UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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BRIEFING ON PERFORMANCE ASSESSMENT PROGRAM

IN HLW, LLW, AND SDMP

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PUBLIC MEETING

Nuclear Regulatory Commission

White Flint Building One

11555 Rockville Pike

Rockville, Maryland

Wednesday, May 15, 1996

The Commission met in open session, pursuant to notice, at 2:04 p.m., Shirley A. Jackson, Chairman, presiding.

COMMISSIONERS PRESENT:

SHIRLEY A. JACKSON, Chairman of the Commission

KENNETH C. ROGERS, Commissioner

GRETA J. DICUS, Commissioner

STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

JOHN C. HOYLE, Secretary of the Commission

KAREN D. CYR, GENERAL COUNSEL

JAMES M. TAYLOR, EDO

JOHN AUSTIN, NMSS

CARL PAPERIELLO, NMSS

MARGARET FEDERLINE, NMSS

NORMAN EISENBERG, NMSS

P R O C E E D I N G S

[2:04 p.m.]

CHAIRMAN JACKSON: Good afternoon, ladies and gentlemen.

Today, the Commission will be briefed by the NRC staff on its performance assessment program that covers three technical areas that are of great importance to the Commission. The areas are low level radioactive waste disposal, high level radioactive waste disposal, and site decommissioning.

Developing a performance assessment model in any one of these three technical areas is a complex and challenging task. I'm sure you're going to tell us that. 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.

The Commission is looking forward to hearing about the new developments in the performance assessment program. Commissioners, do you have anything you'd like to add?

COMMISSIONER DICUS: No, thank you.

COMMISSIONER ROGERS: Nothing.

CHAIRMAN JACKSON: If not, Mr. Taylor.

MR. TAYLOR: Good afternoon. With me at the

table, from the Office of NMSS, are Carl Paperiello, Margaret Federline, John Austin, and Norm Eisenberg to my far left.

I would add to what you mentioned, Chairman, to note that the reorganization of NMSS waste activities into a single division has provided performance assessment greater focus and benefits have been derived from interactions among the various performance assessment inlets and in the activities across all three of the areas that you mentioned, Chairman. It does provide an important linkage among these several program areas.

I would also note that the staff's approach in applying these methods is consistent with the recently issued NRC policy statement concerning the use of probablistic risk assessment methods in our nuclear regulatory activities.

The briefing will be given by Norm Eisenberg. Norm?

MR. EISENBERG: Thank you. Good afternoon. The purpose of this briefing is to provide the status of the performance assessment activities in the Division of Waste Management.

To do this, I will first provide an overview of performance assessment activities, discuss performance assessment activities in more detail in each of the three

programmatic areas where it's used, decommissioning, low level waste and high level waste. Then I'll summarize and provide a brief forecast of upcoming activities.

Performance assessment requires analysts of frequently arrayed and interdisciplinary teams; methods of quantification -- that includes models, codes, and the computer infrastructure to implement the computer codes; and, finally, data, both general data and, more important, facility-specific data from the licensee.

Performance assessment is not a black box method of analysis and may require considerable involvement of the analyst, who needs to synthesize the inputs and interpret the modeling results. There's a continuing need to refine the tools to keep up with the state-of-the-art and fundamental science, disposal practices, and computational techniques.

The overall objectives for performance assessment are, number one, to support the individual program objectives in the three major areas in the division -- high level waste, low level waste and decommissioning; number two, to maintain -- I'm sorry, we need the next slide.

[Slide.]

MR. EISENBERG: Second, we need to maintain and to employ flexible, usable tools and trained, experienced analysts; and, three, we need to provide quantitative input

for risk-informed regulatory decisions, including rule-making and licensing actions.

COMMISSIONER DICUS: Could I interrupt just real quick for a question? Can you clarify a little bit for me -- you're using performance assessment and later on we also talk about PRA. What's the difference, if any, between these to help, early on, understand what we're doing, particularly when it relates to the low level waste or high level waste program or even the site decommissioning?

MR. EISENBERG: Well, I speak to that, to some degree, later on. But let me just say briefly now that PRA is general intent under which a lot of analytical methods sit and performance assessment is one of them.

Performance assessment is PRA through a waste disposal system. So it's usually only conceived of in terms of waste disposal. There are a number of other differences. One of the ones I will discuss at some length later is that the focus of performance assessment is usually on consequence analysis, whereas PRA has a large focus on the probablistic analysis or fault tree analysis, the front-end analysis, so-called levels one and two, whereas for waste disposal, you're focused more on level three.

So there are a great many differences. For example, the waste disposal systems that we analyze are totally passive, whereas PRA for reactors, those systems

involve redundant active systems to provide for safety.

I could go on for a while, but I think those are some of the important differences.

CHAIRMAN JACKSON: But you said you're going to speak a little bit more about them as you go along.

MR. EISENBERG: Right. Okay. The specific program objectives of performance assessment depend, of course, on the programmatic area application. For decommissioning, the objective is to perform National Environmental Policy Act analyses to evaluate the adequacy of the proposed remediation and decommissioning, of site decommissioning, management plan sites, including alternative actions for those sites.

For low level waste, the objective is to provide guidance and technical support for state regulatory authorities and the development of the NRC review capability. Finally, for high level waste, the objective is to use performance assessment of the proposed Yucca Mountain repository as the technical basis for implementing the high level waste standards, commenting on the DOE site viability assessment, which is expected in 1988, commenting on the site recommendation to the President that DOE will make, and ultimately performance assessment is envisioned as a significant input to the NRC licensing action.

The approach and scope of performance assessment

depends on the characteristics of the application, which includes the waste characteristics, the regulatory requirements, and the disposal concept.

These factors vary among the three programmatic areas and depend on the characteristics of each, and these characteristics include the depth of the waste -- for example, for decommissioning, it's on the surface; for low level waste, it's in the near sub-surface; and, for high level waste, it's very deep -- the hazard of the waste, which is low for decommissioning and high for high level waste; the timeframe, which is determined by the regulation or the nature of the waste; the composition of the material -- for example, which radionuclides are there and their chemical form; the nature of the engineered components -- for example, casks and waste packages; and, the nature of the environmental transport; the nature of the site; the distance between the waste and where the performance is measured.

To achieve these various objectives, the staff engages in activities and develops products. Examples of these products and activities include, for decommissioning, we perform screening analyses for confirmation of decisions using bounding assumptions, and for more complex situations, we use performance assessments to help in the preparation of an environmental impact statement.

For low level waste, we've developed a branch technical position for low level waste performance assessment. We have an accompanying test case that demonstrates the methodology in the branch technical position and we have provided technical assistance in consultation with some states.

For high level waste, we have evaluated DOE's performance assessments. We've done analyses to help formulate the new regulatory structure mandated by either current or upcoming legislation and we've evaluated the importance of key technical issues on which our program is structured.

COMMISSIONER ROGERS: Just before you leave that, I don't know if you're going to touch on this later, but I'm interested in just to what extent there has been technical assistance to the states, how many states have been involved, and whether they are states that have high capability or low capability, and just what the nature has been of our assistance.

MR. EISENBERG: I'll speak to that subject.

CHAIRMAN JACKSON: Also, giving you all your advance warning here. When you talk about in the high level waste area, I'm interested in to what extent there are similarities or differences between our approach to performance assessment and DOE's approach and how they

impact on these bullets you have here.

MR. EISENBERG: I'll speak to that. In addition to the programmatic objectives for the various applications of performance assessment, our activities are guided by technical objectives, which, again, are specific to each program area. For decommissioning, the staff evaluates disposal alternatives for complex sites and implements the decommissioning criteria.

For low level waste, staff uses iterative performance assessment to tie performance of the waste disposal system to the site characterization and design alternatives. For high level waste, staff uses use of probablistic analysis, facilitates estimating performance over the long time and space scales that are inherent in the high level waste problem, and the use of system analysis gives insights to the staff on integrated performance, using both the site and the engineered components, and gives us insight into the roles played by each in the total system performance.

[Slide.]

MR. EISENBERG: The next slide is a schematic representation of the physical system at Yucca Mountain. I chose to use Yucca Mountain because the high level waste performance assessment is really the most comprehensive and inclusive. So you might bear in mind that for other

applications, we might only use parts of this.

As you can see, the physical system consists of infiltration resulting from precipitation, forming the unsaturated zone, saturated flow. We have the waste in the repository. It will dissolve with the groundwater and migrate to the accessible environment. And the system is subject to perturbing events, such as climate change, volcanism and seismicity.

We are trying to schematically indicate the probablistic aspects of the analysis, which are shown by these distributions in the circles. These result from, first, the stochastic nature of the disruptive events and, secondly, from the probablistic description of uncertain parameters.

For our system, as I mentioned before, the complex fault tree analyses are generally not needed because the systems are passive and don't have these active redundant systems.

Now, this physical system that's schematically shown here must be appropriate synthesized with the models for the performance assessment as is shown on the next slide.

[Slide.]

MR. EISENBERG: The analysis method shown here consists of steps that are parallel to probablistic risk

analysis. There's a system description or a system familiarization step. There's a scenario analysis, consequence analysis. We bring the two together to do a risk computation and usually there is a sensitivity uncertainty and/or importance analysis.

The focus of the waste systems is the variability of the parameters and the consequence analysis. The scenario of really sequences of events that define boundary conditions for the system and these are arrived at. There are a few significant ones that are then combined.

Detailed fault tree analyses are not that helpful and are usually not used.

One point in showing you the juxtaposition of these two charts was to illustrate that the role of the analysts is critical in moving from the physical system to its analytical treatment. The focus is often on the choice or the construction of models to represent the subsystems, the synthesis of field data into appropriately representative parameters or parametric distributions, and the synthesis of field and experimental information into appropriate boundary conditions.

The activities are frequently accomplished, as I said before, by teams of both performance assessment specialists and people from other discreet technical specialties, such as geology or hydrology.

A central focus of the performance assessment methodologies is the treatment of the various types of uncertainty. Three main classifications are considered. Parameter uncertainty -- for example, the hydrologic parameters that were shown in the previous figure. Future state uncertainty -- for example, the disruptive events, such as seismicity and volcanism. And modeling uncertainty, and here, for example, you can represent the hydrologic system as discreet units. That representation is not unique. An analyst could choose three or five or seven layers as a representation, depending upon what the end goal is.

CHAIRMAN JACKSON: How do you then do comparisons?

MR. EISENBERG: Well, you compare results and then you have to -- if there are differences, you have to trace back as to the cause of the results. Now, quite often, one would choose different representations of the physical system because you believe it's closer to the real case or because it better represents a particular phenomena or process that's taking place in the system.

So, first, you would do a numerical comparison, but almost always we immediately go back and try to trace why the differences have occurred.

For example, we're planning to have a technical exchange with the Department of Energy next week. One of

the issues, one of the presentations is going to be a trace through one of their calculations, where Tim McCartin, one of our senior analysts, tried to reproduce the results and couldn't. So we're going to try to figure out where the differences hide.

And I would expect that a lot of the discussion during the licensing process will be about the assumptions in the representation of the system.

CHAIRMAN JACKSON: Has the center been involved in the high level waste area in the development of these models?

MR. EISENBERG: Absolutely. Absolutely. And our phase two performance assessment was a joint effort of the center and the NRC staff.

The overall scope of the performance assessment provides a flexible tool adaptable to various programmatic goals. Example of this flexibility include the fact that the analysis may be probablistic or deterministic. It may treat various scenarios or just the nominal case. It may use selected or all the components of the consequence chain of models and codes. It may include a formal sensitivity and uncertainty analysis or not.

It may be iterated or be done in a single pass and it may be complex or simple depending upon the nature of the hazard, the issues and the timing; that is, how soon you

need to get an answer.

Now, I'd like to discuss, for each program area -- decommissioning, low level waste and high level waste -- the scope of the performance assessment activities, examples of recent progress, and an example of the type of analysis that we've been performing.

The scope of the site decommissioning management plan performance assessment activities is largely controlled by the desire to select an analysis method appropriate for the issues posed by the site. We use deterministic screening analyses for simple cases and quite frequently that suffices and we can make a decision based on these bounding deterministic analyses. An example of that is Curtis Bay, Maryland.

We may then move to --

CHAIRMAN JACKSON: Tell me about -- can you give us a two-sentence statement about Curtis Bay?

MR. EISENBERG: Curtis Bay is a site that had thorium nitrate stored there, I believe, since early in the century. A Defense logistics agency owned it. They had a number of warehouses there. The material leaked out of the boundaries into the floors of the building and to the loading dock.

It underwent a clean-up routine, but part of the problem was that the loading dock or some of the buildings

were missing, probably buried underneath that's part of the road bed. Rather than have the Department of Defense dig it up and dispose of it or remediate it, a calculation was made of the doses that would be obtained from the buried loading dock, which would be contaminated to some degree, and because the doses were so small, it was decided to just leave them in place, if they were even there. Nobody was really sure where they were.

CHAIRMAN JACKSON: But it was deterministic in the sense that you had ample data that you could actually do those dose calculations. Is that true?

MR. EISENBERG: That's correct. And it was the screening analysis that used very conservative assumptions.

Second level analysis would be linear complicated, but still bounding and deterministic. An example of that is the environmental impact statement for the Shieldalloy site in Cambridge, Ohio. Actually, the example for that I will discuss next.

Finally, probablistic treatments may be used for cases with very complex source terms, environmental conditions, and/or dosimetry. An example of this was the preliminary analysis for Parks Township.

Also, because NEPA considerations may apply, the analysis needs to consider chemical as well as radiological impacts.

[Slide.]

MR. EISENBERG: The next slide is an example of a decommissioning analysis. This is a simplified map of the Shieldalloy site. Note the complexity of the source term and hydrology, which I would guess is fairly typical for decommissioning facilities. There are two slag pile sources, shown in orange; two ponds and a small stream, shown in blue; and there's roads and other neighboring activities.

The NRC staff is performing the calculations to evaluate the decommissioning alternatives for the environmental impact statement.

[Slide.]

MR. EISENBERG: The next slide is an example of the results or three disposal options -- no action, disposal off-site, or stabilization in place. There are four exposure scenarios. Scenario A is the worker on-site who was off-site; B is the resident on-site who works off-site; C is an on-site residence who is also a subsistence farmer on-site; and D is the off-site farmer at the site fence. As you would expect, C is generally the largest dose.

What this shows is that there is a factor of 15 reduction in dose by stabilization in place versus no action, which is the kind of information useful for regulatory decision-making.

COMMISSIONER ROGERS: The disposal off-site, those numbers, do they include exposures of individuals at the new disposal site?

MR. EISENBERG: I believe so.

MR. AUSTIN: No, they do not.

COMMISSIONER ROGERS: They don't.

MR. AUSTIN: No.

COMMISSIONER ROGERS: Wouldn't that be an important item for comparison here?

MS. FEDERLINE: They do include transportation doses.

COMMISSIONER ROGERS: But wouldn't you want to look at the total exposure question?

MS. FEDERLINE: That's generally the intent of the analysis.

MR. AUSTIN: The exposure time at a disposal site is very low relative to what we calculate by way of human intrusion and would add very little.

COMMISSIONER ROGERS: It's not there, but it's not important. Is that what you're saying?

MR. AUSTIN: It's -- yes.

CHAIRMAN JACKSON: Is that because at a disposal site, the disposal methodology presumably is designed to minimize exposure?

MR. AUSTIN: Minimize exposures. They're

regulated just like any other licensee. They have to apply ALARA considerations.

MR. EISENBERG: Could I have the next slide, please?

[Slide.]

MR. EISENBERG: Moving on to low level waste performance assessment, first, here's a limited chronology of some low level waste performance assessment activities. In December of '82, the governing regulation was promulgated, Part 61. In June of '91, the Commission issued a requirements memorandum on low level waste performance assessment, requiring the staff to develop a low level waste performance methodology. And in November of '94, the staff held a workshop of low level waste performance assessment branch technical position, with participation by state regulators and implementers. Just a flavor of some of the activities.

Next slide.

[Slide.]

MR. EISENBERG: The low level waste performance activities consist of performing monitoring analyses and site characterization consistent with the site complexity; the development of methods for propagating uncertainty; the development of process-level models and codes to describe the performance of various system components, such as

engineered barriers, caps and vaults; the incorporation of flexibility in the performance assessment methodology; giving flexibility to both the implementer and the regulator in their approach.

A low level waste performance assessment has individual dose as the compliance end point and to date, the performance assessment methodology has been applied by the NRC staff only to hypothetical sites and designs.

COMMISSIONER DICUS: Why is that or when do you plan to use it on an actual site and has there been a request from states -- that's another question I'll get to -- to do that?

MR. EISENBERG: We have been supporting states by giving them technical advice in developing this guidance. But currently, as I understand it, there are no plans for a license to be submitted directly to the NRC.

COMMISSIONER DICUS: And a state has not requested that you use this methodology for their site.

MR. EISENBERG: That's correct.

CHAIRMAN JACKSON: But you're saying -- when you say you provide technical support, you make them aware of the models and the methodology so that if, in fact, they wanted to apply it, they would be in a position to do so.

MR. EISENBERG: That's correct, and we would assist them in using the models and codes.

CHAIRMAN JACKSON: If they wanted that assistance.

MR. EISENBERG: If they requested it.

CHAIRMAN JACKSON: Let me ask you a question. Are there any other places or organizations, either at the state level -- you mentioned that this performance assessment methodology initially, I guess, was developed at Sandia. But who else works on these things besides us, or has?

MR. EISENBERG: Well, there's a number of implementers that have their own consulting firms that do the analyses. In fact, many of them are using methodology that was developed for the NRC.

CHAIRMAN JACKSON: I see. But no one necessarily, in this particular area, is working actively to develop new models.

MR. EISENBERG: Well, yes. The Department of Energy also has a national program on low level waste where they meet periodically and provide assistance to the states and also do some methodology development.

MR. AUSTIN: The Environmental Protection Agency also has a lot of activity in groundwater modeling. Universities will develop them for specific applications and performance assessment, as a methodology, goes to pick which available code fits the particular site they've been working on.

CHAIRMAN JACKSON: Right.

MS. FEDERLINE: DOE also has an active program in this area in the application of low level waste methodology to their own sites. They also have a performance assessment review team which conducts reviews of the DOE low level waste performance assessment. So they have an infrastructure in place and do provide assistance to the states through their low level waste program.

MR. EISENBERG: The staff also participated with the International Atomic Energy Agency in activities devoted to low level waste, where they've done cross-comparison type exercises.

The next slide.

[Slide.]

MR. EISENBERG: Some recent progress in low level waste performance assessment includes the preparation of a Commission paper on four technical policy issues related to the guidance provided in the branch technical position, which is on its way up to the Commission.

A continuing effort to complete the documentation of the test case, which is based on the methodology in the branch technical position. Review of the State of North Carolina regulatory program in low level waste performance assessment. This is the IMPEP, integrated materials performance evaluation program. We've also provided technical assistance to agreement states; namely, North

Carolina and Nebraska. They both requested assistance from the staff.

North Carolina was especially interested in the timeframe for the analysis, which is one of the technical policy issues in the branch technical position. Nebraska was interested in the performance assessment methodology in general.

MR. AUSTIN: If I could add. The states, back in November of 1994, we held a workshop on the draft branch technical position here in our auditorium. The states expressed considerable interest in what we were doing. They raised a number of issues. This paper that Norm mentioned is on its way to you on four policy issues and many are still looking forward to us formally publishing the branch technical position for comment.

COMMISSIONER DICUS: Do you anticipate that this PA will be used routinely in IMPEPs and LLW states or was this a sort of first -- obviously, this was the first time. Is it sort of a test case or do you think it will become part of that review? And how did the states feel about it?

MR. EISENBERG: Well, of course, there are only a few states that are planning to have low level waste sites.

COMMISSIONER DICUS: Right. But do you plan to use it in those states, is the question.

MS. FEDERLINE: What we did as part of the IMPEP

review is do a programmatic review of the states, the regulator's performance assessment program. So we would actually not be conducting a performance assessment, but we would be looking at their capabilities, the programmatic capabilities.

COMMISSIONER DICUS: And the question is, in all of the states that are developing sites as part of the IMPEP, in that state, and also the states that have the site decommissioning monitoring plans, the SDMPs, is that anticipated?

MS. FEDERLINE: We are looking at that now. We are planning to conduct it in the low level waste area.

COMMISSIONER DICUS: But not in the SDMPs.

MS. FEDERLINE: We're currently looking at that now, yes.

DR. PAPERIELLO: A parallel effort, in cooperation with IRM, we are in a process of acquiring a couple of P6 Pentium platforms to run both under Windows NT and UNIX in order to try to take these programs off of some work stations and put them on a less expensive platform and make them more accessible to states, as well as licensees.

[Slide.]

MR. EISENBERG: The next slide is another example of analysis results. This shows a type of parametric study, which can be very informative and useful to people doing

performance assessment. Note that the dose to the individual, which is the regulatory end point, is the sum of doses from the significant radionuclides -- in this case, iodine, technetium and radium. You should read the dose as annual dose.

What this is is a parametric study on the effect of the retardation factor for iodine on the results. The retardation factor is a measure of the degree to which the radionuclide is absorbed onto rock or soil through which the groundwater is carrying the radionuclide.

[Slide.]

MR. EISENBERG: For the first chart, the retardation factor is 25. For the next slide, the retardation retardation factor was moved to be 100, four times as great. Note that the peak for iodine is delayed by a few thousand years and is smaller by a factor of three or four, the height of the total dose.

Staff that is doing performance assessment or reviewing performance assessment needs to understand this kind of effect and how the results depend on these highly variable input parameters.

Now on to high level waste. First, a limited chronology of the high level waste performance assessment activities. Again, in June of '83, Part 60, our regulation was promulgated. In May of '92, we issued the iterative

performance assessment phase one report, which was the staff's demonstration of its capability to conduct a performance assessment.

In August of '95, we provided a Commission paper on high level waste performance assessment status, and this briefing is an update of that status for the Commission.

The scope of the high level waste performance assessment activities are characterized by developing and using models for the undisturbed repository performance and the repository performance with disruptive events and processes, certainly folding in their associated probabilities.

It includes a complete chain of consequence models, from the corrosion of the waste package, the dissolution of the waste, the migration in the unsaturated zone followed by migration in the saturated zone, transport in the biosphere, and ultimately dose to man.

There is a probablistic treatment of parameters and future states and the focus is certainly on Yucca Mountain performance since the change in the law in '87. Also note that the potential regulatory changes mandated by current or proposed legislation may reorder the importance of subsystems and technical issues, and this environment reemphasizes the need for maintaining and using a flexible quantitative performance assessment tool. A Commission

paper on the rule changes is planned for later this summer.

Some examples of progress in high level waste performance assessment include review of DOE's performance assessment in '95, total system performance assessment in '95, with a technical exchange on the 22nd and 23rd of this month. Key issues to be discussed include the assumptions about dilution in the saturated zone and the longevity of waste packages, and this involves the possible use by DOE contractors of probablistic estimates for several parameters in the analysis.

We have been providing technical input to the Environmental Protection Agency for development of the high level waste regulations. In particular, we've held four meetings to date with the EPA staff. The expert elicitation branch technical position, which the Commission was briefed on, was sent out for public comment in February and finalization is planned by this fall.

We plan to issue -- we're currently working on it. We plan to issue a status document on the resolution of key technical issues, which is planned for November of this year.

[Slide.]

MR. EISENBERG: The next slide is an example of a high level waste performance assessment. This is similar to the example for low level waste. It's a parametric study.

In this case, however, the parameter of interest is the infiltration. Again, the total dose is the sum of the doses from individual radionuclides that are major contributors; in this case, technetium, iodine and neptunium.

The first slide curve is an infiltration of one-and-a-half millimeters per year. The second slide shows that decreasing the infiltration reduces the size of the peak, and this is because it reduces the dissolution of the waste and the movement of the dissolved waste into the groundwater for subsequent migration.

MS. FEDERLINE: This might be the most appropriate time to answer your question. You asked us a comparison of DOE and NRC methodologies. DOE uses a very similar approach that NRC does, a hierarchical approach that involves the definition of process models at the bottom level, representing site characteristics, and then abstracting those into higher level systems models which can be run in a simpler and less time-consuming mode, but having the underlying process models to make sure that the key parameters and assumptions are well based in data.

Norm might want to add some additional comparisons.

MR. EISENBERG: There are some differences in the way scenarios are treated, which we're working with DOE to work out. There are some major differences in the

assumptions used in some of the key models, as I mentioned, in dilution and in waste package lifetime.

I guess one of the keys that certainly the regulatory staff is looking at is whether there is sufficient substantiation for the models. As Margaret says, in this hierarchical approach, you need to have the homework at a very refined level of modeling to be able to substantiate the abstractions that are made to the higher level modeling, which is run in a Monte Carlo mode thousands of times in order to produce estimates of performance.

COMMISSIONER ROGERS: On those models, for a given model, is there any possibility of developing scaling laws for parameters that are in those models? Is it a state of refinement to that point or do you have to just redo the calculation all over again?

MR. EISENBERG: I'm not sure I quite understand your question.

COMMISSIONER ROGERS: You've got a model that's based on some set of not only input data, but some parameters that are adjustable that might be relevant. And the question is do you have to rerun the model if you make a change in the parameter or do you have some scaling laws that would give you a reasonably good estimate of the end point result if you just change one of the parameters by a certain amount.

MR. EISENBERG: One approach that DOE is using is to do that kind of parametric study and then use curve fits to represent the model. But I should say that what we have are chains of coupled models, as I described, going from corrosion of the waste package all the way out to dose demand. These are linked models and changing a parameter can affect more than one model. For example, infiltration can affect the rate of waste package corrosion, it can affect the rate of waste dissolution. It certainly can effect the travel time in the unsaturated zone and it may affect other parameters or other models.

So we have, on occasion, been surprised and one of the things, of course, that we do in doing performance assessment is we have our intuition and when things don't turn out the way we think our -- the way our intuition tells us, we always go back and check to find out why. And we've had occasions where non-intuitive results occur because we couldn't -- we weren't smart enough at the beginning to see what the couplings would be at the end.

So we, of course, are trying and DOE is trying to do the kind of simplification that you're talking about, but it has to be done very cautiously to make sure that it's a true representation of the system.

COMMISSIONER ROGERS: Thank you.

MR. EISENBERG: Okay. If we could go on to the

summary and look forward. For high level waste waste, our performance assessment has moved from a demonstration phase to application in the current program, both for interacting with DOE and for evaluating our own program.

COMMISSIONER DISCUS: Quick question. Have you used the PA methodology to look at EPA's standard, say, for example, for high level waste which incorporates an MCL requirement? If so, what kind of results did you come out with?

MR. EISENBERG: Well, we've been working on that for some time. We've got a sequence of analyses to support or to illuminate the rule-making and our interactions with EPA. We have looked at the issue of MCLs and depending upon the location defined, it may be very difficult to meet that particular requirement, no matter what repository you have.

We expect to continue to provide cost-effective improvements in our capability. Our near-term purpose, of course, is the technical basis for the development of the new high level waste rules and the evaluation of the importance of our key technical issues, which are inherent in our program structure.

For low level waste, the Commission paper that is in the works seeks approval to publish the low level waste branch technical position for comment. We are completing documentation of the demonstration test case and we are

continuing to provide support to agreement states.

For decommissioning, we feel that additional staff experience applying performance assessment to complex decommissioning sites will lead to improvements in our modeling approaches and some streamlining of our activities.

Finally, some generic points. Consistent with the Commission guidance on the use of PRA methods, our use of performance assessment will consider the complexity of the safety issues, the availability of the data, and the capabilities of the licensees. We will continue to aggressively pursue a program of training in performance assessment and we expect that a category of experienced performance assessment analysts and suitable tools will continue to provide a technical basis for risk-informed regulatory decisions in the waste management program.

CHAIRMAN JACKSON: Thank you. An excellent briefing, I must say. Commissioners, do you have any additional questions?

COMMISSIONER ROGERS: What is your view of the extent to which the states are interested and capable of picking up this methodology for low level waste sites? It looks to be a very systematic, powerful way to proceed, but are the states able to do that? We've got a fairly -- we've got a strong program here. I'm not sure that individual states have anything that can match what we have.

To what extent are they picking up on it and interested in using this? And if they're not, does that give us some heartburn?

MR. EISENBERG: Let me try to start out an answer to that, anyway. Our assessment, when we reviewed North Carolina, is that they had a sufficient staff capability to take advantage of the methodology, and we expect that several of the other states would have a similar capability. Now, it's within their prerogative to make a decision as to how to use the methodology, whether to do completely independent analyses and calculations or just use the principles articulated in the methodology to evaluate the analysis that's provided by the licensee. So that's one aspect of it.

Also, we did investigate, to some degree, the reactions of the various states to the branch technical position and there were varied reactions. A few were not interested in it. Many others were and very much wanted to have the guidance.

MS. FEDERLINE: It's important to recognize that there are also a range of sites out there. California is a dry site and much simpler analyses are appropriate for that sort of site. We see the range of capabilities out there. Nebraska is looking to do an independent performance assessment on the part of the regulator.

So I think the answer is yes, that the capabilities are out there to take advantage of them and apply them in an appropriate way, given the complexity of the sites.

COMMISSIONER ROGERS: It does seem that it's a methodology that answers a lot of questions and that if that's done, it may make it easier to proceed to an end point. And despite the fact that California has a very good site in many ways, if they haven't answered all the questions that come up when you do a performance assessment, they may have found themselves in a stronger position if they had done that at the outset.

On the types of uncertainty, these are the ones that are always troubling. With respect to future states -- that was your slide 11 -- what kind of process do you have for looking to see whether you think you've really considered all the important possibilities for future states?

MR. EISENBERG: There are several methods. I have long contended that the first axiom of risk analysis is that you can never assure completeness, but that's my own personal view.

COMMISSIONER ROGERS: It's a safe position, actually.

MR. EISENBERG: One effort that has been going on

for some time is international efforts to assemble sort of comprehensive lists of all the processes and events that could possibly affect repository performance. The IAEA has issued a document that has a list of fundamental processes and events and currently the NEA is conducting a study of features, events and processes which try to, by inter-comparing waste programs in different countries, kind of come up with a comprehensive checklist to make sure that everything that should be considered has been considered.

Now, I have to say that one of the things that you want to do in a performance assessment is early on, screen out events that are so unlikely they need not be considered, such as Tsunamis at the Yucca Mountain site. But these comprehensive lists are quite helpful in trying to assure completeness.

CHAIRMAN JACKSON: That's until California drops off. Commissioner Dicus.

COMMISSIONER DICUS: One other thing on your slide 22, these potential regulatory changes coming to us, some idea what we're looking at in potential regulatory changes.

MR. EISENBERG: Well, just based on the 1992 Energy Policy Act, we're on a course now for EPA to provide a regulation conforming with the recommendations of the National Academy of Sciences. They're going to switch over to a dose standard. The old standard was a containment

standard. Human intrusion, because the Academy concluded there was no scientific basis for predicting it, is going to be probably treated as a stylized calculation done separately and not included in the entire performance assessment as it currently has been.

Because it's a dose standard, there will be an additional focus on determining the critical group, which is another recommendation of the Academy of Sciences. And our staff believes that some focus should be given to defining a reference biosphere or biospheres to help reduce the range of speculation, but still provide adequate safety.

CHAIRMAN JACKSON: And if the direction of the high level waste program changes completely, you may be looking at different things all together.

Again, I want to congratulate you. It was an excellent briefing, very informative. I think all we would say is continue to develop. And I think there's also -- I'm particularly struck by this synergy that you're working between the low level waste program and the SDMP program. That seems like a very excellent approach. It's useful in both areas and one can play off of the other.

But I would also urge you, in the spirit of coherence within the agency, to, even though you may not do detailed fault trees, to cross-photolyze with others doing PRA within NRC, including those in NRR and Research.

Thank you. We're adjourned.

[Whereupon, at 2:58 p.m., the Commission meeting was adjourned.]

CERTIFICATE

This is to certify that the attached description of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON PERFORMANCE ASSESSMENT PROGRAM IN HLW, LLW, AND SDMP - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Wednesday, May 15, 1996

was held as herein appears, is a true and accurate record of the meeting, and that this is the original transcript thereof taken stenographically by me, thereafter reduced to typewriting by me or under the direction of the court reporting company

Transcriber: Natalie Renner

Reporter: Jon Hundley

STAFF BRIEFING ON THE STATUS OF THE PERFORMANCE ASSESSMENT PROGRAM

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May 15, 1996

OUTLINE OF BRIEFING

1. Overview of Performance Assessment (PA) Program
2. PA Support for Site Decommissioning
3. PA Support for Low–Level Waste
4. PA Support for High–Level Waste
5. Summary and Look Ahead

WHAT IS PERFORMANCE ASSESSMENT?

- A type of systematic analysis:
  1. What can happen?
  2. How likely?
  3. What are impacts?
- Integrates and Couples Information
- Provides Quantitative Estimates of Performance
- Analysis is matched to need

COMPONENTS OF PERFORMANCE ASSESSMENT

- Analysts
- Quantification
  - Models
  - Codes
  - Computer Infrastructure
- Data (facility specific from licensee)

OBJECTIVE FOR PA

- Support program objectives in HLW, LLW, and Decommissioning
- Maintain and employ flexible, useable tools, and trained, experienced analysts
- Provide quantitative input for risk–informed regulatory decisions

PERFORMANCE ASSESSMENT PROGRAM OBJECTIVES

<u>Decommissioning:</u> NEPA analyses to evaluate adequacy of proposed remediation and decommissioning of SDMP sites

<u>LLW:</u> Methods, guidance, and technical support for state regulatory authorities; development of NRC review capability

<u>HLW:</u> Performance assessment of the proposed Yucca Mountain repository as technical basis for:

- implementing HLW standards
- comments on viability assessment
- comments on site recommendation to President
- licensing

ANALYSIS IS DRIVEN BY CHARACTERISTICS OF APPLICATION

Approach and scope depend on waste characteristics, regulatory requirements, and disposal concept:

Depth

Hazard

Time Frame

Composition of Material

Engineered Components

Environmental Transport

EXAMPLES OF PRODUCTS AND ACTIVITIES

Decomm.	Screening analyses
	PA analyses for EIS
LLW	Branch Technical Position (BTP) for LLW PA
	Test Case to demonstrate BTP
	Technical Assistance/consultation with states
HLW	Evaluate DOE PA's
	Analyses to help formulate new HLW rules
	Evaluate importance of technical issues

PA TECHNICAL OBJECTIVES

Decomm.

- Evaluate disposal alternatives for complex sites
- Implement decommissioning criteria

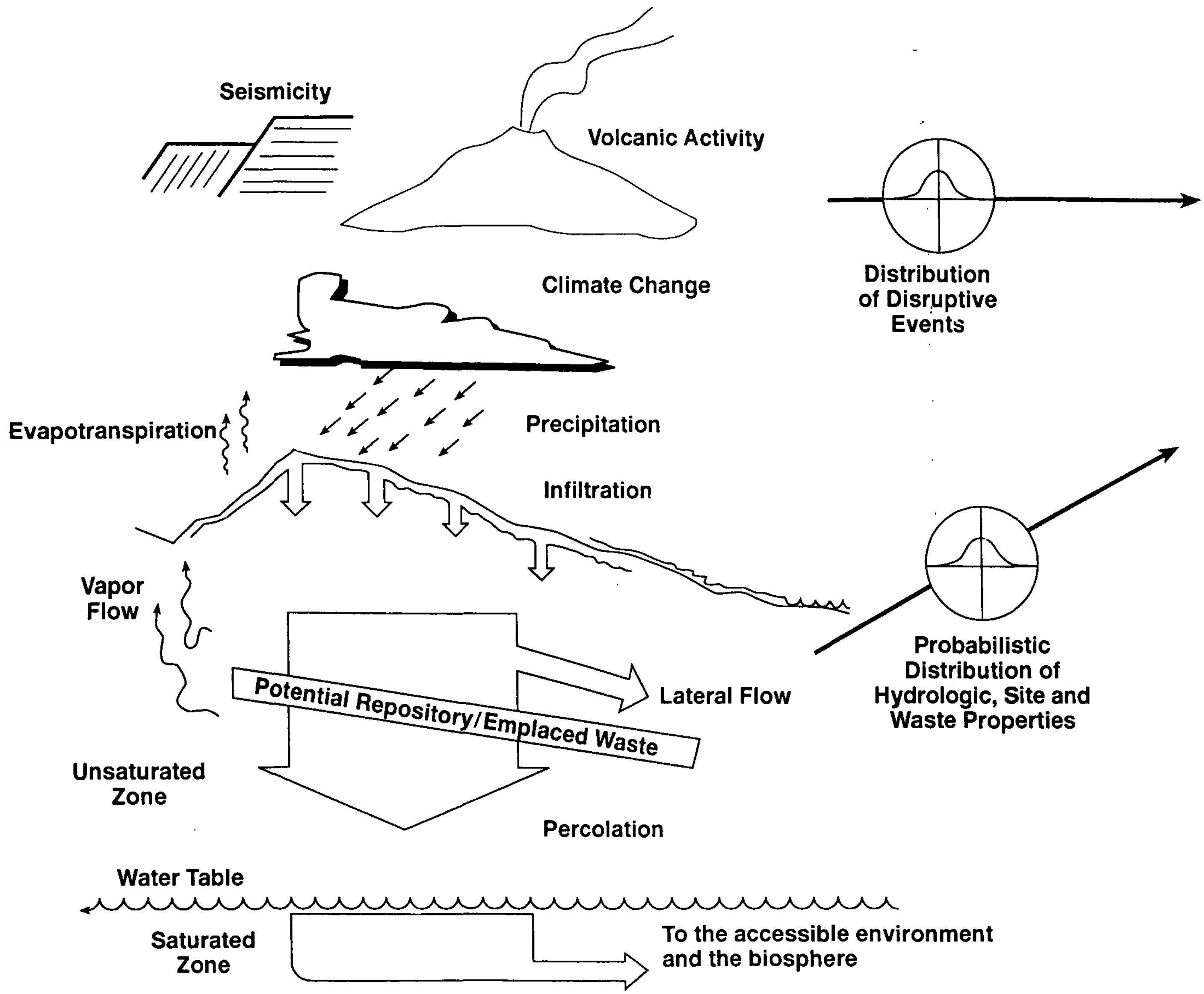
LLW

- Iterative PA to tie performance to site characterization and design alternatives

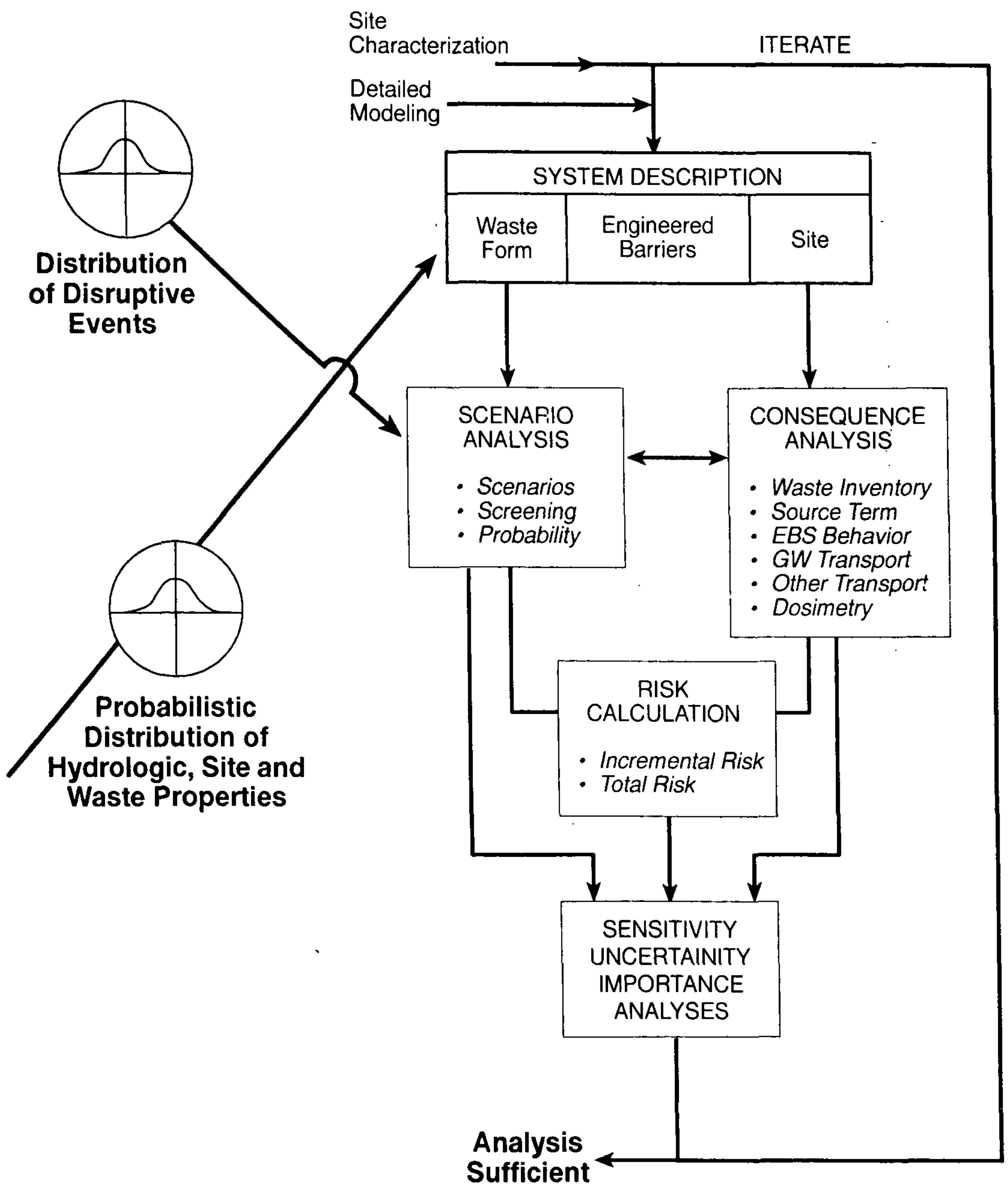
HLW

- Probabilistic analysis facilitates performance estimates over large time and spatial scales
- System analysis facilitates understanding of integrated performance of site and engineered components

SCHEMATIC OF HYDROLOGIC SYSTEM + PERTURBATIONS



SCHEMATIC OF ANALYSIS PROCESS



TYPES OF UNCERTAINTY

- Parameter
  - uncertainty in numerical input to models caused by sparse information and/or spatial variability
- Future States
  - uncertainty in events and conditions characterized by timing, magnitude, manifestation in the disposal system, and overall probability of occurrence
- Modeling
  - uncertainty in the conceptual and mathematical representation for the system due to viable alternative concepts and/or approximations

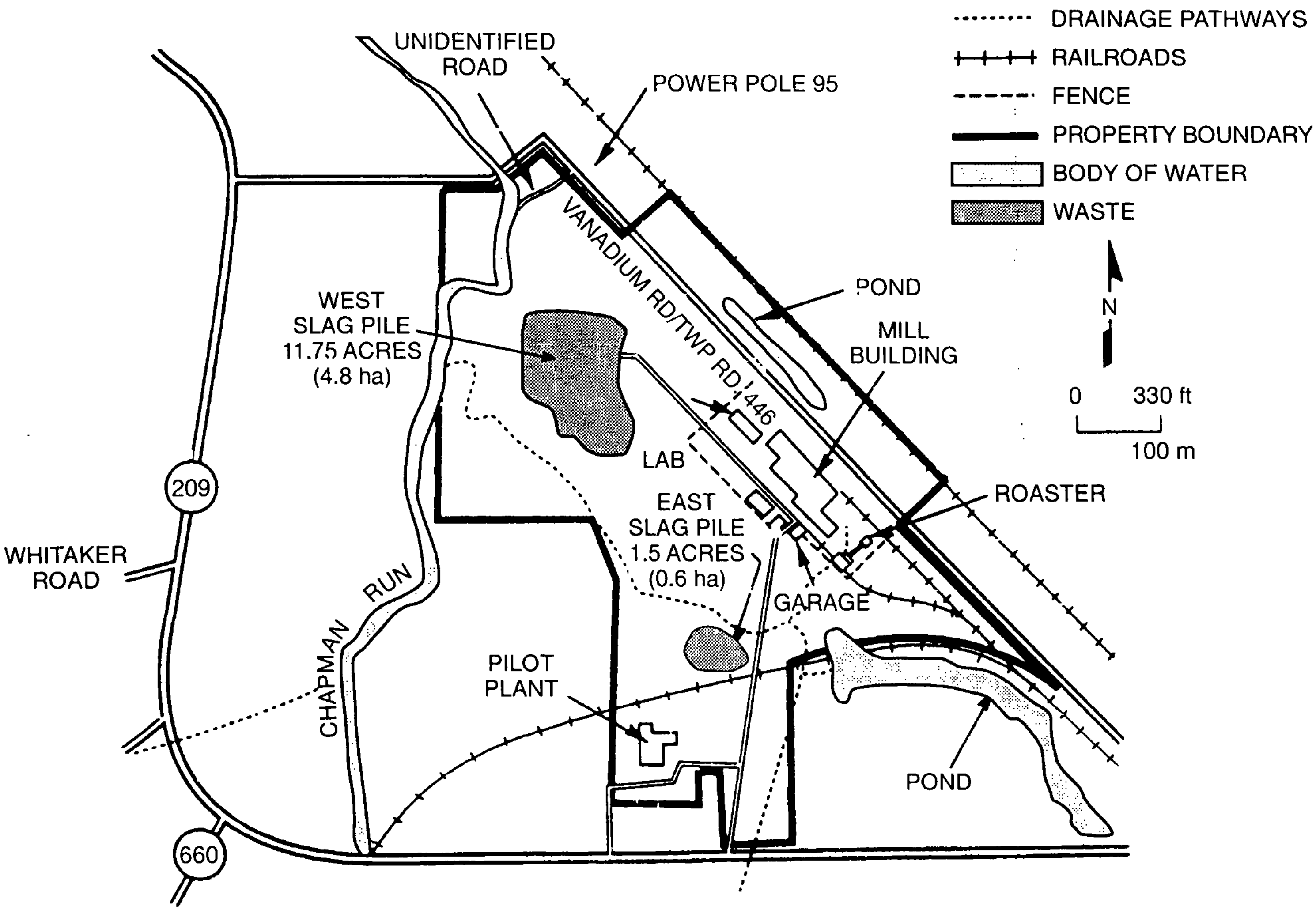
FLEXIBILITY OF PA

- Probabilistic or deterministic (bounding) analyses
- Various scenarios or nominal case
- Selected or all components of the consequence chain of models and codes
- Formal sensitivity and uncertainty analyses or none
- Iterate analysis or one–pass
- Complex or simple analysis, depending on hazard, issues, and timing

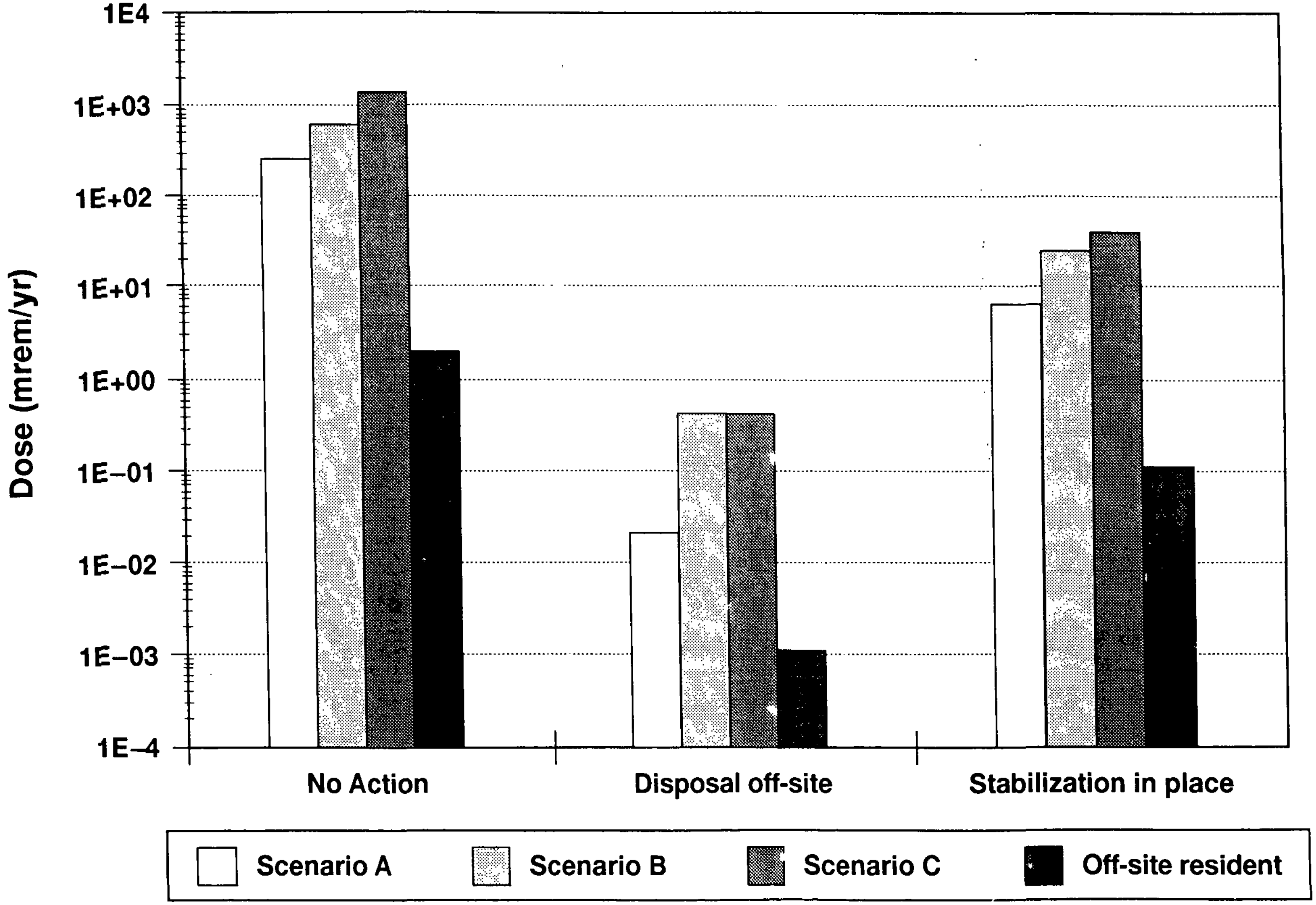
SCOPE OF SDMP PA ACTIVITIES

- Select analysis method for the issues posed by the site:
  - deterministic screening analysis for simple cases
    Example: Curtis Bay, MD
  - bounding, deterministic analyses for more complex cases.
    Example: Draft EIS for Shieldalloy, Cambridge, OH
  - probabilistic treatment for cases with very complex source term, environmental transport, and/or dosimetry.
    Example: Preliminary analysis for Parks Township, PA
- Considers chemical, as well as radiological, impacts

SHIELDALLOY METALLURGICAL CORPORATION CAMBRIDGE, OH SITE



ANNUAL DOSES TO HYPOTHETICAL INDIVIDUAL - SMC SITE



CHRONOLOGY OF LLW PA ACTIVITIES

December 1982	10 CFR Part 61 promulgated
1988–1990	SNL LLW Performance Assessment Methodology
June 1991	SRM on LLW PA
1993–1995	ACNW Presentation on LLW PA BTP/ Test Case
November 1994	Workshop on LLW PA BTP
May 1996	Commission Paper on four technical policy issues to be resolved in the BTP
FY 96	Sustain capabilities for LLW PA through SDMP PA activities

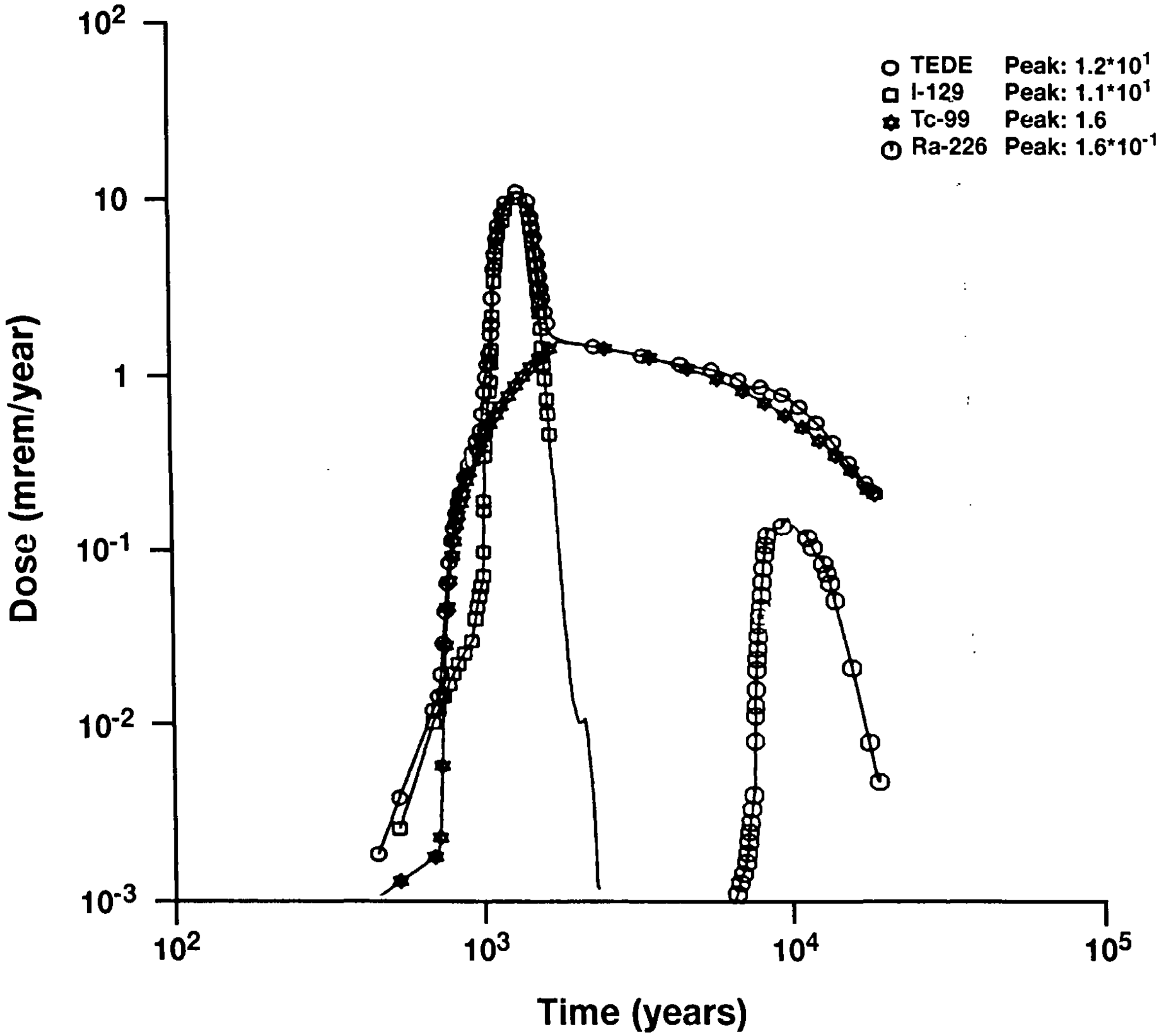
SCOPE OF LLW PA ACTIVITIES

- Modeling, analyses and site characterization consistent with site complexity
- Develop methods for propagating uncertainty
- Develop process–level models and codes to describe performance of various system components
- Incorporate flexibility in PA methodology
- Individual dose is compliance end–point
- To date, applied to hypothetical sites and designs

RECENT PROGRESS IN LLW PA

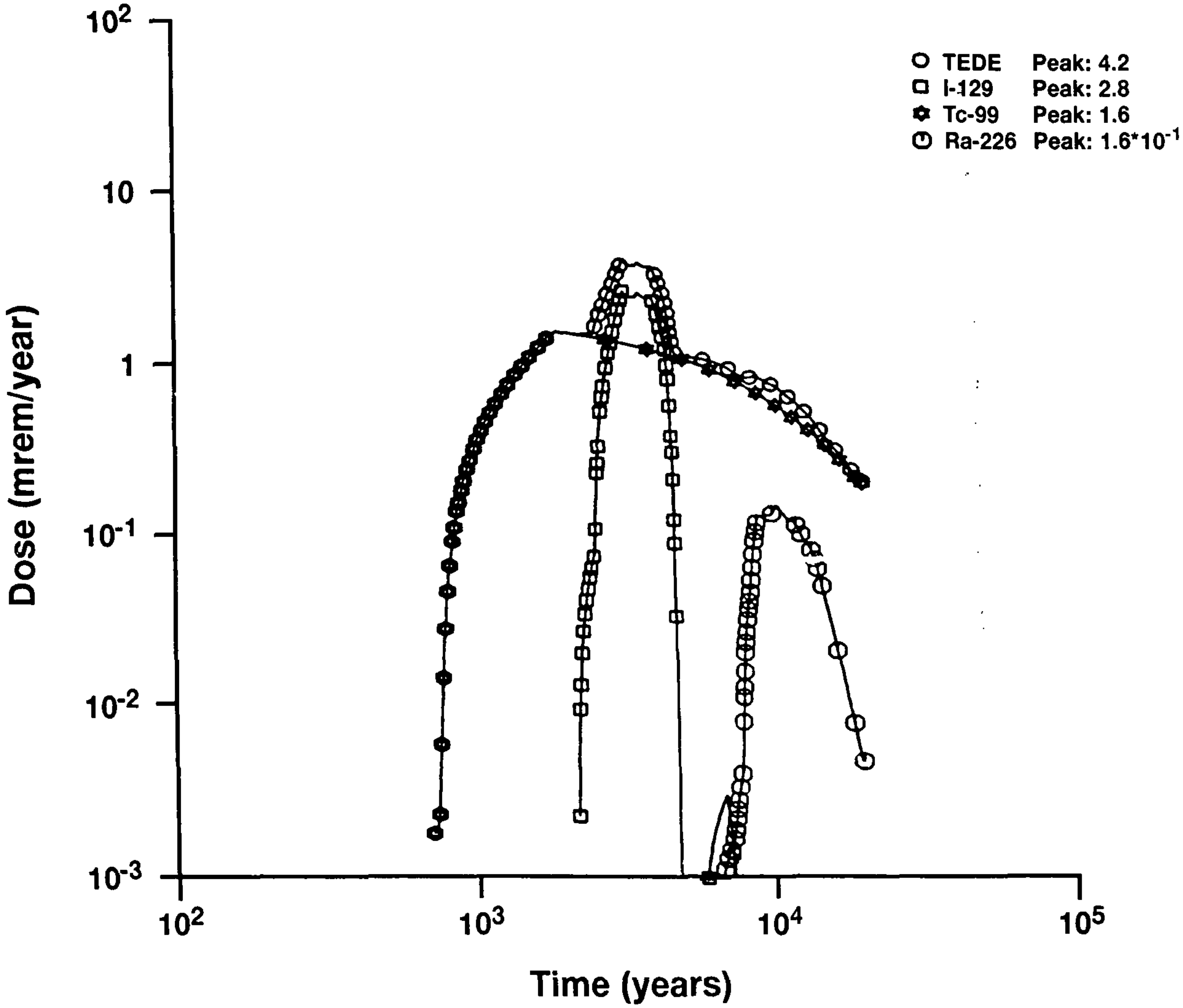
- Commission Paper on four technical policy issues related to the guidance provided in the BTP
- Continuing effort to complete documentation of Test Case
- Review (IMPEP) of State of North Carolina regulatory program
- Technical Assistance to Agreement States
  - North Carolina
  - Nebraska

LLW PA DEMONSTRATION



Effect on performance of varying the value of a single parameter. R_D, geochemical retardation for iodine, = 25.

LLW PA DEMONSTRATION



Effect on performance of varying the value of a single parameter. R_D, geochemical retardation for iodine, = 100.

CHRONOLOGY OF NRC HLW PA ACTIVITIES

June 1983	10 CFR Part 60 promulgated
1976–1989	Extensive R&D by SNL in HLW PA
May 1992	IPA Phase 1 Report
1992 – 1995	Regular ACNW Reviews
August 1995	Commission Paper on HLW PA status
October 1995	IPA Phase 2 Report
1995	Initiation of IPA Phase 3

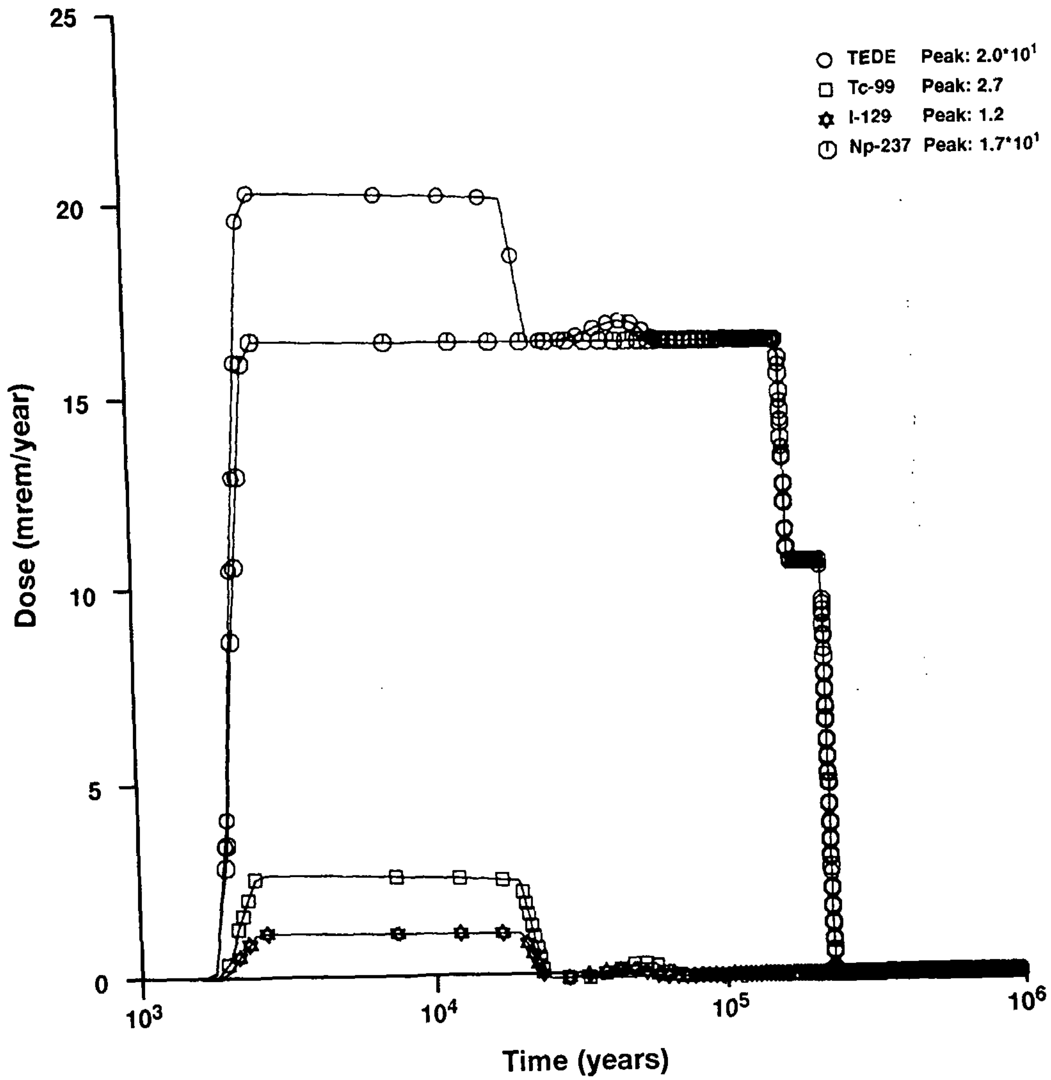
SCOPE OF HLW PA ACTIVITIES

- Models undisturbed repository performance and disruptive events and processes, with associated probabilities
- Includes complete chain of consequence models
- Probabilistic treatment of parameters and future states
- Focus on Yucca Mountain performance
- Potential regulatory changes may reorder the importance of subsystems and issues; emphasizes need for a flexible, quantitative performance assessment tool

PROGRESS IN HLW PA

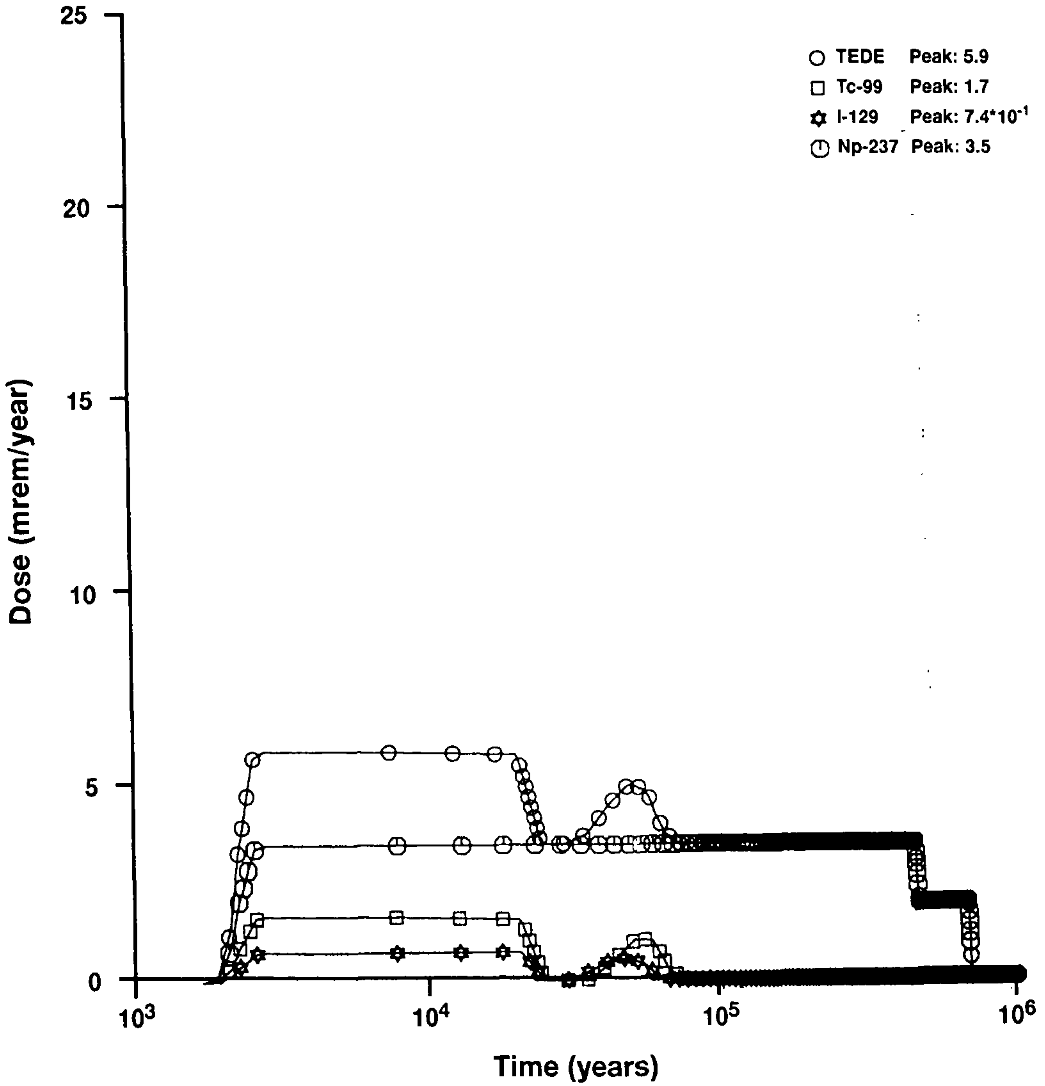
- Review of DOE's TSPA–95; technical exchange in May 1996
- Technical input to EPA for HLW regulation; e.g. four meetings to date
- Expert Elicitation Branch Technical Position out for comment; finalization planned by fall, 1996
- Key Technical Issue Status Document – November 1996

HLW PA DEMONSTRATION



Example of calculation of dose from drinking water from a stylized HLW repository assuming 1.5 mm infiltration per year.

HLW PA DEMONSTRATION



Example of calculation of dose from drinking water from a stylized HLW repository assuming 0.5 mm infiltration per year.

SUMMARY AND LOOK FORWARD

HLW:

- PA has moved from demonstration phase to application
- Cost-effective improvement in capability
- Near-term focus: technical basis for new HLW rules and importance of key technical issues

LLW:

- Commission Paper seeks approval to publish LLW BTP for comment
- Complete demonstration test case
- Provide support to agreement states

DECOMMISSIONING:

- Additional staff experience applying PA to complex decommissioning sites will lead to improvements and streamlining

SUMMARY AND LOOK FORWARD
(CONTINUED)

GENERIC POINTS:

- Guidance on the use of PA (PRA) methods will consider complexity of the safety issues, the availability of data, and the capabilities of licensees
- Will continue an aggressive program of training in PA.
- Experienced PA analysts and suitable tools will continue to provide technical basis for risk-informed regulatory decisions in the waste management program

BACKUP SLIDES

Recent Commission Direction (SECY-96-032) - Charter of the Committee to Review Generic Requirements (CRGR) - (Proposed Revision 6):

3. The NRC staff should use PRA for materials licensees, as well as power reactors, when the potential safety consequences warrant its use, sufficient data are available, and the licensees can reasonably be expected to be capable of performing such analyses.

NATURE OF PROBABILISTIC ANALYSIS FOR EACH PROGRAM AREA

SDMP: Can be completely deterministic; probabilistic treatment of parameter uncertainty

LLW: No explicit scenarios; some probabilistic parameters related to potential scenarios

HLW: Probabilistic analysis used to treat parameter variability and frequency of scenarios

CHARACTERISTICS OF AREAS FOR PA APPLICATIONS

PA Area	Governing Regulation	Depth	Hazard	Time Frame (yrs)	Composition of Material	Engineered Components	Environmental Transport
Decom.	10 CFR 20 10 CFR 30 10 CFR 40 10 CFR 70	surface, near surface	small	1000	few radionuclides, frequently long-lived	Usually none; sometimes caps or vaults	Often very complex near surface
LLW	10 CFR 61	near surface	medium	10,000	large variety of radionuclides, most short-lived	Substantial caps and other engineered features	Sites selected to simplify analysis of transport
HLW	10 CFR 60	deep (>300m)	high	10,000 -10^6	Spent fuel and vitrified HLW	waste packages and other engineered components	large times and distances increase complexity

The nature of the regulation and the system analyzed determines the character of the analysis, e.g. the level of detail, the degree to which it is probabilistic or deterministic.