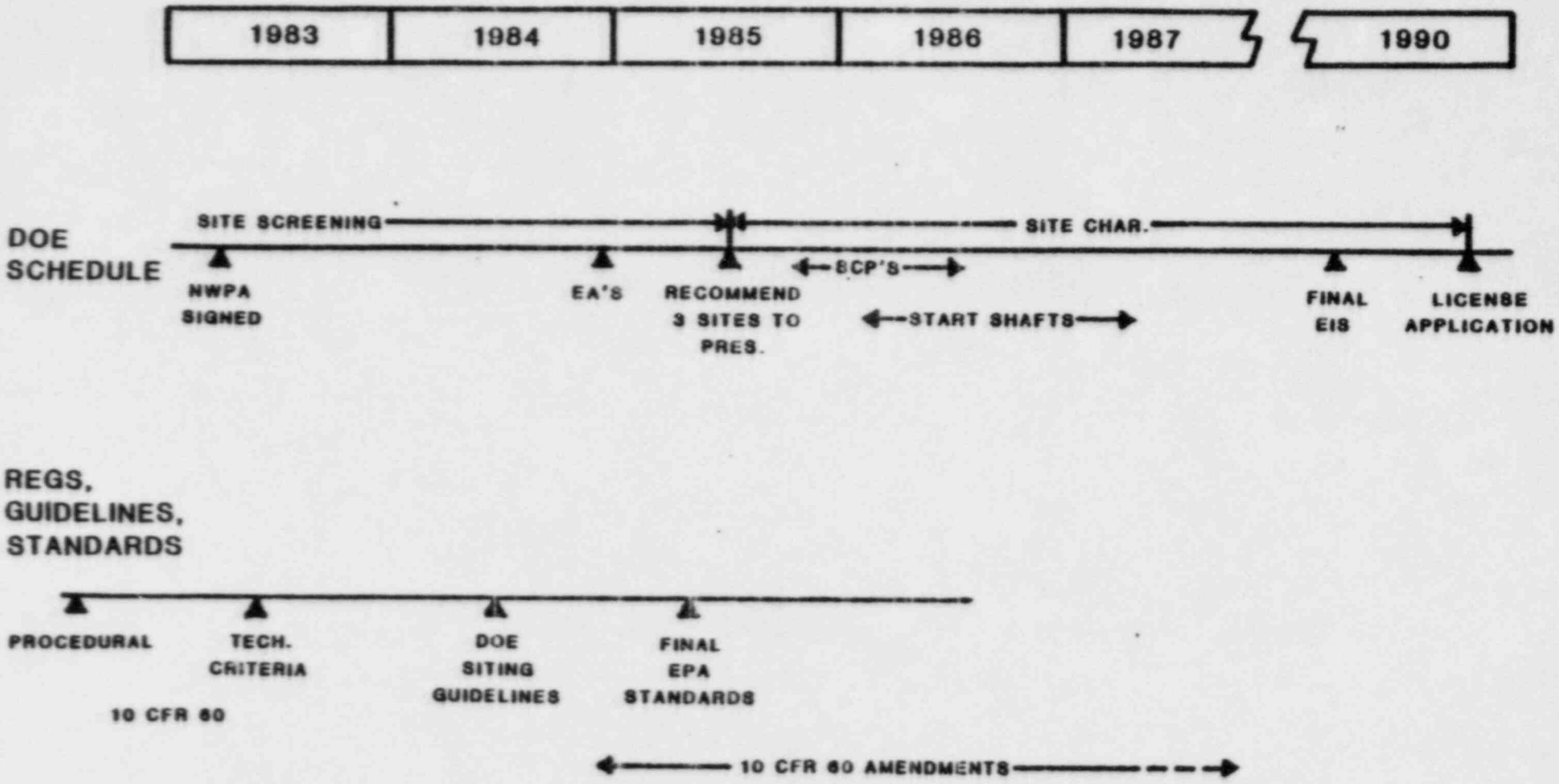

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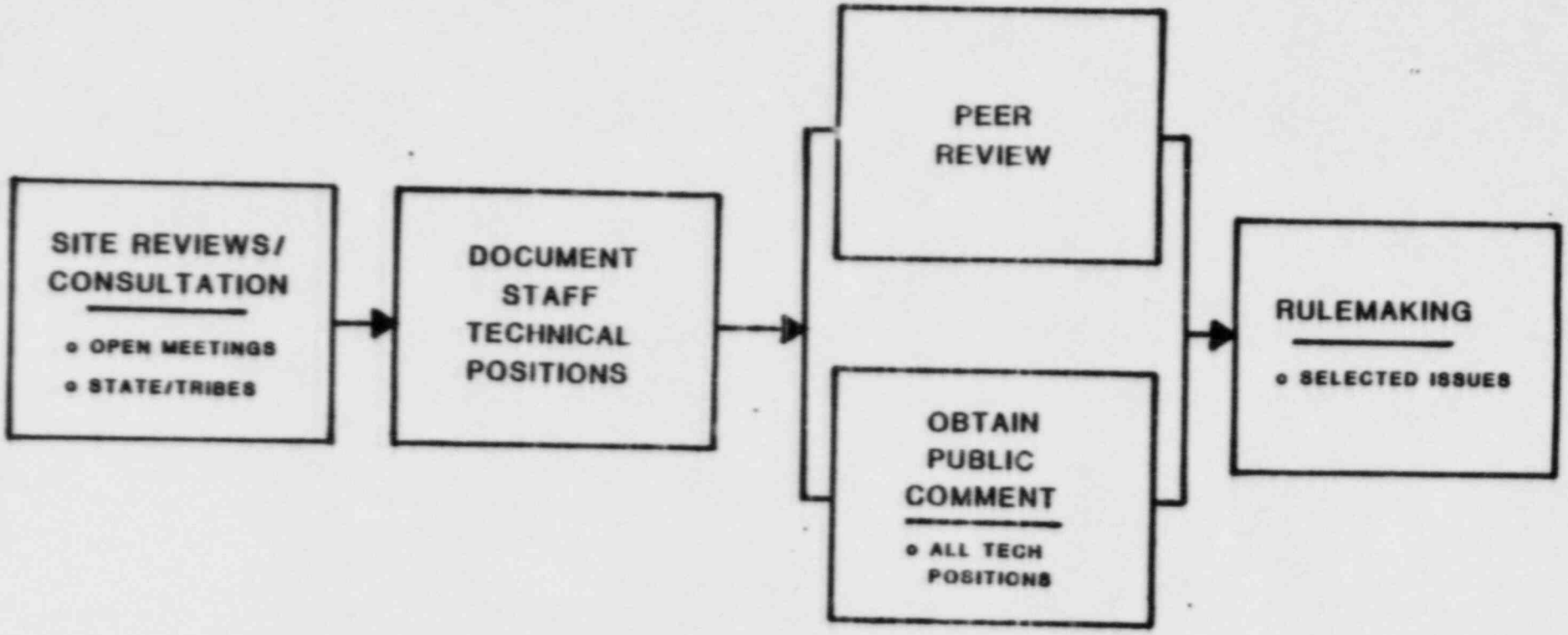
POTENTIALLY ACCEPTABLE SITES FOR THE FIRST REPOSITORY

REGIONS BEING CONSIDERED FOR THE SECOND REPOSITORY



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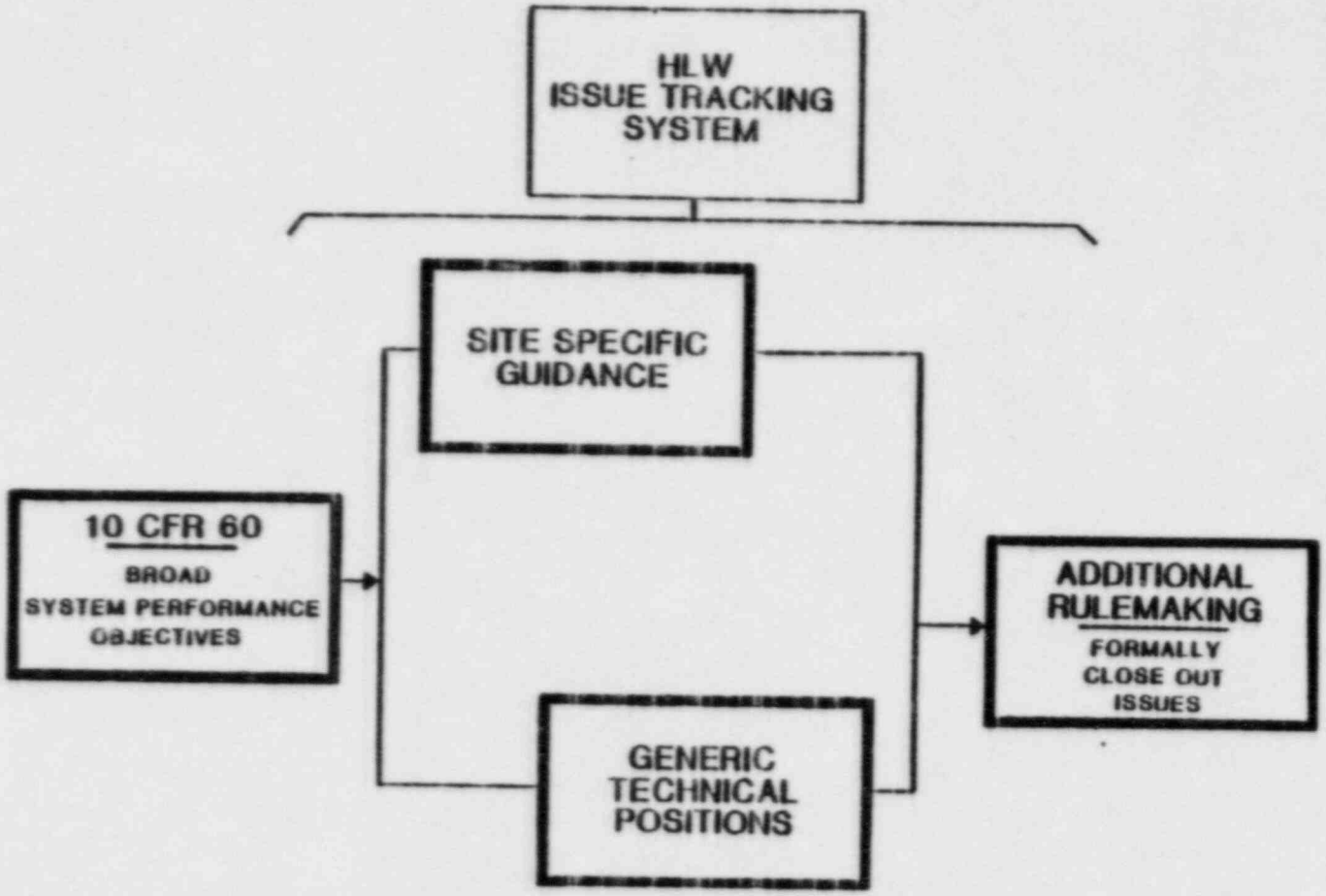
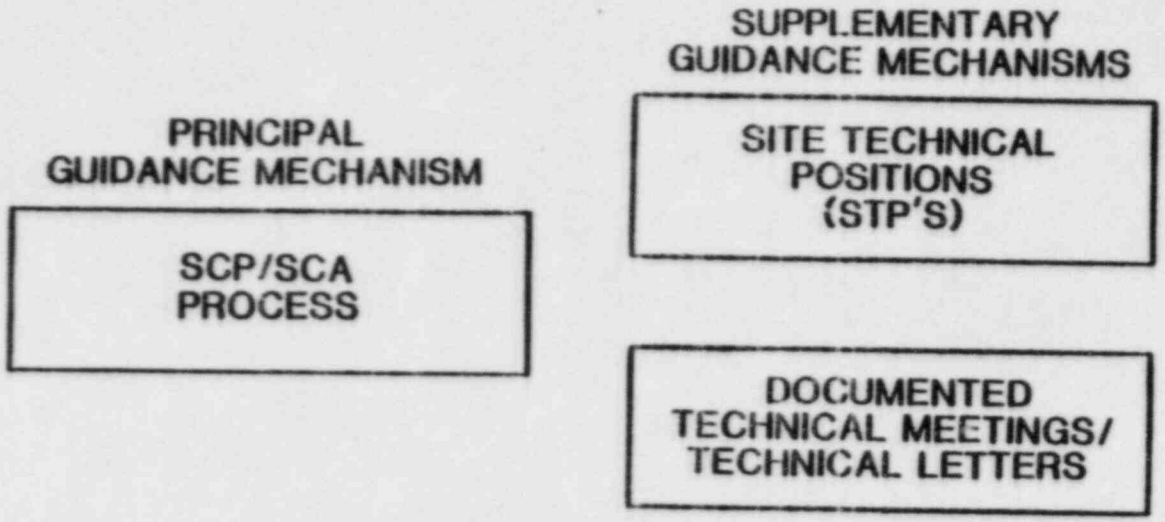


NRC HLW LICENSING GUIDANCE PROGRAM



SITE SPECIFIC
LICENSING GUIDANCE

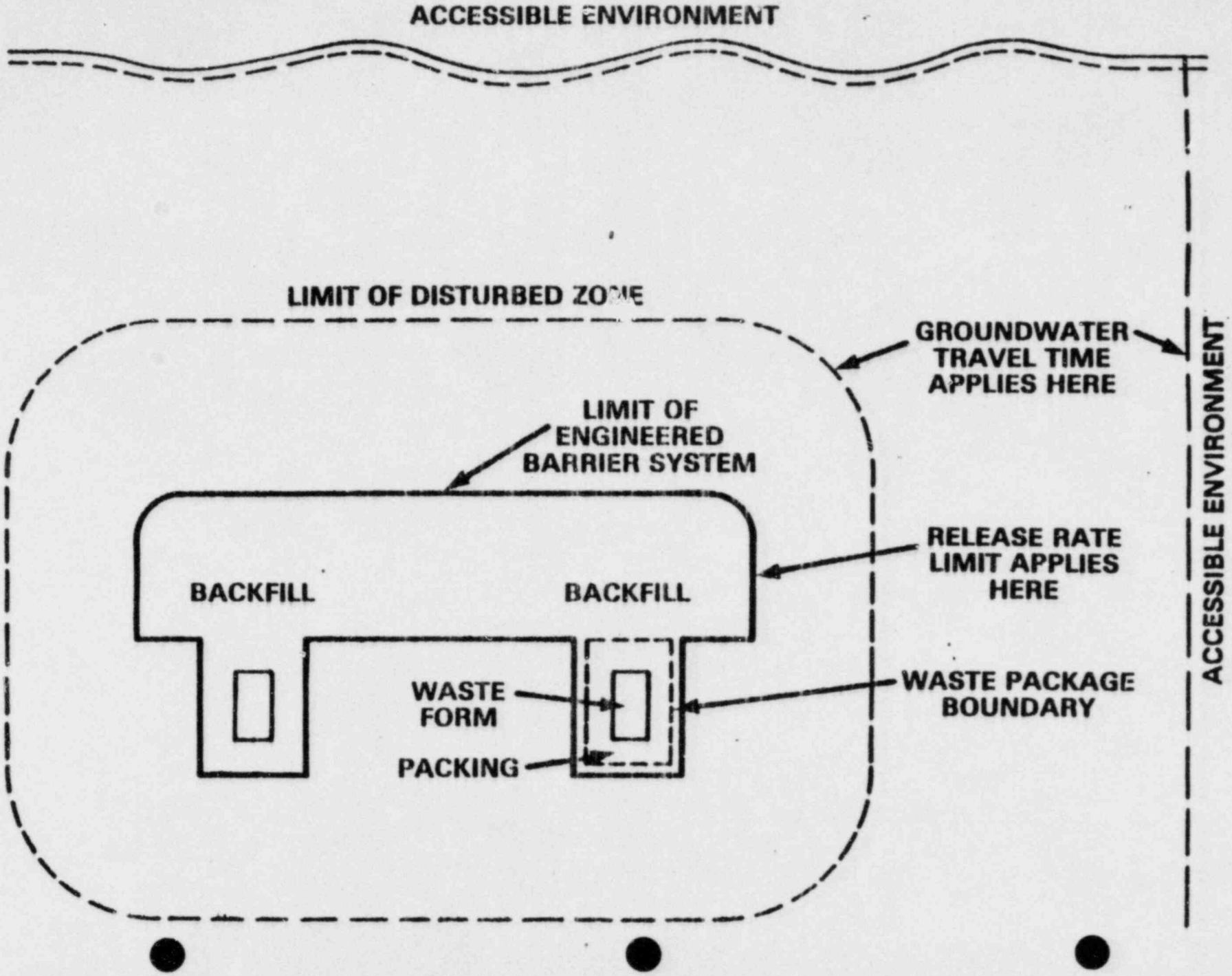
TECHNICAL REVIEWS/WORKSHOPS
(FY 80-84)

	BWIP	NTS	SALT	GENERIC
OVERALL SITE/FIELD REVIEW	3	3	3	
GEOLOGY	2	1	1	
GEOCHEMISTRY	2	3	1	2
HYDROGEOLOGY	7	3	1	
WASTE PACKAGE	2	1	1	
DESIGN (UNDERGROUND TESTING)	5	1	2	1
PERFORMANCE ASSESSMENT	1	—	1	2
TOTAL	22	12	10	5

DECEMBER 1984

HLW - TECHNICAL ASSISTANCE

1. CRITICAL REVIEWS OF DOE DOCUMENTS
2. PREPARATION OF GUIDANCE
3. ACQUISITION OF MODELING/LICENSING ASSESSMENT CAPABILITIES
4. SELECTED CONFIRMATORY MEASUREMENTS
5. ISSUE TRACKING AND INFORMATION MANAGEMENT


ACCESSIBLE ENVIRONMENT
LIMIT OF DISTURBED ZONE
GROUNDWATER TRAVEL TIME APPLIES HERE
LIMIT OF ENGINEERED BARRIER SYSTEM
RELEASE RATE LIMIT APPLIES HERE
BACKFILL
BACKFILL
WASTE FORM
WASTE PACKAGE BOUNDARY
PACKING
ACCESSIBLE ENVIRONMENT

WASTE FORM AND PACKAGE

KEY ISSUES

- ENVIRONMENTAL CONDITIONS
  - -- E.G., TEMPERATURE; REDOX CONDITIONS; GROUNDWATER FLOW RATES
- WASTE FORM PERFORMANCE
  - -- E.G., MECHANISMS AND RATES OF LEACHING
- CANISTER PERFORMANCE
  - -- E.G., MECHANISMS AND RATES OF CORROSION
- PACKING PERFORMANCE
  - -- E.G., ION-EXCHANGE CAPABILITY

CONTRACTS

- TA: OAK RIDGE B0288; BROOKHAVEN A3164, A3167; AEROSPACE A4165
- RES: BATTELLE-COLUMBUS B6764; BROOKHAVEN A3237; ARGONNE A2230, A2239; OAK RIDGE B0462

HYDROLOGY

KEY ISSUES

- ISSUES AT ALL SITES
  - o FLOW SYSTEM CHARACTERIZATION
    - -- E.G., NATURE AND EFFECTS OF FAULTS, FRACTURES AND OTHER DISCONTINUITIES
  - o TEST STRATEGIES AND METHODS
    - -- E.G., ROLE OF LARGE-SCALE PUMP TESTS
- UNSATURATED ZONE FLOW (NTS)
- FRACTURE FLOW (BWIP/NTS)

CONTRACTS

- TA: HYDROLOGY BOA B7330
- RES: SANDIA A1266; UNIVERSITY OF ARIZONA B5753, B7291

GEOCHEMISTRY

KEY ISSUES

- ENVIRONMENTAL CONDITIONS
- RETARDATION OF RADIONUCLIDES
  -- E.G., SOLUBILITY; SORPTION; MATRIX DIFFUSION
- TEST STRATEGIES AND METHODS
  -- E.G., EXPERIMENTAL CONTROL OF REDOX CONDITIONS
- COUPLED THERMAL EFFECTS

CONTRACTS

- TA: OAK RIDGE B0287, B0288, B0290; SANDIA A1756
- RES: LBL B3040, B3046; AUSTRALIAN AEC BG661; OAK RIDGE B0426

GEOLOGY/GEOPHYSICS

KEY ISSUES

- GEOLOGIC STABILITY
  -- E.G., SEISMIC IMPACTS ON REPOSITORY
- CHARACTERIZATION OF GEOLOGIC STRUCTURES
- NATURAL RESOURCES

CONTRACTS

TA: LIVERMORE A0294; COE B6935; WESTON GEOPHYSICAL D1003; TBD12

RES: LIVERMORE B0367; LBL B0346; NSF B7121; UNIVERSITY OF DELAWARE B8944, TBD B5693

REPOSITORY DESIGN

KEY ISSUES

- SYSTEMS IMPORTANT TO SAFETY
- RETRIEVAL
- SHAFT AND BOREHOLE SEALS
- ENGINEERED BARRIERS PERFORMANCE

CONTRACTS

- TA: ENGINEERS INTERNATIONAL B7327, B7328, D1004; BUMINES B6932, B6934, D1010; SANDIA A1755
- RES: UNIVERSITY OF ARIZONA B6627; ASTM B7115; SANDIA A1380

PERFORMANCE ASSESSMENT

KEY ISSUES

- OVERALL SYSTEM METHODOLOGY
- PRE-CLOSURE RISK ASSESSMENT
- WASTE PACKAGE CONTAINMENT
- CONTROLLED RELEASE FROM ENGINEERED SYSTEM
- FAR-FIELD FLOW AND TRANSPORT

CONTRACTS

- TA: SANDIA A1158, A1165, A1166, A1755, A1756; AEROSPACE A4165; LIVERMORE A0294
- RES: UNIVERSITY OF DELAWARE B8944; SANDIA A1266, A1380; LBL B3046

HIGH LEVEL WASTE

DOE MUST DEMONSTRATE ACHIEVEMENT OF PERFORMANCE OBJECTIVES

- o CONTAINMENT PERIOD
- o CONTROLLED RELEASE
- o GROUND WATER TRAVEL TIME
- 0 EPA 10,000 YEAR RELEASE LIMIT

NRC MUST HAVE REASONABLE ASSURANCE OF COMPLIANCE - PREDICTION OF PERFORMANCE

- o COMPLETENESS - ALL SIGNIFICANT PERFORMANCE FACTORS IDENTIFIED
- o COMPETENCE - PROCESSES AND EVENTS ADEQUATELY UNDERSTOOD AND PROPERLY MODELED, MODELS PROPERLY APPLIED
- o ACCURACY - ENGINEERED AND NATURAL SYSTEMS ADEQUATELY CHARACTERIZED
- o TESTING - PROTOCOL PROCEDURES DEFINED AS ACCEPTABLE

RES MUST ASSIST LICENSING STAFF TO DELINEATE AND FOCUS TECHNICAL ISSUES IMPORTANT TO LICENSING

- o PRE LICENSING INTERFACE MEETINGS
- o GUIDANCE ON DOE LICENSING SUBMITTAL
- o TIMELY AND EFFICIENT CONDUCT OF THE LICENSING REVIEW
- o POSSIBLE SOURCE FOR RULEMAKING

RESEARCH NEEDED TO ASSESS CAPABILITIES, LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

- METHODS FOR IDENTIFYING/QUANTIFYING FAILURES IN COMPONENTS AND OVERALL SYSTEM

- METHODS FOR EXTRAPOLATING SHORT-TERM LABORATORY AND FIELD TESTS OVER LONG TIMES

JULY 23 USER NEED STATEMENT

HIGH LEVEL WASTE

- o TRACKS (WITH SOME LAG)
  - DOE DECISIONS ON SITE, DESIGN AND MATERIALS
  - NMSS DECISIONS ON LICENSING STRATEGY
- o USES CONTEXT OF DOE COMPLIANCE DEMONSTRATION TO ADDRESS REPOSITORY SYSTEM AND COMPONENT PERFORMANCE
  - CONTAINMENT: CORROSION; GEOCHEMICAL; AND THERMAL EFFECTS
  - CONTROLLED RELEASE: LEACH RATE/SOLUBILITY; MEDIUM-SPECIFIC RADIONUCLIDE CHEMISTRY AND THERMAL EFFECTS
  - GROUND WATER TRAVEL TIME: RELIABILITY OF DATA EXTRAPOLATIONS
  - PRESENCE OF FAVORABLE/ADVERSE CONDITIONS: INFLUENCE OF AND INTERACTION WITH NATURAL ENVIRONMENT AND REPOSITORY SYSTEM
  - EPA STANDARD: NEAR FIELD COUPLED EFFECTS (THERMAL, MECHANICAL, CHEMICAL, HYDROLOGIC); FAR FIELD RADIONUCLIDE TRANSPORT (GEOCHEMISTRY: FRACTURE FLOW)

HIGH LEVEL WASTE

MATERIALS AND ENGINEERING

- ASSESSMENT OF WASTE PACKAGE FAILURE MECHANISMS
- EXTRAPOLATION OF SHORT TERM TESTS TO 300 - 1000YR CONTAINMENT PERIOD
- STABILITY OF EMPLACEMENT AREAS

HIGH LEVEL RADIOACTIVE WASTE PROJECTS FOR FY86
MATERIALS AND ENGINEERING PROJETS

PROJECT
TITLE

ASSESSMENT OF WASTE PACKAGE FAILURE MECHANISMS

identification of the chemical and physical processes and conditions of waste package failure--e.g., corrosion, devitrification, H_2 embrittlement, sensitization from canister welding

Effects of Manufacturing

Container Assessment

Pitting corrosion chemistry

EXTRAPOLATION OF SHORT TERM TESTS

address the key considerations in assessing waste package performance including the applicability of short-term tests to long times, uncertainties in model calculations of performance over long times, and evaluation of time-dependence of failure mechanisms, and validation of methods for comprehensive performance testing of waste packages

Long Term Performance of
Waste Packages

Electrochemical Predictive
Techniques

Integrated waste package performance experiments — New Start

STABILITY OF EMPLACEMENT AREAS

identify the important parameters, conditions, types of data, and measurement methods needed to achieve confidence in the accuracy and stability of the repository engineering design envelope

Modification of Backfill

Rock Mass Sealing

Backfill performance experiments — New Start

HIGH LEVEL WASTE

HYDROLOGY AND GEOCHEMISTRY

- ASSESSMENT OF WASTE FORM/WASTE PACKAGE INTERACTION WITH GROUNDWATER
- BEHAVIOR OF RADIONUCLIDES IN THERMALLY, MECHANICALLY CHEMICALLY DISTURBED AREA (NEAR-FIELD)
- UNSATURATED ZONE

HIGH LEVEL RADIOACTIVE WASTE PROJECTS FOR FY86
HYDROLOGY AND GEOCHEMISTRY PROJECTS

PROJECT
TITLE

WASTE FORM/WASTE PACKAGE INTERACTION WITH GROUNDWATER

identify the key physical and chemical condition and processes that control the interaction of the waste form/waste package with its environment, perform field experiments to validate hydrothermal models

Coupled T-H-M-C Study

Glass Analog Study

Hydrothermal field experiments New Start

NEAR-FIELD RADIONUCLIDE BEHAVIOR

establish the chemical processes and species that dominate radionuclide migration in the chemically, physically, and thermally perturbed region within and near to the underground facility

Radionuclide Migration

Valence Effects on Adsorption

Site Geochemistry

UNSATURATED ZONE

initial study into the likely effects of an unsaturated environment and how unsaturated flow can be understood - consideration of likely mechanisms of saturation of a repository sited above the water table

Climates of the Holocene

Unsaturated Flow

HIGH LEVEL WASTE

COMPLIANCE ASSESSMENT AND MODELING

- GEOLOGIC, HYDROLOGIC, GEOCHEMICAL STABILITY
- RADIONUCLIDE TRANSPORT BEHAVIOR OVER LONG TERM
- LIMITATIONS IN COMPLIANCE ASSESSMENT TECHNIQUES

HIGH LEVEL RADIOACTIVE WASTE PROJECTS FOR FY86
COMPLIANCE ASSESSMENT AND MODELING PROJECTS

PROJECT TITLE	
GEOLOGIC, HYDROLOGIC, GEOCHEMICAL STABILITY	
identifies, establishes the nature and significance, and quantifies the uncertatinties associated with demonstrating the (design) assumption that the geologic setting will not suffer and drastic or catastrophic changes (i.e. outside the design envelope) over the period of performance	
Thermal Effects on Repository Performance	
Study of off-nominal conditions	New Start
Systems Integration	
RADIONUCLIDE TRANSPORT OVER LONG TERM	
establishes the link between radionuclide migration over long times and potential and expected changes in the geologic setting, establishes "operational range" of geologic repository	
Field validation hydro model	New Start
Groundwater flow and transport of contaminants	
Field validation of transport models	New Start
LIMITATIONS IN COMPLIANCE ASSESSMENT TECHNIQUES	
identifies uncertainties and methods for dealing with uncertainties in compliance demonstrations arising from data variabilities and inaccuracies, uncertainites in test extrapolation over long times, uncertainties in model descriptions of observed and predicted phenomena	
Compliance Assessment Issues	New Start
Resource considerations	New Start
Development of a Methodology for Risk in non-salt Media	

HIGH LEVEL WASTE

HOW RESULTS WILL BE USED:

- o IDENTIFICATION OF TECHNICAL ISSUES
  - UNDERSTANDING OF KEY PHENOMENA, PROCESSES AND BOUNDARY CONDITIONS
  - SYSTEMS INTEGRATION TO IDENTIFY CRITICAL GAPS AND PRIORITIES
- o NMSS LICENSING DECISIONS
  - ESTABLISH SPECIFIC TECHNICAL REQUIREMENTS
  - PROCESS OF NRC/DOE PRELICENSING MEETING IDENTIFYING, CLARIFYING AND RESOLVING TECHNICAL ISSUES
- o PRESENTATION AND USE OF RESEARCH RESULTS DEPENDS ON LICENSING STRATEGY

LOW LEVEL WASTE

- LLW POLICY ACT 1980 - FORMING OF STATE COMPACTS
- ACCEPTANCE OF WASTES MAY BE RESTRICTED BY COMPACT STATES AFTER JANUARY 1, 1986
- AGREEMENT STATES WILL LICENSE, COMPACTS WILL OWN AND OPERATE
- INCREASED INTEREST IN ALTERNATIVES TO SLB
- ASSISTANCE TO STATES WILL BE NEEDED BEGINNING IN 1986 FOR
  - LICENSING REVIEW BY STATES
  - COMPLIANCE DEMONSTRATION
  - OPERATING AND DESIGN CRITERIA
  - SITE SCREENING AND SELECTION
  - ALTERNATIVES TO SLB

LOW LEVEL WASTE

- o TECHNICAL INFORMATION NEEDED ON
  - WASTE CHARACTERISTICS
  - RADIONUCLIDE RELEASE FROM WASTE (SOURCE TERM)
  - ON SITE MOVEMENT THROUGH SOILS
  - OFF SITE TRANSPORT
  - OPERATIONAL MONITORING OF PERFORMANCE
  - ALTERNATIVES TO SLB
- o COMPLICATED BY VARIETY IN
  - WASTE FORMS, WASTE CONTENTS, AND CHARACTERISTICS
  - SITE SOILS AND CLIMATES
  - ORGANIZATIONS - OPERATORS, REGULATORS, USERS

TOPIC AREAS STUDIED

	DOE	NRC	EPA	USGS	EPRI
WASTE STEAM CHARACTERIZATION/CLASSIFICATION					X
WASTE FORM, TREATMENT AND VOLUME REDUCTION	X				X
STANDARDS AND CRITERIA			X		
SLB SITING, DISPOSAL AND MONITORING	X	X			
RADIOISOTOPE MIGRATION (SLB)	X	X			
MODELING		X	X		
CORRECTIVE MEASURES AND CLOSURE	X	X			
SITE SPECIFIC STUDIES				X	X
ALTERNATIVES TO SLB		X			X

PRACTICES USED FOR DISPOSING OF LOW-LEVEL RADIOACTIVE WASTES

Country	Disposal Practice				
	Surface Facility	Shallow Burial	Geologic Repository	Well Injection	Ocean Dumping
Argentina	•				
Austria					
Belgium					
Brazil					•
Bulgaria	•				
Canada	•	•			
China		•			
Czechoslovakia	•		•		
Egypt		•			
Finland					
France	•	•			
Germany (GDR)			•		
Germany (FRG)			•		
Hungary	•				
India	•				
Italy	•	•			
Japan	•				
Korea		•			
Netherlands					
Pakistan					
Poland	•				
Rumania	•				
South Africa		•			
Spain			•		
Sweden					
Switzerland					•
Taiwan	•	•			
United Kingdom		•			•
United States		•		•	
USSR	•			•	
Yugoslavia	•				

LOW LEVEL WASTE

MATERIALS AND ENGINEERING

- ESTABLISH PROPERTIES OF STABLE WASTES AND WASTE CONTAINERS
- ASSESS METHODS FOR INHIBITING WATER INFILTRATION IN HUMID CLIMATES
- INVESTIGATE ALTERNATIVES TO SHALLOW LAND BURIAL

LOW LEVEL RADIOACTIVE WASTE PROJECTS FOR FY86
MATERIALS AND ENGINEERING PROJETS

PROJECT
TITLE

PROPERTIES OF WASTES AND CONTAINERS

experimental program to establish the bounds of the range of properties than can be expected (wasteform and container) in LLW, with immediate focus on power reactor decontamination wastes

Properties of Radioactive
Wastes and Containers

In-plant Solidification of
Rad Waste

ASSESS METHODS FOR INHIBITING WATER INFILTRATION

field demonstration of trench cap designs for impermeable caps and for designs that control infiltration through the use of vegitation in humid climates

Closure Methods Assessment

SLB ALTERNATIVES

investigate the feasibility, practicality, and variety of engineering alternatives to SLB for LLW disposal

LLW Alternative

New Start

LOW LEVEL WASTE

HYDROLOGY AND GEOCHEMISTRY

- STUDY EFFECTS OF CHEMICAL COMPLEXANTS/ENHANCED MOBILITY
- ASSESS CONTRIBUTION OF SOURCE TERM TO SLB PERFORMANCE
- ASSESS REQUIREMENTS FOR HYDROLOGIC AND GEOCHEMICAL MODELABILITY OF SLB SITES

LOW LEVEL RADIOACTIVE WASTE PROJECTS FOR FY86
HYDROLOGY AND GEOCHEMISTRY PROJECTS

PROJECT
TITLE

CHEMICAL COMPLEXANTS/MOBILITY

identify and quantify the effects of the presence of chemical complexants mixed with the wastes in the waste form and in SLB trenches on both the availability for transport and the mobility of the radionuclides in LLW

Soil-Biotic-Hydrological
Processes--Migration

SOURCE TERM CONTRIBUTION

identify and quantify the contribution to the overall uncertainty in demonstrating expected performance of SLB LLW disposal, develop an operating source term for LLW performance assessment

LLW Source term

HYDROLOGY AND GEOCHEMICAL MODELABILITY REQUIREMENTS

establish the data, types of measurements, and key parameters needed to predict performance of SLB site - establish the expected precision and residual uncertainty in hydrologic and geochemical models applied to SLB sites

Stochastic Analysis
of Groundwater Syst.

Chemical Speciation in LLW
(Chalk River Experiment)

Field application of hydro models — New Start

Field application of transport models — New Start

LOW LEVEL WASTE

COMPLIANCE ASSESSMENT AND MODELING

- ESTABLISH METHOD FOR FIELD VALIDATING SLB HYDROLOGIC MODEL
- IDENTIFY SOURCES OF DESIGN FAILURES AND OPERATIONALLY INDUCED FAILURES FOR ALTERNATIVES TO SLB

LOW LEVEL RADIOACTIVE WASTE PROJECTS FOR FY86
COMPLIANCE ASSESSMENT AND MODELING PROJECTS

PROJECT
TITLE

FIELD VALIDATION OF SLB MODELS

evaluate methods and develop criteria for field validation of hydrologic models for use in evaluating SLB site performance - establish requirements for and evaluate uncertainties in SLB performance models

LLW/SLB Model field valid

LLW systems integration — New Start

Assessment of Kriging — New Start

FAILURE SOURCES

identify, quantify, and to the extent possible evaluate the significance of design and operationally-induced failures for alternatives to SLB

SLB alternative hazards

HOW RESULTS WILL BE USED:

NMSS LICENSING DECISIONS AND ASSISTANCE TO STATES (WITH SP) WILL

- IDENTIFY KEY PHENOMENA, PROCESSES AND BOUNDARY CONDITIONS
- ESTABLISH SPECIFIC TECHNICAL REQUIREMENTS
- PROVIDE GUIDANCE ON COMPLIANCE DEMONSTRATION AND LICENSE REVIEW

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JUL 23 1984

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MEMORANDUM FOR: Robert B. Minogue, Director
Office of Nuclear Regulatory Research

FROM: John G. Davis, Director
Office of Nuclear Material Safety
and Safeguards

SUBJECT: USER NEED STATEMENT FOR THE WASTE MANAGEMENT PROGRAM

One of the recommendations of the Executive Summary of the High-Level Waste Oversight Committee Report is for NMSS to transmit a user-need statement to RES, identifying technical work that we support for inclusion in RES waste management program.

Through the ongoing NRC/DOE HLW prelicensing technical interactions, the DWM staff is identifying both general technical areas and specific technical problems that must be addressed by DOE in its technical programs to support its license application. From this body of technical work which will be performed by DOE, the DWM staff has identified specific areas where NRC confirmatory technical work is needed to provide technical support to the licensing staff's independent assessment of DOE's HLW license application. A similar process has led to DWM identification of technical work needed in LLW. These specific areas are identified in Enclosure (1).

The focus of the required technical work should be to assess the capabilities, limitations, assumptions and uncertainties associated with:

- Methodologies for identifying failure modes and for quantitatively assessing the risks associated with the failure of both the components and the overall radioactive waste disposal systems;

- Methodologies for extrapolating short-term laboratory and field observations to long-term predictions for application in HLW and LLW regulatory assessments.

The licensing staff must have products from NRC technical programs that (1) can be used to support the staff in the development of guidance to applicants on acceptable methods for data collection and analysis to support demonstrations of compliance with regulatory requirements, and (2) provide support to our independent evaluation of the license applications.

An NRC research program that is focused on this confirmatory technical work and that is coordinated with DWM's own technical assistance program is needed by DWM. The DWM will continue to work closely with RES to ensure existing and future waste management research work is consistent with the technical assistance program and that schedules for specific products support our activities consistent with the Nuclear Waste Policy Act and the Department of Energy's Mission Plan.

The DWM staff will continue to assess the technical work required to support NRC's licensing procedures for waste management activities and will update this user-need statement periodically. The DWM is still reviewing the detailed technical comments of the High-Level Waste Oversight Committee report; if additional needs for technical work are identified from this review, we will supplement the user-need statement.

Of course, we are always interested in and encourage any specific ideas RES may have regarding research necessary to support the Waste Management Program. We stand ready to review any such proposals as they arise.

If there are any questions about this user-need statement, please contact Robert Browning or Michael Bell of my staff.

(Signed) John G. Davis
John G. Davis, Director
Office of Nuclear Material Safety
and Safeguards

Enclosure:
As stated

NMSS STATEMENT OF RESEARCH NEEDS

In order for the NRC licensing staff to critically review and evaluate a DOE license application for a deep geologic repository for high-level radioactive waste, the staff of NMSS has the following needs for technical work which may appropriately be addressed by research programs. The areas of technical work in HLW have been identified by the licensing staff based on its consideration of the findings required by 10 CFR 60, applying the logic process described in Appendix C of NUREG-0960. From the broader list of potential topics for technical work, these areas for NRC work were selected based primarily on the following criteria:

- o the technical work addresses highly uncertain phenomena or processes;
- o the work uses unconventional approaches to developing models or collecting data;
- o the research is designed to confirm studies that are important to NRC's 10 CFR 60 determinations.

The comprehensive set of general technical areas and specific technical problems must be addressed by DOE in its technical programs to support its license application. The focus of the NRC technical work should be to assess the capabilities, limitations, assumptions and uncertainties associated with:

- o Methodologies for identifying failure modes and for quantitatively assessing risks associated with components of and with overall radioactive waste disposal systems;

- o Methodologies for extrapolating short-term laboratory and field observations to long-term predictions for application in HLW and LLW regulatory assessments.

While the needs identified focus primarily on the information or capability that is needed to independently assess DOE's license application, NRC research programs should be structured to provide interim results as they become available to provide a basis for guidance to DOE during the prelicense application, site characterization phase.

A. Waste Form and Packaging

1. Identification and assessment of potential failure modes for waste packages.

The NRC requires a critical evaluation of waste package failure modes to assess the performance objective of long-term containment of radionuclides (10 CFR 60.113(a)(1)(ii)(A)). The work must permit application of results to the materials most likely to be considered by DOE (currently, iron, carbon steel and stainless steel containers) and the most likely weak point in the package (currently considered to be the container weldments.) Hydrogen embrittlement should be one of the failure modes that is analyzed. The product should be a report that identifies and critically evaluates potential waste package failure modes under the full range of repository environments and conditions.

2. Assessment of rate of pitting corrosion of iron and low carbon steel

The NRC staff has documented its position that pitting corrosion is a likely failure mode for waste package containers. The staff considers work is needed to allow it to independently assess the rate of pit growth as a function of the age of pits. This work should also include tests to determine whether heat flux (as well as temperature) influences the rate of pit growth. This information will help determine the limits to which isothermal tests can be used to project pitting corrosion behavior in waste-package containers. The final report should assess whether pit growth is related to pit age and, where possible, include empirically derived relationships for rate of pit growth as a function of age in candidate container materials that are susceptible to pitting. In addition, the report should describe the extent to which the results of isothermal tests can be extrapolated as approximations of pitting corrosion behavior under the full range of repository conditions. The report should also present the necessary criteria for when such extrapolations can be made reliably.

3. Evaluation of interactions between waste packages and the repository environment.

NRC requires an identification and critical evaluation of the materials properties, and environmental parameters that will have a significant influence on the interactions (chemical, physical and radiolytic) between waste packages and the repository environment. This evaluation is needed in order to conduct quantitative performance assessments (including sensitivity and uncertainty analyses) of waste package containment and the rate of release of radionuclides after the containment fails. The work must address how container materials and their alteration products

interact with the waste form to cause its alteration and how these interactions could affect the release of radionuclides. The final product should be a report that identifies the relative importance of properties and parameters that can have a significant influence on interactions between waste packages and the repository environment.

4. Synergistic effects of waste package components

NRC requires an identification and evaluation of potential synergistic effects between waste package components. The technical work is needed to provide DOE with early guidance on licensing issues which will need to be addressed. While the spent fuel materials may not have a degrading effect on the cladding, some materials or contaminants could adversely affect containers. Synergistic effects could include chemical interactions between spent fuel materia or contaminants and waste canister materials. The final product should be a report that identifies potential synergistic effects and their importance to waste package containment and release mechanisms.

5. Laboratory analogs of leaching and migration.

The staff anticipates that DOE may use laboratory analogs to model leaching of the spent fuel and high-level waste form (after failure of containment) and subsequent migration of radionuclides. The licensing staff needs technical support that addresses the extent to which laboratory analogs may be relied upon to assess leaching and near-field migration processes. The work must address the assumptions that must be made and limitations of using short-term, laboratory-scale experiments as analogs. The final report should identify a set of criteria that the staff could use (1) in formulating guidance to DOE on appropriate laboratory-analog studies and (2) in reviewing DOE data on spent fuel and HLW leaching and migration effects.

6. Electrochemical techniques for predicting pitting corrosion of waste package containers.

Preliminary assessments reported by RES staff to NMSS suggest that the onset of pitting corrosion of container materials may be predicted on the basis of electrochemical measurements. The NMSS staff supports confirmatory work into electrochemical or other physico-chemical techniques that can be used in predicting the beginning of pitting corrosion of containers. The final report should describe the assumptions and limitations, as well as laboratory protocols, for all predictive techniques studied and should include criteria that the staff could use to

(1) formulate guidance to DOE on appropriate prediction techniques, and (2) review DOE data on pitting corrosion of high level waste package containers.

7. Effects of HLW waste package fabrication on corrosion and mechanical properties.

The NRC staff has established draft technical positions on the reliability of anticipated waste package performance. A potentially important source of variability in the corrosion and mechanical properties of waste package materials is the fabrication process. The NMSS staff supports continued work on the effects of waste package fabrication on the corrosion and mechanical properties of waste packages. The final report should document the sensitivity of corrosion and mechanical properties to waste package fabrication processes. In particular, the report should identify and critically evaluate factors in waste package fabrication that may adversely affect waste package performance. These results should be presented in a format that will permit the licensing staff to efficiently review DOE fabrication design specifications as they may affect estimates of waste package reliability.

8. Properties of low-level radioactive wastes and waste containers

NRC requires evaluations of waste forms and packages to ensure that waste form reviews can be performed to address the stability requirements of 10 CFR Part 61 and to assess the source terms at existing and future low-level waste sites. This would include work to: (a) correlate results from small sample size leach testing with waste forms under actual disposal site conditions, (b) assess the effects of chelating agents on migration of radionuclides from decontamination wastes and determine retention properties of chelating agents in soils, and (c) improve the source term data base for radionuclides at LLW disposal sites.

B. Repository Design and Rock Mechanics

1. HLW Preclosure Safety Systems Analysis.

NRC regulations specify general design criteria for the structures, systems and components important to safety (both surface and subsurface) during the preclosure phase of repository development (10 CFR 60.131(b)). The licensing staff must be in a position to independently assess the preclosure safety analysis and requires technical support in developing a methodology for analyzing preclosure safety. The technical work must develop a systematic methodology that will identify and quantitatively

prioritize the structures, systems, components and operations that are important to safety. The final product shall be the full documentation of the methodology and shall include a provision for technology transfer that will permit licensing staff to become familiar with the application of the methodology.

2. Coupled interactions of thermal-mechanical-hydrologic systems.

Assessment of compliance with the performance objectives for containment (60.113(a)(1)(ii)(A)), radionuclide releases from the engineered system (60.113(a)(1)(ii)(B)), and radionuclide releases to the accessible environment over 10,000 years (60.112) may require consideration of coupled thermal-mechanical-hydrologic effects over time, particularly in the near-field. The final product of technical work in this area should be a report that identifies and critically evaluates the coupled processes that may be important to meeting the above-cited repository performance objective. The report must identify the assumptions and limitations of the technical approaches used in the studies and should provide explicit recommendations on how coupled processes may be addressed, including bounding and extreme analytical approaches that could be used, along with substantive criteria that the licensing staff could apply in implementing the recommended approaches.

3. Rock-mass sealing.

The NMSS staff supports continued work that identifies significant material and fabrication parameters for sealing shafts, drifts and boreholes that might, if they failed, provide preferred pathways for radionuclide migration or might otherwise compromise long-term repository performance. The work should assess seal and plug performance under the full range of repository conditions. The final report should identify and prioritize material and fabrication parameters that may be important to rock-mass sealing in different media. Technical information developed should be suitable for use in review of DOE's proposed designs.

4. Testing procedures for rock mechanics.

To assess the repository design with respect to its impact on the numerical performance objectives (60.113), the retrievability requirement (60.11)(b)), and the qualitative design criteria (60.131-60.135), the staff must be able to evaluate the mechanical, thermal and hydraulic properties of rocks. The staff supports ongoing work to develop a set of standards for rock mechanical testing procedures. The standards will be used by the NRC licensing staff to develop guidance to DOE on acceptable

testing procedures for the design and construction of geologic repositories for HLW. The standards must be developed and set by a National Standards committee in time to support the findings required by 10 CFR 60.

C. Earth Sciences

1. Development of models and computer codes for independent assessment of groundwater flow and radionuclide transport.

As part of DOE's HLW license application, DOE must demonstrate that the pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment exceeds 1,000 years (60.113(a)(2)), and that releases of radionuclides to the accessible environment after permanent closure are limited to those permitted by the proposed EPA standard (60.112). In analyzing the groundwater flow and radionuclide transport, DOE will rely heavily on predictive modeling. In order for NRC to independently assess DOE's analysis of compliance with Part 60 and the EPA standards in its license application, NRC must also rely on predictive modeling. Thus, technical work is needed by NRC to produce technically defensible models and computer codes to predict groundwater flow and radionuclide transport. It is essential that the models and codes have a sound basis and are accepted by the earth sciences technical community. The final product will be a set of models and computer codes for saturated basalt, domed salt, and, most importantly, for unsaturated tuff.

2. Natural analog studies.

As part of its independent perf. mance assessment capability, NRC must have a basis for comparing labo ratory study results with estimates of repository performance over long time periods. Such information cannot be obtained from laboratory or in situ field tests, where the measurement period is instantaneous with respect to geologic time. Thus, technical information is needed from natural settings and natural analog studies on processes that are being studied in the laboratory. In particular, geochemical studies need to be focused on natural settings where appropriate water/rock/physical-chemical conditions that are relevant to geologic repositories prevail, and, for radionuclide-migration analog studies, where an appropriate source term is available. The final product should emphasize the similarities between the natural analog or setting and expected near- and far-field repository environments and processes, and contain information concerning (1) colloid formation and transport

processes; (2) the effects of organic complexation on radionuclide mobility; (3) the effects of oxidation state and redox kinetics on the mobility of redox sensitive radionuclides; and (4) the retardation processes that affect radionuclide transport.

3. Groundwater chemistry evaluation over time.

In developing the capability to independently assess waste package performance and to evaluate radionuclide source terms, NRC needs information on the evolution of groundwater chemistry as the result of waste emplacement and the interaction between rock/backfill/water. This information will provide data concerning changes expected in the environment of waste packages for comparison to DOE project-produced data. The technical work should include assessments of rock-surface processes that are involved in the control of the redox state of groundwater. Information is also needed on the kinetics of redox processes, which is important to the understanding of redox conditions of both pre-closure and post-closure groundwater and its effect on waste package stability and radionuclide migration. The final products for each of these studies should be reports containing the basic data of the experimental work, documentation of the experimental procedures used, including all assumptions and limitations, and a set of criteria that can be used by the licensing staff to help evaluate DOE data, analyses and conclusions concerning the chemical evolution of groundwater over time in both the near field and the far field.

4. Valence effects on sorption and solubility

In order for NRC to provide guidance to DOE on the isolation of waste, technical work is needed on valence effects on radionuclide sorption and solubility. The technical work should include an assessment of the basic behavior of redox-active elements such as technetium, neptunium and plutonium under appropriate repository conditions. Since uncertainty in the results of analysis of radionuclide speciation at the low concentrations of interest introduces a large degree of uncertainty into estimates of radionuclide behavior, the technical work should contribute to understanding basic reduced-technitium chemistry and the analysis of speciation of other redox-active radio-elements at very low concentrations. The final product should be a report containing the basic data of the experimental work, documentation of the experimental procedures used, including all assumptions and limitations, and a set of criteria that can be used by the licensing staff to help evaluate DOE data, analyses and conclusions concerning the isolation of waste.

5. Backfill mineralogy

In order for NRC to provide guidance to DOE on the repository design, and to independently evaluate DOE's assessment of releases from the engineered system, technical work is needed in the area of backfill mineralogy. The technical work should include an assessment of the physical changes in the backfill that may be expected as a result of changes in backfill mineralogy over time and an assessment of the changes in water chemistry that may result, as well as changes in sorptive capacity of the back-fill materials. The final product should be a report containing the basic data of the experimental work, documentation of the experimental procedures used, including all assumptions and limitations, and a set of criteria that can be used by the licensing staff to help evaluate DOE data, analyses and conclusions concerning backfill performance.

6. Response of the geologic repository operations area to strong ground motion.

An independent evaluation of compliance with the safety aspects of the design criteria for the geologic repository operations area, 10 CFR 60.130 through 10 CFR 60.134, with respect to the effects of strong ground motion from near-field seismic events will require knowledge of the potential magnitude and frequency of the vibratory ground motion that will be generated. Although geologic repository operations area includes both the surface facilities and the underground openings, this study should be focused on the effect of depth on the nature of the vibratory motion. The final product of a technical program in this area should include an analysis of the modification of the vibratory spectra with depth in a generalized rock media, the effect of the insertion of a network of both vertical and horizontal tubular voids in this media, and boundary conditions between the voids and the media.

7. Effects of spatial variability on groundwater flow and radionuclide transport

Groundwater flow and radionuclide transport are controlled by the highly variable properties of natural geologic materials. NRC needs an awareness of the effects of that spatial variability on simulations and predictions of three-dimensional groundwater flow and radionuclide transport during site characterization and performance assessment. In addition, NRC needs the capability to independently simulate those processes, incorporating important stochastic effects. Hydrogeologic and geochemical properties which exhibit significant variability include hydraulic conductivity, porosity, dispersion, retardation, and geochemical reaction terms.

Products should include: (1) an evaluation of the importance of performing stochastic analyses of three-dimensional groundwater flow and radionuclide transport during site characterization and performance assessment; (2) techniques for predicting behavior of large scale heterogeneous groundwater systems using measured field data and spatial variability; (3) techniques for estimating error and correction terms for state-of-the-art non-stochastic models; (4) a comparison of different techniques for incorporating three-dimensional spatial variability into flow and transport models, including techniques under consideration by DOE and others.