

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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BRIEFING ON PERFORMANCE ASSESSMENT  
PROGRESS IN HLW, LLW AND SDMP

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PUBLIC MEETING

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Nuclear Regulatory Commission  
Commission Hearing Room  
11555 Rockville Pike  
Rockville, Maryland

Thursday, May 15, 1997

The Commission met in open session, pursuant to notice, at 2:07 p.m., the Honorable SHIRLEY A. JACKSON, Chairman of the Commission, presiding.

COMMISSIONERS PRESENT:

- SHIRLEY A. JACKSON, Chairman of the Commission
- KENNETH C. ROGERS, Member of the Commission
- GRETA J. DICUS, Member of the Commission
- EDWARD McGAFFIGAN, JR., Member of the Commission
- NILS J. DIAZ, Member of the Commission

STAFF AND PRESENTERS SEATED AT COMMISSION TABLE:

- JOHN C. HOYLE, Secretary
- KAREN D. CYR, General Counsel
- JOSEPH CALLAN, EDO
- MALCOLM KNAPP, NMSS
- JOHN GREEVES, NMSS
- NORM EISENBERG, NMSS

P R O C E E D I N G S

[2:07 p.m.]

CHAIRMAN JACKSON: Good afternoon, ladies and gentlemen. Today, the Commission will be briefed by the NRC staff on its performance assessment program, which covers three technical areas that are of great importance to the Commission. These areas are low-level radioactive waste disposal, high-level radioactive waste disposal and site decommissioning.

The staff made it clear at least year's Commission briefing on this subject that developing a performance assessment model in any one of these three technical areas is a complex and challenging task. I remember your very informative briefing, Mr. Eisenberg.

However, the development of high-quality performance assessment models for low- and high-level waste and site decommissioning would enable the Commission to obtain significant quantitative and qualitative input for making risk-informed regulatory decisions on these matters. But we also understand the performance assessment is more than risk assessment.

The Commission is looking forward to hearing the

new developments in the performance assessment program as it relates to radioactive waste disposal and SDMP sites. If none of my clients have opening comments, Mr. Callan, why

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don't you proceed.

MR. CALLAN: Thank you, Chairman. Good afternoon.

Chairman, you covered the points I was going to make in my opening remarks. I will just introduce those at the table. With me are Mal Knapp, the deputy director of NMSS, John Greeves, the director of the Division of Waste Management and, as you introduced him, Chairman, Norman Eisenberg, the senior advisor for performance assessment who works for John Greeves in his division and, as last year, Norm Eisenberg will be the principal briefer.

Norm?

MR. EISENBERG: Okay, thank you very much.

If we could go to slide two, this is an outline of the briefing. I will begin by defining performance assessment, just to get us all on an even footing. Second, because of the Commission focus on PRA, I will discuss the similarities and differences between PRA and performance assessment which we feel is the manifestation of PRA and waste management.

Third, I will discuss for each of the Division of Waste Management program areas the PA program recent accomplishments and limitations that we have. And, finally, I will summarize.

Performance assessment is a type of systematic safety analysis that explores for a waste facility what can

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happen, how likely it is and what the impacts of the occurrence are. In this regard, the performance assessment is consistent with the Kaplan-Garrick triple used to define risk. Performance assessment integrates information, number one, across a wide variety of disciplines. We go from inside near the waste package all the way out to the far field in the biosphere so we include disciplines such as corrosion science, geochemistry, radio nuclide transport, hydrology, heat transfer, rock mechanics, the list goes on and on. In addition, PA integrates information across program areas. For example, design information, site characterization information, analytical studies and, of course, our bottom line is regulatory compliance.

The term performance assessment as used in the Division of Waste Management encompasses a broad range of quantitative analyses applied to waste disposal facilities and we try to match these analyses to the need. Deterministic bounding analyses are used most often but probabilistic analyses are used for complex facilities or issues like the high-level waste repository.

CHAIRMAN JACKSON: Let me ask you a question. I don't want to de-track you but perhaps Dr. Knapp or Mr. Greeves can answer this question. Can you give us some examples of actual regulatory uses that have been made, if there have been any, of performance assessment results and

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do you have regulatory guidance documents in the performance assessment area that, in fact, you make use of?

MR. KNAPP: I will turn to these gentlemen to talk a little bit about the documents but you give me an opportunity to talk about something we did when I was active in this area over 15 years ago. And that was when the Department of Energy was actively investigating the Hanford site, known as PWEB. And we used performance assessment as

a basis for debating with them and I believe reaching conclusions that we preferred over the analysis of groundwater at PWEB. That was a very early application of some embryonic things that Norm has subsequently developed in detail. But that is one that comes to mind. Although you might not call it a formal regulatory use, in our interactions with the Department of Energy in high-level, it was a very useful tool.

CHAIRMAN JACKSON: It is coming to resolution on some technical issues.

MR. KNAPP: Exactly. I am sure they could have other examples but I will turn to John to talk about it.

MR. GREEVES: I will try and be brief and give you a couple of examples. One, Norm is going to talk about the branch technical position in low-level waste. That is an example of guidance level use in a regulatory format.

Another one is, as you know, with the

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decommissioning rule, there is a whole set of guidance that needs to lay underneath of that. The staff is working on that guide presently and our goal is to have it available in a timely way. So that is another example.

And a third, it might not be quite the example you were looking for but DOE has completed eight performance assessments on ten of their sites and they have a headquarters review group that is, in fact, performing a regulatory function at this point in time in terms of reviewing the performance assessment that was conducted at the site.

I am not as familiar as I would like to be with that process but I am told it has many of the elements that we are using and I will just finish with one. We have got the West Valley project facing us in the future so I see these tools being applicable to that in a regulatory environment where we have a direct role.

CHAIRMAN JACKSON: Could you speak to the issue of the regulatory guidance documents and the extent to which they either exist or are being developed?

MR. GREEVES: As far as the regulatory guidance documents, the principal one that I would point to is the branch technical position. We put out a draft of that in '94, we have been working on it since and you are going to hear Norm talk about it in terms it is about ready to go out

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the door.

Norm, can you add any other regulatory guidance?

MR. EISENBERG: Well, there is the --

MR. GREEVES: The high-level waste material, the expert elicitation documentation.

MR. EISENBERG: Right. Then regulatory decisions have been made on specific cases. I don't know if you recall but last year we talked a little bit about the Curtis Bay facility and as I understand it, either in a few weeks or a few weeks ago they had a public meeting because they are going to take the site off the list. So there is real world regulatory decisions being made.

CHAIRMAN JACKSON: Thank you.

MR. EISENBERG: Okay, I think we are on slide four.

Some points of comparison between performance assessment and PRA. Both are types of safety system analysis and have very similar analytic structures. I will say a little bit more about that later.

Although PRA is used as a complement to deterministic requirements for reactor regulation, performance assessment is used to demonstrate compliance with regulatory requirements for waste facilities. In simple cases, it may just be a simple deterministic analysis. Both performance assessment and PRA generally

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treat the same types of uncertainties related to model parameters. The models themselves and future states of the system or scenarios.

Performance assessment and PRA integrate risks from likely and unlikely events and both methodologies are adaptable to the nature of the problems studied. However, I think, the differences from site to site for commercial nuclear reactors is much less than the differences from site to site for waste facilities. There is a lot more variability.

CHAIRMAN JACKSON: Are there places where the actual models overlap? I mean, have you ever used similar models or the same types of models?

MR. EISENBERG: Certainly in some cases, especially in the area of doses, certainly the fundamental methodologies are similar. However, they must be adapted for the case at hand so we couldn't, for example, use the CRAC code to analyze the volcano extruding waste into the atmosphere from a repository because a very important part of the problem was the interaction of the waste with the magma and the dynamics of the ash plume migration. That is something that isn't in CRAC so it wouldn't do a good job on that.

CHAIRMAN JACKSON: I guess what I am really asking, more in terms of kind of probabilistic

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distributional assumptions of dating the distributions and how things are parameterized, that kind of thing.

MR. EISENBERG: I think there may not be a whole lot of similarity in that regard. As I will point out later, both methods use Latin hypercube sampling in order to do a whole --

CHAIRMAN JACKSON: Which I am going to ask you to define.

And last two quick questions, you know, is most of our performance assessment work done in house? And how many experts such as yourself do we have on staff?

MR. EISENBERG: For high-level waste, of course, we share resources with the center and they make a great many contributions to our efforts. For low-level waste, we have used some other contractors to help us but there was a large effort internally. For SDMP work, we are also getting outside contractor help but a lot of work is being done in house. In fact, the case work is largely done in house.

MR. GREEVES: I'd like to point out that a number of the staff sitting here with us are the people we rely on in terms of doing this performance assessment, right here.

CHAIRMAN JACKSON: So we better not have anything happen to them.

MR. GREEVES: We can't afford to have anything happen to them. I would say there is a large amount of the

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work being done in house and I would also like to point out that research is doing performance assessment. They are developing some tools for us. So there is a lot going on and I am pleased with it, I would like to see more of it. But we will do what we can with the resources we have.

CHAIRMAN JACKSON: So six people?

MR. EISENBERG: No, I think Keith McConnell is the section leader for performance assessment and I think there are nine or ten people in the section. So that is a core group. But then we take advantage of talents elsewhere on the staff as needed.

COMMISSIONER DIAZ: And the center, do we do approximately 50 percent of the work in house? Approximately, a ballpark?

MR. GREEVES: I think it is more than half. That would be my assessment. I could get back to you with a better answer.

CHAIRMAN JACKSON: Thank you.

MR. GREEVES: It is basically the center is the main contractor we use and, actually, we are trying to use them in all three of these areas.

CHAIRMAN JACKSON: Okay. Commissioner McGaffigan?

COMMISSIONER MCGAFFIGAN: Could I ask in comparison with other agencies, you mentioned DOE had done some performance assessments. Does EPA use performance . . . 12  
assessment? You know, their norm sites, the coal ash sites, that sort of thing, or any other area? Do they look at the sort of -- develop the sort of models you guys use here?

MR. GREEVES: Again, my information is somewhat limited. Maybe Dr. Knapp would like to add to it. But, yes, they are doing things. In fact, one of the tools we are working on, EPA participates in the funding process for one of those we are developing in house. So I know they do some of it. Carl Papierello speaks about it frequently, he likes some of their codes. But, Mal, you want to add to that?

MR. KNAPP: I would say there is not an unreasonable amount of overlap in terms of what we try to do. That has, again, gone on for years. But the codes are different.

In general, I would say that EPA's codes tend to be a little more generic and a little less site specific than ours. I would argue that ours tend to be a little more realistic than theirs are but I suspect if there were an EPA representative to my right --

CHAIRMAN JACKSON: We would hear it the other way.

MR. KNAPP: Exactly. But the codes, we have a number of codes that are somewhat in common that differ a little because of our different missions and I think we talk about them and occasionally debate them enthusiastically.

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As a matter of fact, yesterday in a meeting of discourse, the group on radiation standards, we were talking about how we were going to reconcile some of the differences in codes.

CHAIRMAN JACKSON: Did I hear you say that EPA funds some work together with us?

MR. GREEVES: We just had a briefing today on a code development process that research has a lead on it and it has been funded by a number of entities, including DOE, EPA and NRC. That funding profile looks a little bit like the budget cycle in the last five or six years but it is a valuable tool that I think could be back giving you more information on when it becomes more useful.

COMMISSIONER MCGAFFIGAN: Could I clarify whether realistic was a synonym for conservative or stringent? I have heard in this norm case the EPA code is a code that we

would love -- well, I am not sure we would love to use because we don't think it is realistic, we think it is too liberal in its assumptions.

MR. KNAPP: I don't have a simple answer for that. It would depend on the code and the particular assumptions. Some, we view as more realistic. Of those cases where we feel we are more realistic, in some cases we think that EPA may be nonconservative. Some of our concerns, and I will look to Norm and John to correct me, but in low-level codes,

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we would say there are some areas where their more generic codes developed earlier were less conservative. But I wouldn't say we are putting conservatism in.

If you would like, I would argue that we are realistic and they may be nonconservative. But that might be for two or three variables in the code and the fourth variable it might be either way. It is just there is no simple answer but I would certainly ask either of them to correct me or elaborate.

MR. EISENBERG: I think that's right. There is not an across-the-board, simple relationship.

CHAIRMAN JACKSON: Okay, why don't you proceed.

MR. EISENBERG: I think we are on slide five.

I would like to talk a little bit about the approaches in PA and PRA. There are many shared approaches, the structure of the analysis, both have a risk focus. Latin hypercube sampling was adopted by the PRA folks. It was developed in the waste program. Latin hypercube sampling is a type of stratified sampling.

Instead of doing strict Monte Carlo -- well, there will be a slide coming up, two slides, where we will talk about doing sampling or propagating uncertainties for consequence models.

CHAIRMAN JACKSON: Would it be better to wait, then?

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MR. EISENBERG: Okay, let's wait. You convinced me.

Certainly, also, the categorization and treatment of uncertainties. However, there are some fundamental differences between the systems analyzed in waste and the systems analyzed in PRA for reactors. There are differences in approaches because of the differences in systems.

For example, waste systems are largely continuous and their components degrade in a continuous fashion.

CHAIRMAN JACKSON: Actually, so do reactors but they are treated discretely.

MR. EISENBERG: Yes.

CHAIRMAN JACKSON: Some of them do. That's my statement. You don't have to agree.

Sorry to throw you off, but go on.

MR. EISENBERG: The waste systems have engineered and natural components whereas the reactor is a largely engineered system with natural events possibly impinging on it. The waste facility is often large and dispersed with many similar components like waste packages, while the reactor is a single system with major failure modes affecting the entire system.

For example, a single leaking waste package in a repository of 20,000 may not be a major thing. If you have a loss of coolant in the reactor vessel, that's a problem.

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The mission time for the reactor, say 40 years, is long compared for the time of development of the

consequences of a reactor accident, say hours to days; whereas, for a waste system, the mission time, say 10,000 years, is comparable to the time of development of consequences, which is also thousands to tens of thousands of years. Thus, for the waste facility, one failure mode, say waste package corrosion, will be overlapped by other failure modes such as an earthquake.

For a reactor, these multiple events occurring together are so unlikely they are generally left out of the analysis with good cause.

Finally, the waste facilities are largely passive while the reactor has many active redundant safety systems.

CHAIRMAN JACKSON: Let me stop you for a second. You are going to talk about how uncertainties are accounted for in the decisionmaking process at the same time when we talk about the Latin hypercube sampling. Is that what you promised?

MR. EISENBERG: One slide later.

CHAIRMAN JACKSON: Okay. And let me just ask one last question. Can you talk a little about how passive systems are treated probabilistically in performance assessment and would you venture a statement as to whether that approach would also work for passive reactor systems?

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MR. EISENBERG: We tend to treat the passive systems and their behavior in the consequence analysis because that is really the essence of the waste system behavior. We treat some -- but, of course, we include uncertainties as we will see in a minute.

But in terms of probabilistic treatments in terms of conditions that occur or don't occur, these are treated similar to the way external events are for the reactor analysis.

We are working on a problem and I hope we are successful trying to develop importance measures for the waste system. Since we don't have a strong embedding in fault tree and event tree analysis, we can't take full advantage of the current methods, the pressure vessel type importance, things like that, and we are trying to develop some other methods. If we are successful, they might be applicable to some of the passive systems in the reactor business also but we are not sure we will succeed.

CHAIRMAN JACKSON: Thank you.

MR. EISENBERG: Okay. The next figure shows the sequence of analysis for PRA and performance assessment and, as you can see, they are quite similar. The components of the analysis are similar but they are not identical and if I could just take one as an example, the source term analysis in a level two PRA deals with phenomena relating to

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migration of radio nuclide material from a damaged core to outside the containment structure and those phenomena could include high-temperature chemical reactions of the corium plate-out inside the containment building and leakage through penetrations in the building.

For performance assessment, the facility source term involves or could involve corrosion of the waste package, chemical conditioning of the water coming in contact with the waste, dissolution of the waste, and all of that occurs at relatively low temperatures to what might go on inside a reactor vessel. So the structure is quite similar but the components we use in each facet are different.

Okay, here comes -- I can't avoid it any longer.

This slide attempts to show how a linked chain of performance assessment consequence models with uncertain inputs produces a distribution of performance for the system. In other words, this is variability. Treatment of uncertainty in the inputs is propagated to a distribution of outputs giving you a measure of uncertainty in the output.

Just for example, model A could represent the source term with uncertain inputs for things like corrosion rate, the solubility limit, flux into the waste package. Model B might be transport of radio nuclides into groundwater with uncertain inputs for porosity, permeability and groundwater flux. Model C could represent biosphere transport with uncertain variables representing foodstuff intake, irrigation rate variables like that.

By sampling these input parameters repetitively, one runs the whole chain of models and gets an estimate of performance related to that particular choice. When you do this hundreds of thousands of times, you get a distribution of performance for the entire system. One way to do that is to do strict Monte Carlo sampling where the input parameters are chosen randomly.

We used a method called Latin hypercube sampling which partitions each distribution into segments that are equally probable and we sample from them without replacement. So we have a whole routine to go through in order to generate samples for the inputs that give us these variable outputs. The advantage is that you are assured of covering the entire probabilistic regime with the appropriate probability weights in a much more economical fashion than doing strict Monte Carlo sampling which, of course, is going to sample a whole lot around the mean.

CHAIRMAN JACKSON: Do you perform sensitivity studies?

MR. EISENBERG: Once we have the distribution of outputs and we have the distributions of inputs, we can then look for correlations which translate into sensitivities.

It is kind of a global type of sensitivity rather than sensitivity in a particular point in this multi-dimensional parameter space.

CHAIRMAN JACKSON: And how do you identify the dominant contributors to risk for a given scenario?

MR. EISENBERG: We have so far looked at these correlations and the ones that come up being having the greatest influence or the highest effect on the output are deemed the ones that are most important.

I should say in that regard that the same variable might appear as an input to different models or the inputs to the models might be correlated. So in what I just said, the irrigation rate is related to the rainfall. Well, the infiltration of water into the waste package is related to the rainfall too. So you have these correlations and they have to be taken care of and considered in the sampling.

CHAIRMAN JACKSON: What is the role of expert opinion? And then I am going to defer to Commissioner McGaffigan.

MR. EISENBERG: Well, I would say expert judgment is used to generate the distributions, the probability distributions for the various parameters, the PDFs. I think it is -- you could almost take as a given in the waste business these parameters are rarely, if ever, measured directly. These are almost always inferential measurements



so that if you are interested in the porosity of a geologic unit, one thing you can do is take a piece of core, take it into the lab, push water through it and see what its permeability is.

Well, you can also pump water into it and see how much water you can pump into it with a given back pressure. That is another way. So there are all different ways to approach these things and these various lines of evidence have to be integrated and expert judgment plays a strong role --

CHAIRMAN JACKSON: -- role in that integration.

MR. EISENBERG: And interpreting these fundamental data into the inputs for the performance assessment.

CHAIRMAN JACKSON: Commissioner McGaffigan.

COMMISSIONER MCGAFFIGAN: I am not sure this is the right time to ask this but Latin hypercube sampling versus Monte Carlo, what biases get introduced? I mean, I understand Monte Carlo. I haven't studied Latin hypercube.

If you have the same graphs for the various models and you run it, how close do they come to each other?

MR. EISENBERG: If you are able to take enough samples, and there is an art to determining how many samples, and in fact sometimes what we do is we run 200 and then we run 400 and if the answer doesn't change very much we say, well, 200 is good enough.

But the answer is, if done properly, there should be no biases introduced because you are using the same

probability distributions; you are just using an economical way of sampling.

CHAIRMAN JACKSON: It's the sampling, right.

MR. KNAPP: One of the ways I think of it is if you use Monte Carlo with the same numbers as Latin hypercube, there is a risk that when you generate your final response surface there might be some holes in it. Just by virtue of where you picked your initial parameters there is an area where you don't have very much data.

Whereas, by Latin Hypercube, you would tend to get a better distribution among your input parameters so you would have more confidence in the response surface for the same number of runs. And runs can be in the -- not now as much as they used to be. But they can be expensive. So anything you can do to run fewer runs and still have high confidence is very valuable.

That was what was the basis for the development of Latin hypercube.

CHAIRMAN JACKSON: But now with workstations --

MR. KNAPP: you know, it is interesting that 20 years ago we had models that were right on the ragged edge of what workstations could do and 10 years ago. So even today, as the models are developed with, I think, some very

good results from what has been done in the last year or so, Latin hypercube is still a valuable asset.

CHAIRMAN JACKSON: Let me ask you two last questions.

Can you describe the peer process for your performance assessment program? Peer review.

MR. EISENBERG: Well, of course, let me talk about high-level waste. There, we have usually a team of performance assessment analysts plus other required

disciplines that are doing the study. Quite often or universally before it goes out it is given distribution to other staff that have not been involved for internal peer review as well as the normal management review.

We have always issued our performance assessments for review in public and we published papers on it and peer reviewed the literature.

CHAIRMAN JACKSON: And perhaps either Dr. Knapp or Dr. Greeves, you know, NMSS has done considerable work on expert elicitation in the high-level waste program and so you have obviously developed a strong knowledge base. Have you passed along any of this to NRR and Research?

MR. KNAPP: My understanding is that we have and are but I would certainly turn to John and Norm to talk about specifics.

MR. EISENBERG: Yes. First of all, when we were  
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developing the BTP on expert elicitation, we passed it around to all the other offices in the agency and we certainly have made it available to them and they indicate that they use it as it seems to apply in their work and we of course participate in the PRA coordinating committee and the subject comes up there and is discussed.

MR. GREEVES: The real key is DOE is using this process, as they indicated this morning. And it has, I think, been a valuable tool.

CHAIRMAN JACKSON: Thank you.

MR. GREEVES: I think Norm probably has that later in a slide, too.

MR. EISENBERG: Okay, if I could just make one more point on slide seven --

CHAIRMAN JACKSON: You're taking a chance.

[Laughter.]

MR. EISENBERG: I would say that a distribution of the output is produced and it may be some normalized releases or individual dose, whatever. But because the uncertainties are large for many waste facilities, some realizations will exceed the regulatory limit, almost always. This means that the staff has to provide reasonable but protective limits for compliance and must use appropriate statistical criteria to determine compliance. Given that the performance of the system is represented as a  
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distribution.

For example, in the low-level waste PA BTP, compliance is based on the mean of the distribution of dose plus there is a cap on the ninety-fifth percentile of the dose distribution. So that is the kind of thing we will be facing here and, I expect, for decommissioning in the future.

Slide eight.

The evolution of PA as a programmatic tool can be described in four stages. Method development began in the mid-'70s with the same group at Sandia National Labs that was doing the pioneering work on the reactor safety study. From that, we got insights into the repository system and it helped to formulate Part 60.

Second, we entered a demonstration of capability phase in the mid-'80s to early '90s. It helped to identify R&D needs and the need for integration across the various disciplines.

We are now in a mode of applying PA to high-level waste. It is an integrated technical basis for interactions with the Department of Energy. It is an input to rule

development and it is helping to set NRC program priorities.

Another stage that we entered very recently is the high-level waste tools and methods have been adapted for other waste applications and those include things like the

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low-level waste performance assessment working group which started in 1990 and continues to now, the development of the PA branch technical position on low-level waste, demonstration of the test case and some applications in SDMP which began in 1995.

Slide nine, please.

Performance assessment supports the Division of Waste Management mission in decommissioning, low-level waste and high-level waste. For decommissioning, the goal is evaluation of options for remediation and decommissioning. For most cases, simple analyses suffice. For complex sites, we perform analyses to support the NEPA process.

For low-level waste, we are providing guidance and support for state regulators and are attempting to maintain an NRC review capability.

For high-level waste, our focus in the proposed Yucca Mountain repository, of course. Two main areas of activity are analyses to support high-level waste regulations including those for interactions with EPA and interactions with DOE on important stages of the program, viability assessment, recommendation of the site to the President and, of course, licensing.

Slide 10, please.

Now, I am going to begin the description of performance assessment in the three Division of Waste

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Management program areas. For decommissioning performance assessment, we try to fit the analysis method to the problem at hand. As I have said before, simple analyses for simple problems, complex tools when we have to.

We do a probabilistic treatment to the extent appropriate of source term which, as I mentioned before, is highly variable for the decommissioning sites, for environmental transport and for the dose calculations and the decommissioning PA because it is involved in NEPA has to consider chemical as well as radiological effects.

Slide 11.

Recent progress and plans in decommissioning PA. We have a draft methodology for performance assessment applied to SDMP sites, we got a draft methodology in January and will be briefing the ACNW next week. This methodology includes the ability to evaluate sites under the new decommissioning rule. Those sites which will not be releasable for unrestricted use.

We have a very preliminary analysis of the no-action alternative for Sequoyah Fuels and Sequoyah is being used as a test case to evaluate this draft methodology.

We have published a draft EIS for the Shieldalloy site in 1996. There is a public meeting scheduled for September and a preliminary final environmental impact statement for July. This is an example of the failure of

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institutional controls.

We have a preliminary analysis for Parks Township with a plan to publish the draft EIS in July of '97 and the final in March of '98. That analysis includes a probabilistic analysis of the well location for an intruder.

MR. GREEVES: Which the staff is conducting. It

is the staff making these calculations.

MR. EISENBERG: Slide 12.

Now going to the scope for low-level waste PA, we developed methods to treat uncertainty, especially the propagation of parameter uncertainty, developed process level models to describe the performance of various components and for low-level waste you have the unique thing is the engineered component such as cells and covers.

We have a flexible overall performance assessment methodology. It is an iterative approach that links site characterization, design and performance assessment. Individual dose is the compliance end point and to date it has been applied only to hypothetical sites and designs.

Recent progress and plans, the draft BTP on low-level waste performance assessment will be ready for public -- issued for public comment momentarily. The -- we have assisted in the reviews of the Nebraska low-level waste state regulatory program and plan to participate in the IMPEP review for Texas in June and provided assistance as

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called on by states for their low-level waste regulatory program.

Slide 14.

The scope for high-level waste PA, we have to treat both the undisturbed repository and disrupted repository with associated probabilities. We have to consider the entire chain of consequence models, if you will recall the earlier chart. In some decommissioning work you can get away with a subset if you make very conservative bounding assumptions about pieces of the system. In high-level waste, we have to look at everything.

We do a probabilistic treatment for model parameters and future states which, of course, lead to scenario classes, things like climate change, earthquakes and vulcanism.

The potential regulatory changes, that is a new standard based on the current law or on proposed legislation, may reorder the importance of subsystems and issues. For example, currently proposed legislation and the NAS recommendations both would treat human intrusion as a separate stylized calculation whereas the current standard causes it to be incorporated into the distribution of total system performance. This reemphasizes the need for flexible quantitative performance assessment methods.

Slide 15.

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We have two slides of recent progress and plans.

In May 1996, we had a technical exchange on DOE's latest total system performance assessment, TSPA-95, which resulted in general agreement on the importance of infiltration and establishing the basis -- having a strong basis for mixing depth assumptions in the dilution analysis.

We have reached general agreement with DOE on the use of expert elicitation. The branch technical position was published in November of '96. DOE adopted the BTP for their work, as they indicated in their statement that they gave today.

NRC and center staff have been observing the ongoing expert elicitations on volcanism, seismic hazard, unsaturated flow and other topics as they are progressing.

CHAIRMAN JACKSON: Now that the DOE has come out of the mountain, they have completed their principal tunneling, I don't know what the status is of the various alcoves within the ESF but have you been able to use any of

the site-specific data in your models?

MR. EISENBERG: Yes. Maybe the best example is that there has been a long-running controversy over what the infiltration rate is in the Yucca Mountain repository and whether the flow from the surface is localized in fractures or whether it is spread out in the matrix and the chlorine 36 measurements in the tunnel seem to indicate that indeed

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there are areas where the flow is focused.

CHAIRMAN JACKSON: So you have been able to actually fold that into your model?

MR. EISENBERG: Yes. And as more information is available, they are the principal processors of the information. But as it becomes available to us, we fold it into our models.

They have also been gathering information on the structure of the geology in the region, as evidenced also under ground and that has also been folded in.

Okay. Slide 16.

We have another area of progress that we have provided analysis to EPA for evaluating the implementability of draft rules. We had information exchange meetings last spring. Some summary analyses of this implementability nature were published in the annual report for high-level waste which you heard about yesterday and Wes Patrick spoke to that.

We expect to more fully document these analyses in a NUREG coming this year.

Finally, we have a more user-friendly total system performance assessment code. It facilitates use by a broader segment of the staff. We have a beta testing version that was delivered on March 17. It is under review. We are currently running the TSPA code or the total system

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PA code. We call it the TPA code, on a Sun workstation. It was formerly run only on the Cray supercomputer and we anticipate that this rapid local response will facilitate the analysis.

CHAIRMAN JACKSON: This is the code developed by the center?

MR. EISENBERG: Well, it was developed jointly by the center and the NRC staff.

Okay, moving into the summary and the look forward, first some generic points.

Guidance on the use of performance assessment, which is, as I claimed, the waste management version of PRA, will consider the complexity, the safety issues, the availability of the data and the capabilities of the licensees and I believe that is consistent with the PRA implementation plan.

We will continue a program of PA training for the NRC staff.

We have teamed new hires with experienced PA staff. The staff as well as the tools which are the computer codes and the computer facility are essential ingredients to provide a technical basis for making risk-informed regulatory decisions in the entire waste management program.

Declining funding is a challenge which we are

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trying to address by the use of more powerful computing tools and enhanced staff training.

Now, for some specifics, in decommissioning, we

have tried to achieve a degree of optimization by applying the staff experience in PA, both high level and low level, to the complex decommissioning sites. Under the current regulatory regime and the current schedule, PA is providing analyses for about a third of the complex sites requiring site-specific environmental impact statements. The remainder of the sites are on backlog.

Low-level waste --

CHAIRMAN JACKSON: They are on backlog in terms of your being able to provide the analysis.

MR. EISENBERG: That's right.

CHAIRMAN JACKSON: Because of your resources.

MR. GREEVES: Let me jump in a little bit. As you know, there are a large number of these sites. Fortunately, not all of them are the "large" sites but nominally we have about 13 large sites.

We are working aggressively on Parks Township, you have heard about that, we have briefed you on that. The Sequoyah Fuels site, we are actively looking at making that a trial run on the test case. Another one, the West Valley site is going to be challenging us early on.

The point is, we have 14 of these sites and we are

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working aggressively on three. I don't know how we would handle any more than that at any one point in time. So these others are there. The owners of these sites are developing their plans. If they all come in at once, that's the problem. So we are pretty thin.

CHAIRMAN JACKSON: You can say that again for the record.

MR. GREEVES: The staff is thin. Stretched.

[Laughter.]

MR. GREEVES: I would be happy to go further.

CHAIRMAN JACKSON: No, that's fine. I think you've gone far enough.

[Laughter.]

MR. EISENBERG: On low-level waste, we plan to respond to comments on the BTP and finalize the resources permit, pursuant to the direction-setting issue number five.

COMMISSIONER DICUS: Could I ask you a question about that? Is that, given the fact the resources permit is a qualifier but is that on track or is that going to be delayed?

The states, I understand, were rather critical about that.

MR. GREEVES: Yes, there are some states that have been critical of it. I think the view is mixed. But even at the recent low-level waste forum meeting, a number of the

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states said, where is it. In fact, they would love to have had us come in, some of them, would love to have us come out and brief at this forum meeting.

But when you are working on these sites over here and people are putting in extra hours, it is hard to keep up with the BTP. I would have hoped that we could have gotten it out before this and called it a product. It is right there in terms of going out through the door.

But an example, to answer your question, there was also the test case which we wanted to go with the BTP. We can't get the test case done. The documentation is showing how to implement the branch technical position.

CHAIRMAN JACKSON: How far behind are you on that, roughly?

MR. GREEVES: In which?

CHAIRMAN JACKSON: When do you see yourself getting to the point of --

MR. GREEVES: I don't see us finishing the test case.

CHAIRMAN JACKSON: You don't see finishing it at all?

MR. GREEVES: Keith?

CHAIRMAN JACKSON: Can you talk about the test case again, Dr. Greeves? They want to --

MR. GREEVES: Could I ask Keith to come up to the

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table? He is more familiar with it --

CHAIRMAN JACKSON: Sure.

MR. McCONNELL: My name is Keith McConnell. I am the section leader for performance assessment. I would say right now we are several months behind on BTP itself. The original SRM that we got asked us to come back to the Commission in August of this year and we are just about ready to go out for public comment, as I have said, and we are looking at a 90-day public comment period. We expect, as people are aware, a significant number of comments and some tough issues to address before we come back to both the ACNW and the Commission.

The test case, we have used it, we have used the results of it quite a bit but we are not staffed to do the documentation. I would say that extends into fiscal year '98.

MR. GREEVES: This is a program that has 10 to 20 FTE back in the early '90s and with the DSI-5, we are at four FTE and, frankly, the West Valley site came in on top of us and it is a real challenge. So it is going to have first bidding in terms of these kind of resources.

Mal, do you want to --

MR. KNAPP: The only thing I would say is I don't want to belabor issues which we visited in strategic assessment, recognizing things like low-level waste sites by

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and large are being developed in agreement states, recognizing what our limitations are and what we are trying to do.

I think what we have here is responsive to the spirit of the SRM on DSI-5. That is the best I can do.

COMMISSIONER McGAFFIGAN: The test case, is that a real case or what do you mean by a test case? I am just not familiar. Is it a low-level waste site, a real site, that you are applying the BTP to?

MR. McCONNELL: It is a hypothetical site.

COMMISSIONER McGAFFIGAN: It is a hypothetical site?

MR. McCONNELL: It is a hypothetical site for humid conditions with a realistic source.

MR. KNAPP: Understand it is hypothetical deliberately because, were we to pick a real site, there would be implications with our results.

CHAIRMAN JACKSON: Okay.

MR. EISENBERG: Okay. Slide 19.

Clearly, in high-level waste we have moved from a demonstration of PA capability to heavy usage of it in support of programmatic goals. We will invest in refinements to our computing capability, especially our total performance codes, only to the extent that such refinements are expected to have a significant impact on

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performance.

Our near-term focus for performance assessment is developing a technical basis for the new high-level waste rules. Early feedback to DOE on the total system performance assessment for the viability assessment, we have been doing this. We have been attending abstraction workshops and expert elicitations. We plan a technical exchange with DOE, as you heard earlier today, in July on their approach for the total system performance for viability assessment and we expect to receive the PA for viability assessment in September of '98. At the requested budget level, we plan to use PA to help prioritize our KTIs.

CHAIRMAN JACKSON: Commissioner Rogers?

COMMISSIONER ROGERS: Yes.

To what extent are licensees able to use performance assessment for decommissioning, particularly those sites which are not the biggies that represent an organization with a lot of capability and a lot of resources? Is it a tool that is actually useful for licensees to adopt or is it just something that we have to sort of retain for our own purposes and share basic conclusions from it with licensees.

In other words, can they -- you know, it seems to me this has taken us a long time and a lot of hard work to get where we are and I don't quite see how a garden variety .

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licensee could do it at all and so how do we couple that into the activities of licensees other than to evaluate their plans when they have gotten them together? Is there any way this can be used to assist them in analyzing their own sites?

MR. EISENBERG: Well, remember that we are using performance assessment in a programmatic sense that covers a wide variety of analytic techniques and at various levels of complexity so I would tend to agree that, for some facilities, it is inappropriate and the licensees would not use these very complex tools nor would they try to maintain a capability to do so.

However, for some of the sites, they are doing very complex analyses because that is what the problem calls for.

COMMISSIONER ROGERS: I guess what I am trying to get at, is there any way that this very specialized expertise that we are developing here now could somehow or other be partly digested and fed to licensees so that they could use bits and pieces of it? In other words, through some kind of guidance or some technical reports or something that they could actually use?

MR. GREEVES: Let me try for a minute.

This is what I view as a graded process. There are a number of licensees out there now that use the RESRAD .

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approach. RESRAD is a code, it's out there, DOE does briefings, people go around the country. And our staff uses RESRAD. I think what Norm was portraying was, use the simplest tool you can and if you can satisfy the criteria then you're out.

So we have sites where we run the RESRAD code, the licensees, they are capable of running that, many of them, if they hire the right consultant. So that one is a fairly first-level type of approach.

Separately, we mentioned earlier on, we got this decommissioning rule that we are expecting to deal with and we are putting in place guidance on how to deal with that.



So the goal is, within a period of time, that we would have some tools out there, and you probably heard about the D&D code that would allow people to determine what the concentration is, if they have a single isotope and is there a way we can come up with a concentration for that. And then it gets more complicated as you go on. So I think we have between three and four levels.

Most of what Norm was talking about here today was the fourth level, the third and the fourth level. It is more complicated. The probabilistic distributions, et cetera. There are a couple of levels above that that we do need to get out to the licensees that I think, you know, within the next year we will have some of that. There are a

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few tools like RESRAD out there now and, also, under the action plan, the licensee could come in and use a 30 microcurie per gram uranium. He doesn't have to do a performance assessment. What he has to do is go in and do a survey and show he is under 30 microcuries per gram of uranium or 10 microcuries per gram of thorium. So it is what I call a graded approach to a regulatory process and I think it will be better after we get this guidance out that is coming underneath --

CHAIRMAN JACKSON: So you are working on this?

MR. GREEVES: Yes, we are. And I would expect the next time we brief you, we will include that.

CHAIRMAN JACKSON: Have more to say?

MR. GREEVES: Excuse me?

CHAIRMAN JACKSON: You will have more to say on that?

MR. GREEVES: Yes.

CHAIRMAN JACKSON: Commissioner Dicus.

COMMISSIONER DICUS: I understand that there have been some differences in the use of PA between DOE and NRC, particularly like waste package lifetime. I wonder if those differences still existed and, if so, are they particularly significant? Are we going to try to resolve them?

MR. EISENBERG: Well, of course, we are trying to resolve them. This is part of the meetings that we attend

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with them and the technical exchanges that we have with them.

I think, and Chairman Jackson asked the question how the PAs for DOE and NRC compare this morning.

I would say that there are three areas that need to be discussed in terms of comparability. There is the results of the performance assessment. That is, the estimates of performance of the system. There is the overall methodology and approach and how comparable those are. Then there are the specifics of the models and parameters and assumptions that are used to describe the various components of the system, so I think there are those three levels.

In terms of overall performance, generally we have, and it is probably because it goes with the territory, come up with higher doses, worse performance for the system, than DOE. Right now, based on the last analyses available, it is one to two orders of magnitude for the average dose in the undisturbed case. So that is one answer.

A second aspect of the answer is that the methods that are used are quite comparable. They share an awful lot in common. There is a little wrinkle regarding the treatment of scenarios and how disruptive events are treated

but I expect we will be working on ironing that out with them.

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The real differences start to arise in the various areas of assumptions and parameter ranges and models and some of the significant differences based on their most recent analysis which, of course, we expect to see some changes in the one for the viability assessment, is that they placed a lot of reliance on matrix diffusion. That is, they assumed that the flow in the fracture and radio nuclide transport in fractures was tied very heavily and integrated with the flow and transport in the matrix. That had the net result of slowing down the migration of the radio nuclides.

We didn't. We didn't assume -- we weren't so positive. So that is a difference that we need to see worked out. There has been an historical difference in assumptions on infiltration rates and, as you heard this morning, we are coming together. They seem to be moving up into the area where we have been.

Another area of concern is the potential for dilution and how much dilution you can take credit for at Yucca Mountain and how the entire process works and the one thing we also feel needs to be worked on is the consequences of volcanism. We have made a lot of progress in closing on the probabilities but we need to maybe look some more at consequences.

So there are certain areas where there are differences and we expect to continue to pursue that.

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CHAIRMAN JACKSON: Commissioner Diaz.

COMMISSIONER DIAZ: On something that you said, you said there is one to two orders of magnitude difference between dose assessment?

MR. EISENBERG: Between the expected dose in the undisturbed repository case.

COMMISSIONER DIAZ: Can you give me an idea of where they lie in absolute value?

MR. EISENBERG: TSPA-95 at five kilometers had four-tenths of a millirem and NRC doing an analysis for one of these EPA analyses got 23 millirem.

CHAIRMAN JACKSON: That is a large difference. Commissioner McGaffigan.

COMMISSIONER MCGAFFIGAN: You may regret making the last remark you did on page 7 but the essence of your remark was when you are dealing with the performance measure you end up with the distribution and you end up having to regulate the mean and the 95 percent confidence interval. That set me to thinking about last week's briefings from NRR and the various documents we are about to put out where we are dealing with issues like 10 to the minus 6 probability of core damage frequency and what that really means.

Is there interaction between -- we were looking for things like 95 percent confidence intervals. In fact, I think those words were used by the Chairman last week.

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Is it appropriate to use some of these same techniques in NRR space that you are using in NMSS space?

That may be the Chairman's question.

CHAIRMAN JACKSON: No, you didn't. You are following on my earlier question about sharing.

MR. EISENBERG: Well, certainly John Austin has been participating in PRA coordinating committee and we have been following what has been going on over there. But remember --

CHAIRMAN JACKSON: They have been following what you have been doing I think is really more the question.

MR. EISENBERG: We go more directly to the issue which is what is the dose. You are using surrogates like large early release frequency and things like that.

CHAIRMAN JACKSON: Right, but I think the message is you are dealing with this issue of what it means to regulate the mean at a certain confidence interval. And that is what we have been pressing in reactor space and I think that may be -- he and I talk back and forth, but --

COMMISSIONER MCGAFFIGAN: That is what I am trying to get at. It sounds like the technique you have come up with here may have some application there in terms of telling us something about confidence around means.

MR. GREEVES: This is part of the branch technical position and we expect to get some comments on this too.

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The low-level waste branch is the one that is going to go out and we may learn something through the comment process.

COMMISSIONER MCGAFFIGAN: NRR might learn something too.

CHAIRMAN JACKSON: Okay, well, thank you very much.

The Commission wishes to thank you for an excellent and a very informative briefing. Mr. Eisenberg, you are setting very high standards here. You can never fall from this particular perch on your performance assessment program. And, as I had indicated earlier, these are areas of great importance to the Commission. Evaluation of long-term performance of low-level waste disposal, high-level waste disposal and site decommissioning, as you have illustrated so amply is not a simple task. But it would appear that, based on today's briefing, you are really making real progress and have a much better sense of that on developing models that should allow us to characterize site performance.

I am particularly struck by the synergy that seems to have developed between the low-level waste program and the SDMP program and you are to be commended for that and that appears to be an excellent approach. It is useful in both areas and they can play off each other.

So the Commission encourages you to continue to

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develop this program and particularly as you develop the ability to do these assessments on other platforms and, as you have just heard, to interact and share the knowledge you have gained in this area both with others within the NRC who are developing PRA models as well as on the outside, to the extent it makes sense through the appropriate regulatory guidance.

These kinds of interactions among our staff can improve the final products for all that are involved in these developmental efforts and allow us to potentiate our resources when we have a lot of work, as you have outlined, Dr. Greeves, on our plates but yet are in a budgetarily and a programmatically constrained system. But it has to be optimized.

So you might consider further the development of base line regulatory guidance even beyond your branch technical position as well as the simple perhaps modular pieces of your codes or other products that could be used by licensees to expedite the processes, particularly as they relate to decommissioning.

Thank you.

Unless we have further comments, we are adjourned.

[Whereupon, at 3:13 p.m., the briefing was  
adjourned.]