UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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REACTOR DECOMMISSIONING RISK WORKSHOP

Holiday Inn Hotel

2 Montgomery Village Avenue

Gaithersburg, MD

Friday, July 16, 1999

The above-entitled workshop commenced, pursuant to notice, at 8:19 a.m.

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P R O C E E D I N G S

[8:19 a.m.]

MR. CAMERON: We're going to get started, but we're going to give Gary Holahan a minute to get in here. I thought what we could do before that, I want to give you a little reprise of yesterday and I would emphasize the little, and then talk about where we might go today.

But we do have some new people at the table with us this morning and I just would like them to introduce themselves. Suzy?

MS. BLACK: My name is Suzy Black. I'm the Deputy Director, Division of Licensing, Project Management.

MR. CAMERON: Thanks, Suzy. And let's go down the line.

MR. BAGCHI: I'm Goutam Bagchi. I'm an Advisor to the Division of Engineering.

MR. ROTHMAN: I'm Bob Rothman. I'm a seismologist in the Division of Engineering.

MR. CAMERON: Dr. Kennedy.

MR. KENNEDY: Bob Kennedy. I'm a consultant in the area of seismic engineering.

MR. CAMERON: And a consultant for NRC.

MR. KENNEDY: On this project, for NRC.

MR. CAMERON: All right.

MR. BAGCHI: In terms of acknowledgement, we need to acknowledge that Dr. Kennedy is going to be the independent reviewer. He has not been briefed by the staff and his availability is made through the Office of Nuclear Regulatory Research. Dr. John Staudenmeier is also here from the national lab and is going to work with Dr. Kennedy on this project. Dr. Wah Chang is the Project Manager from Office of Research and he is also here.

I just wanted to emphasize the fact that Dr. Kennedy is

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going to be the independent reviewer and he has not been briefed by the staff.

MR. CAMERON: Thanks. While we're on the point of clarification, Dr. Kennedy, are you associated with any particular institution?

DR. KENNEDY: Just my own company, RPK Structural Mechanics Consulting.

MR. CAMERON: Thank you. And let's go over here, and we'll have to share this. You are with us here at the table today. Go ahead.

MR. HUBBARD: George Hubbard, Plant Systems Branch, NRC.

MR. ATHERTON: My name is Peter James Atherton. I serve as the nuclear safety consultant for the public.

MR. CAMERON: Okay. Thank you. And for the benefit of the stenographer, Jon, you see people have switched places.

REPORTER: Yes, thank you.

MR. CAMERON: I think that we had a lot of productive discussions yesterday. Yesterday morning, we started out with a discussion of general issues, including the issue of safeguards and security, and we also had a nice concise description of the NRC staff study by Glen Kelly and a useful critique of that by Ed Burns, who is still with us over there.

And George Zinke and his colleagues did an impressive job, I think, of presenting some real useful real life information for us, and then we sort of went into a recalibration phase, which I guess is maybe the kindest word to describe it.

But it focused on the need, the feasibility of the NRC, taking the information that was brought to us yesterday by the industry and attempting to use that, factor that into some type of requantification of the study.

And just to make sure that we're all in the same place on

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that, I'm going to ask Gary Holahan to give us what the staff perspective is on that, and I think we'll probably have a little discussion of that and where we should go from there, not only in the future, but in terms of today's agenda.

We're sort of behind in terms of the agenda, but that's fine, as long as we're still making progress. But I would like to get to the seismic. There are some views that that may be resolved more quickly than the time we have on the agenda, but we need to have a sort of agenda discussion.

But I would just remind everybody that we are short on time and we'll really have to stay focused on the subjects that we're talking about today.

There is a session at the end today where we can have a more wide-ranging discussion of issues of concern, but we do need to stay focused.

Gary?

MR. HOLAHAN: Thank you, Chip. As you probably recall, I wasn't here yesterday afternoon. My understanding is that yesterday's issues had to do with the first presentations by the utilities on what they're actually doing with respect to their organizational and human activities.

I think it's fair to say most people who gave me their views of it were very impressed by what the utilities were doing and, in my mind, what that does is it says the utilities can, in fact, perform at a level beyond what we assumed in the analysis.

So there is room to give credit if, in fact, we know how to do that.

I think, also, it's worth pointing out that these are difficult issues to talk about and sometimes the examples sort of engender emotional reactions. That's because really what we're talking

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about is the difference between good operators or good organization and one that's nearly perfect.

But when we start talking about examples, the examples don't sound like the difference between a good organization and a perfect one. They sound like terrible examples. I think some of the examples, and I won't even repeat them because I think they cause more problems than they solve, are sort of distractions and we're not saying that operators are not paying attention to their job or the organizations are committed to safety.

What we're trying to do is distinguish between what would make an organization or operator, beyond what a normal human reliability analysis credits for operator actions, which leads to this point of where should we go from here, the requantification of the human reliability analysis.

And what I would propose is actually that we start at the other end of the problem. We had some information yesterday provided by Ed Burns. We are, in fact, getting independent expert input. The first thing we ought to reevaluate and requantify is the non-human reliability analysis, so we know what sort of challenges and what sort of expectations we ought to have for the operators.

So we ought to relook at initiating event frequencies and availability of equipment and those sorts of issues, because what I propose as a second step is even though some of what we're talking about here is beyond what I think of as the current state-of-the-art in human reliability analysis, I think we are willing to push the state-of-the-art, but we need to recognize, to do that, we will have to spend some time, some money and invest some expertise that I think hasn't yet been brought to this project.

What I would suggest is we look at initiating event frequencies, we look at the thermal hydraulic analysis and how much time

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is available and all those sorts of issues, so that we have available a more solid set of information to give the human reliability expert community.

On Ed Burns' slide yesterday, he suggested Gareth Parry was one of those experts. I'm inclined to agree to that. But this is a sufficiently difficult subject, that I don't want any one of our experts or anybody's experts making decisions on their own.

So I think some follow-up activity, focused on a clearer question of what is our expectation for the operators, needs to go on, and whether that's a separate study or a workshop or an expert elicitation or whatever it is, I think we need to sort that out.

I would like to see interested parties offering real expertise in the area of human reliability analysis, combined with the kind of information that the utilities brought as to what they're actually doing and what they're capable of doing.

And I think the commitment that we could make is we will requantify, to the extent that the state-of-the-art and the experts in this area say that that's the right thing to do.

Now, we can probably do some requalification. There may be some areas in which the real experts, of which there are not many in this room, but the real experts will say we can't quantify beyond a certain point or there's maybe certain types of activities that can't be requantified, and you can only make qualitative judgments.

I think we need to ask the experts how far to go on this issue. Then I think it's our commitment to publish a report that has the best information available. We're not interested in publishing a report that we don't really believe in. So what I imagine is sort of a staged process; let's get the best information available on the other parts of the issue, let's give that information to the expert community, let's get their advice as to how much, how far, what type of

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requantification can be done, we'll put that in the analysis, and that ought to be --

To a certain extent, we may be establishing a new state-of-the-art, and that's okay. Now, that takes commitment of resources, time, expertise. We have a few of those experts. We have -- the Office of Research has both expertise and contact to expertise on a contract basis.

I think we have resources available. If this was an issue that we were pressed to make a decision next month, I think this would not be practical. But we already have a commitment to an ongoing independent technical quality review over the next six months or so.

I think we can work this additional activity into that time-frame. But I think that's about where we are.

Now, I understand that there is also a sensitivity that we, the utilities, other interested parties will want to know what kind of activities are most valuable for the operators to do. We may not be able to distinguish between the value of having three operators on shift versus four operators on shift. That level of detail may not be something that even an expert HRA community can tell you. So there's going to have to be some judgments made.

But I think the most credible thing we can do is clarify the issue, bring in the experts, get their best advice and make a commitment to use the best information available.

And I'd be very interested in hearing people's views on this subject. I've already discussed it with a number of our PRA and human reliability experts and, frankly, they feel that it's sort of pushing the state-of-the-art, but that it's something that's doable and worthwhile.

If there are any other comments, I'd like to hear them. I guess this belongs to Chip.

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MR. CAMERON: Thank you very much, Gary. And why don't you -- we'll test this microphone out again. But I'd like to go over to Mike Meisner now for comment on that.

I'm just taking some notes here to see if whatever we come out of this discussion with, that we'll put that up on the board so everybody knows what it is.

Mike?

MR. MEISNER: I guess I'll give you a couple of personal comments, off the top of my head, after hearing what Gary said, but I thought that I'd maybe reserve final comments till later, till we can get together and talk as an industry.

My view, not being a PRA expert, and I said this when we first got together yesterday morning, was the model the staff put together was pretty good. We were only in disagreement over some of the inputs to the model.

I guess what we're hearing now and what I heard last night was basically the staff saying we can trust this model if it gives high numbers as results, but we can't trust it if it gives low numbers. I'm not sure that's very constructive as a basis for a rulemaking process.

One of the things we are all concerned about going into this effort with the Commission charter was the staff turning this into a long-term research project. Again, it's just my kneejerk reaction, it looks like that's the way we're going.

I, for the life of me, can't understand why you can't simply take the information that we gave you yesterday and modify the inputs to your model, your PRA numbers. I'm not sure that this is really such a state-of-the-art or pushing the envelope that reasonable PRA practitioners couldn't agree on what this means.

MR. CAMERON: Okay. We're going to go to Gary to address that. It might be useful, if there are other PRA experts out there from

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industry, academia, the consulting world, whatever, it would be useful to get your input on this issue, too, so that we can figure out how to move forward here.

Gary?

MR. HOLAHAN: I didn't mean to leave you with the impression that we don't trust low numbers, we only trust high numbers. I didn't say those things, so I don't want you to have that impression.

And it seems to me, even if we seem like we're making this more difficult than it needs to be, and if you are right, then it seems to me when we hand this issue to a bunch of experts, that perhaps they will come back and support your position.

But the only thing we've lost is some time and resources in getting there, but I think even if they come out and they fully support your suggestion, I think we have a more credible way of moving forward, so that other people or the rest of the world sees that we've given this -- which, in fact, we've all acknowledged is the most important part of the decommissioning issue.

It's really in the absence of automatic systems and all that, we are relying on the organization and the individuals. And I think we need to have people understanding that we've given this our most serious thought.

So I think that's -- if it seems a little bit unreasonable to you, I still think it's the best course of action.

MR. CAMERON: Before we go back to Mike, I think let's hear from some other people around the table, we'll go to Alan first, and then we want to test out on people the proposal that Gary put forward. But let's get some more input. Alan?

MR. NELSON: Yes, Alan Nelson, NEI. Yesterday, we forwarded a letter to the Commission noting that they delay action on the SECY-99-168, the rulemaking proposal. The reason being is that we felt

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that today's workshop was the underpinning of that process and the rulemaking activity that was moving forward.

And given that, how would the study or the longer-term activity eventually effect the rulemaking and the Commission vote as we move forward? Because one is -- I see one interlocked with the other.

MR. CAMERON: We're going to give that to Stu Richards.

MR. RICHARDS: I think what we would intend to do is to continue to go forward with the idea of establishing a separate part for rulemaking activities, if you will, to establish the framework.

Of course, it's kind of an empty shell until you start filling it up with the rules that apply. So assuming that the Commission were to give us the green light, we would continue our activities to review Part 50 and the rest of 10 CFR and determine where the various regulations are that apply to decommissioning, to work towards coming out with a rulemaking to establish a new subpart on decommissioning.

But as you've said, the foundation for some of the more significant issues, based on the exemptions of the process, really are going to have to wait until this is put in perspective as far as the risk goes.

So process-wise, I think we would continue on, as long as the Commission gives us the green light. Obviously, we're not going to go anywhere with EP, security, financial protection, some of those until Gary's effort is complete.

MR. CAMERON: Does that answer your question, Alan?

MR. RICHARDS: Again, the Commission has the say on this. You've read our paper, we've made a proposal. I don't want to prejudge what they're going to tell us.

MR. NELSON: I'm just concerned that the outcome of today's discussions and the ultimate study that, who know how long it would

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take, as Mike said, it could take up a protracted length of time, could effect the rulemaking, the rulemaking package, and the focus of the rule itself.

MR. CAMERON: Gary, you seemed to indicate that you were more optimistic about this.

MR. HOLAHAN: I am more optistmic, and since yesterday afternoon, we don't have a detailed plan. But in my mind, we're talking about months, not years, and remember, we've already laid out a schedule that said we were going to study this and follow up on this report through the end of the year.

We may be able to do it in that context. It may stretch things a few months, but I don't envision this being an impediment to the schedule.

I think the other thing I'd like to mention is I don't mean to ignore all the other issues of yesterday, but I think this is one on which what we're talking about is doing something in addition to what we were going to do before in the other areas.

People suggested issues like airplane crashes, for example. I think Mr. Shadis suggested it. That's one of the topics that's already in our report and we will look into any new information on that subject, or seismic, or -- you know, that's already part of our independent assessment and input.

The reason I raise this human reliability analysis is because I think in addition to just re-reviewing it, we would do something more than we were previously thinking about.

MR. CAMERON: Okay. That's a good point, Gary, and I believe those were some of the issues that Ray Shadis brought forward at the end of yesterday, these other issues. Ray?

MR. SHADIS: Please, let's not have it on the record that those are issues I brought forward. What I was saying is that there is

a great deal of new information regarding the various issues that the staff had listed, and that really that ought to constitute part of the input to determining probabilities on those things.

But I think, also, as long as the door is open here, you really want to take a look at what goes on in a decommissioning plant. The staff seemed to limit itself in the outline at least under heavy load drops to cask drops. That was -- at one point, that was the only item listed in one of those cells that you showed yesterday, and there are a number of other situations in which heavy objects can wind up falling into the spent fuel pool.

MR. HOLAHAN: Deconstruction type of things.

MR. SHADIS: Deconstruction things, you have your overhead crane rail which is pretty heavy, you have masonry walls which are not seismically qualified, and I think we really need to look at what the impact of that might be.

Last night I was running through different possible scenarios for criticality as a result of an accident, and it occurred to me that in some decommissioning plants, the systems are not segregated as they are at Maine Yankee, and you have chemical stripping of the primary piping. Somebody may take it, in their mind, that they want to chemically strip the reactor vessel.

I thought you have a situation in which you have a fairly rapid loss of spent fuel pool coolant and someone gets on the phone to say what do we do about it and some other genius decides that maybe there is a lot of liquid available in the primary system.

I'm trying to remember what my chemistry looked like back when, and my grades weren't very good, but I thought, gee, if you dump a lot of caustic material in there, can you precipitate out the boron. I don't know, but what I'm saying to you is that accident conditions, from my perspective, are conditions of chaos and decisions are not always

made in a clear rational way at that time and the most peculiar things can show up under accident conditions.

That falling crane rail could also take out the electricity. So things get complicated in a hurry and I really think that if you're going to go forward to assign risk probabilities and consequences for this kind of an accident, that you really need to take a -- open the arms up and take a broad sweep and bring in all these potential issues.

MR. CAMERON: I think Gary is shaking his head affirmatively.

MR. HOLAHAN: I'm shaking my head affirmatively. We didn't put criticality issues as a specific issue on the list. I think it's because it's not fully developed in the draft report. So in a sense, we didn't want to have a meeting on something that the participants didn't have a chance to see.

Our criticality experts are looking at this issue and, frankly, the chemical aspect of it is something that I hadn't heard before. I think it's just one more thing you can put on their plate.

But they are looking at a whole collection of possible ways of making the spent fuel pool critical.

I don't know that we'll have another workshop, but clearly, when we have a draft of that part of the report, we'll put out for comment and we'll want to work through those issues well.

MR. CAMERON: Okay. These other issues are useful to discuss, but let's try to keep on the proposal, and it may be too strong a word to call it, Gary, but maybe it isn't, but to identify it, Gary's proposal.

Ed Burns, what is your thought on that?

MR. BURNS: I'd have to say that I agree with much of what Gary said. I think that he summarized pretty much the tact I would take in trying to reexamine what the draft analysis has said.

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I'm sort of a pragmatic -- take a pragmatic approach to PRA, so his step-wise approach seemed very appropriate and useful. The only few things I would add to it, I would try to relate each of the specific industry practices that would impact it, impact the model quantitatively when we get to the HRA part of it, which ones of those are the most important to make sure that the industry understands what the model is saying and that the industry can properly feed back any information that may influence that.

The second point would be that from a quantitative standpoint, I think that by incorporating those inputs into the model, that you would be able to identify which sequences might be most important and then which sequences you can say are truncated and you can pick a quantitative value that you might truncate those sequences at, so you're not tied basically to some specific number associated with very low frequencies, but pick a way to truncate those sequences and identify how those got truncated, based on what actual practical things were done or assumed as part of that analysis.

From my own personal point of view, I think that any enhancement to the HRA methodology, as Gary suggested, that from my personal point of view, that's very useful to me, very important to the PRA community and would further the techniques.

I'm not sure that it needs to be tied to decommissioning rulemaking, but that's a judgment for people other than me to make.

MR. CAMERON: Gary, comment on that.

MR. HOLAHAN: If I was looking around the room, it's not because my interest was wandering. I was sort of picking up signals from our various experts that say, yeah, your suggestion sounds very reasonable. It's a good way to proceed.

MR. CAMERON: The suggestion being two things; one, take the specific industry practices, for example, that were talked about

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yesterday and make sure that that's fed into the PRA and then there was this issue of truncation.

MR. HOLAHAN: That's just a technique for dealing with these.

MR. CAMERON: So truncation as related to the specific industry practices. It's a technique.

MR. SHERON: The use of truncation I don't think is important to put up there. It was a -- it's a way to get past the -- get the problem of very low -- showing very low numbers that are difficult to defend when we don't need to. We don't need to show those. We need to say what's important and why it's important and if you're able to dismiss a sequence or dismiss things based on very low numbers, then I think that's sufficient.

MR. CAMERON: All right.

MR. HOLAHAN: If I can make a suggestion that we put some new thoughts of various types on the table, on this subject. We are going to have a wrap-up session this afternoon. I'd suggest that people spend the rest of the morning and their lunch to think about what's been said and let's pick this up again as part of all the various issues to do the wrap-up.

We're at a relatively thoughtful and calm point and I think this might be a good point to just let it simmer there for a while, pick it up in our wrap-up, and maybe we can move on and try to cover seismic and the other things that we said we were going to do.

MR. CAMERON: That seems like a good suggestion. Let me ask Mike, for example, is that okay to let it simmer?

MR. MEISNER: Sure, let's do that.

MR. CAMERON: All right. We're going to let it simmer. We have sort of a crude representation up here about this and we'll go back to it.

Do we have any final comments on this issue before we go to seismic? Glen Kelly.

MR. KELLY: I wanted to put a little clarification about the independent review that we're going to be having performed of our analysis. That independent review will take into account all of the information that's presented here and any additional information that people want to provide to us.

We're also asking that our -- what we've done be looked at from the point of view of its technical adequacy, as well as whether we have caught the breadth of issues that should be covered under potential vulnerabilities or problems with spent fuel pools.

So as these issues come up, we will make sure that they are all covered in our review. Anything that we didn't capture in our program, we'll make sure that it gets covered under there and it will be reviewed and all addressed in the final report when it comes out.

MR. CAMERON: Thank you. Stu, do you have a comment?

MR. RICHARDS: Just a clarifier on the criticality issue, and I just wanted to mention that previously, Mr. Atherton has brought this up at other meetings. Like Gary said, it's still under review. We offered Mr. Atherton the opportunity to meet with us after that issue had been thought out more carefully, and I don't think we've heard back from him yet, but we've offered to hold a separate meeting in the future and address it at that time.

MR. CAMERON: Ray, you have a comment on that?

MR. SHADIS: Yes. I feel like the only person speaking versions around here. I did not bring up the criticality issue, except as an example, speaking primarily about learning what goes on at a decommissioning plant.

So that as you develop potential accident scenarios and you're looking then to build on your list of initiating events, that's

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the place to look, because that's the situation in which this rule or report is going to be applied.

That was my point. My point was not necessarily that you need to look at criticality, although it's certainly a wise idea.

MR. CAMERON: Okay.

MR. SHADIS: I just wanted to clarify that.

MR. CAMERON: Thanks for that clarification. I think Stu's point is good information for people to know, and we'll stop attributing things to you. I made the mistake first. We'll stop that.

Can we get the seismic session going? Is there a presentation that's going to kick that off? How about that. Okay.

MR. RICHARDS: I'm the person that's supposed to kick this off, and in the interest of time, I'll keep it real short. I think seismic is one of the areas that, even going back to NUREG-1353, was an issue that seemed to be above the others.

It's also kind of unique in that nobody is looking to rebuild the spent fuel pool to change the site characteristics. So it seems like the reviews in this area have focused more on what available information there is on seismic data and what it means.

So we're going to have a presentation by our people and then the industry is going to have their presentation. With that, I'll turn it over to our guys.

MR. CAMERON: All yours.

MR. BAGCHI: My name is Goutam Bagchi. I'm with the staff, as I introduced myself. My co-presenter will also be Gareth Parry. And before I get started with this, I need to tell you that back when, as a young engineer, I started working for a consulting company. Maine Yankee was a plant that was I involved in designing. I remember, I believe, working because of the large penetration in the containment structure, and I had plenty of experience dealing with design of nuclear

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power plant structures.

When I came to this issue, seismic event was perhaps representative of the toughest tree in the forest. And I started looking at it and I said to myself, I really need to pay attention to two sides of the equation. One is what is the demand of the structure and what is its capacity.

On the demand side, earthquakes are notoriously fraught with uncertainty in our ability to predict what kind of a down-motion the structure might be subjected to. Our rules and regulations have certain requirements and those are considered in the design basis.

Having said that, let me just go back and say that my first part would be with respect to the reasons for the study and the second would be the perspectives for the study and then what did we do and then some idea about my understanding of where we could go from here.

There may be a slide overlap between my presentation and Gareth's. Yesterday, in the discussion by the industry, it was recognized that seismic and heavy load drop events could lead to loss of inventory, but I want to remind ourselves that the loss of inventory in some cases could be really catastrophic, such as it could not be recovered, and the consequences then could be significant.

So we need to pay attention to the fact that we don't want to get there and the objective of all of this study is how to avoid that.

On the demand side, there has been a significant reduction in the seismic hazard perception. Now, this is the mean seismic hazard, and I want to emphasize the word mean seismic hazard, between 1989 and 1993.

The median estimates were pretty much about the same. They didn't change very much between the 1989 study by Lawrence Livermore Lab and the eventual 1993 study. And when I started looking at different

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spent fuel pool configurations, I recognized that the seismic capacity could be different due to spent fuel location, spent fuel pool location, super-structure, overhead crane consideration, and interaction potential with other unrelated structures, and, therefore, they are site-dependent, plant-dependent.

And another important thing to recognize is that the pool integrity can be determined by the failure mode that has the least seismic capacity and large variations of seismic capacity, as I mentioned, can exist from one plant to another.

Next slide, please.

So we recognize that plant-specific hazard and seismic capacity combination can raise a risk concern. And this study offered us an opportunity to address this issue in a risk-informed manner. We want to deal with absolute numbers and things like that, but recognize where the failure potentials are and what that might mean with respect to public health and safety concerns, and then hopefully make a decision on the basis of those risk-informed insights.

The first objective I already spoke about and the second, let me concentrate on the second one. I believe that as a result of this kind of review, as a result of even future applicants coming in with a request for an exemption and eventually, of course, an engineering rule, we would be able to identify certain conditions that would screen out plants from seismic demand and capacity related vulnerabilities.

Next slide, please.

What did we assume in the study and our approach? The basic NUREG that went into the previous study, NUREG-1353, there was a NUREG CR report that dealt with the evaluation of seismic capacity. It came up with an estimate of seismic fragility of at least about three times the seismic design basis load.

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And based on my experience and engineering judgment, I feel that three times the seismic design basis capacity is readily available provided that plant-specific vulnerabilities or weaknesses can be ruled out.

Seismic hazard curves from the NRC and the independent industry studies, this is primarily the EPRI study that I'm talking about, they used very similar values, as it has been demonstrated by the Duke Engineering report. This is the Duke Engineering report that was submitted at the previous public meeting that we had, authored by Tom O'Hara.

Next slide, please.

In trying to use that three times the seismic design basis value as a way to screen out certain plants, we use information drawn from the NUREG-1407 and its title is Procedural and Submittal Guidance for the Individual Plant Examination of External Events for Severe Accident Vulnerabilities.

It was published in June 1991 and it was part of Generic Letter 88-20, Revision 4. I do have a copy of it with me, but that's not all the reporting.

The important point to make there is that plants are grouped into various levels of seismic hazard. We took that into account.

I looked at the annual probability of exceedance of ground acceleration at three times and then at three and a half times the design level earthquake values at the mean level. This was from NUREG-1488, revised Livermore seismic hazard estimates for 69 nuclear power plant sites east of the Rocky Mountains. It was published in October 1993.

Now, this is not in your slide and perhaps I shouldn't even attempt to show this, but let me dwell on this point just a little bit. The mean hazard curve is so flat that the difference in a factor of ten

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to 100 can cause a big difference in the ground motion itself. So this huge uncertainty, keeping in mind that the consequence of this difference in the ground motion could then mean a difference between the catastrophic failure of the spent fuel pool value you could not recover from the loss of water, and another, you could retain the water and deal with the accident or event in a rather safe manner.

So that uncertainty is the driving force behind our attempt, at least it was my attempt to see whether or not some ways of screening out these weaknesses that might exist on a plant-specific basis.

So in the end, except for a few sites, we found out that three times the design level earthquake has an annual probability of exceedance of the mean value of about two-times-ten-to-the-minus-five per reactor year.

Next slide, please.

With a seismic capacity of three times the design level earthquake, there is high confidence that the probability of failure is about .05. So the hazard and failure probability, this is the high confidence, there is some conservatism there, is about one-times-ten-to-the-minus-six per reactor year. This is the probability of unrecoverable loss of spent fuel integrity and it is about half of the total probability of fuel being uncovered due to a seismic event.

This is just putting things in perspective, so that you can understand what two-times-ten-to-the-minus-six came from.

Next one, please.

As I emphasized earlier, I attempted to discuss various failure modes of the spent fuel pool structure and it is in the report and potential changes in structure response at high level earthquake ground motion. And I needed to emphasize this, that the change in response due to high level ground motion and so that can understand,

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taking a design basis response level and scaling up to a factor of three does not necessarily come up with a true picture of how the structure is going to respond at a very high level ground motion. That's what is of concern here.

And then this is my last point, the last bullet. I believe that we could come up with a very simple checklist to screen out plants on a plant-specific basis which would have no structural vulnerability or identify very simple compensatory measures that will relieve the burden of dealing with the catastrophic loss of water from the spent fuel pool.

Thank you.

MR. CAMERON: And this is Bob Rothman? No. Gareth?

MR. PARRY: Gareth Parry.

MR. CAMERON: All right.

MR. PERRY: I'm just going to make a few additional comments to what Goutam said. I'll talk a little bit about the evaluation of the frequency of spent fuel pool failure due to seismic events.

What Goutam described was a sort of shortcut method to come up with an estimate of the failure probability. The most -- perhaps the most accurate way of evaluating frequencies of seismic failures is to, in fact, follow the methodology that was developed more than 20 years ago now by Dr. Kennedy and others and has been used in most of the IPEEEs that actually did seismic PRAs.

It basically consists of convolving a site-specific hazard curve with a model of the plant that talks about the conditional failure probabilities given a seismic event of a certain magnitude.

Actually, I'm being rather sloppy in my use of the words. Usually, the parameter used in the hazard and the conditional probability formulation is some measure of the ground motion acceleration. This is the approach that I think was adopted in the EPRI

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study that we received a copy of.

The, as Goutam mentioned, significant uncertainties in the evaluation of both the hazard and also in the evaluation of the capacity of structures and components to ground motion, but the methodology is capable of taking that into account. In fact, it's built into the methodology so that you come up with a fairly -- with a good approach to handling both the uncertainty and the initial problem.

As I said, the methodology itself is pretty mature. So in principal, the problem is relatively easy to go about, but then you have to worry about sources of data.

We're very fortunate in that at least for all the plants in the eastern U.S., that we have hazard curves that have been developed, both by Lawrence Livermore and by EPRI. When it comes to the fragility curves or the curves that represent the conditional probability of failure of the pool as a function of acceleration, what we, in fact, have is representative curves for gross structural failure for a particular BWR, Vermont Yankee, and a particular PWR, which is Robinson.

This was reported in NUREG CR-5176, and these were the curves, I believe, that were used or these are the fragility descriptions that were used in the EPRI report. The NUREG also did address system failures, but I think that it was really done for an operating plant, so that the systems that are in place are perhaps a little different from the ones that might be in place for a decommissioned plant, and, therefore, that is an area that needs to be looked at, I think, again.

But let's get back to the big issue, which is the failure of the pump that leads to a complete draining of the pool, so that it can be refilled, which has been identified as one of the big issues, one of the tall trees in the forest, if you like.

I think our major concern is that the structural fragilities

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are likely to be a function -- not likely -- they are a function of site-specific design features and the fragility curves that we used that were developed in the NUREG were, I think, primarily for gross structural failure.

It's probably -- there are other failure modes that perhaps ought to be looked at, such as penetration failures, impact of adjacent structures, and dropped loads, and those are going to be, again, very site-specific issues.

And just to illustrate the significance of making assumptions -- of developing different fragility curves, we included, on this last slide, a sensitivity study using the simple approach that we used in the report to demonstrate the impact of reducing this HCLPF value, that's the high confidence low probability of a failure value. That's the value at which you have at least 95 percent confidence that your failure probability is greater than -- less than .05.

So if we reduce that HCLPF value by 40 percent, we can lead to increases in frequency of failure by a factor of on the order of five.

Now, reduction in HCLPF of 40 percent is fairly substantial. But also a reduction on the order of 20 percent can lead to an increase in the frequency of failure by something on the order of two. So it shows you it's highly non-linear and, therefore, it is a significant area of concern.

That, I think, completes what we have to say on this issue.

MR. CAMERON: Can we go to Tom O'Hara now? Tom, if you could just introduce yourself to us. I'm sorry I didn't catch you before.

MR. O'HARA: Tom O'Hara. I work for Duke Engineering Services. The reason you didn't catch me was I wasn't sitting here.

MR. CAMERON: All right. Do you want to use this microphone

while you do your presentation?

MR. O'HARA: I can sit down here and do it.

MR. CAMERON: All right. And when Tom is done, we'll have a discussion on the seismic issue.

MR. O'HARA: As I say, my name is Tom O'Hara. I'm with Duke Engineering Services. I've got a long line history of experience in areas of seismic hazard and PRAs.

The focus of this presentation, of my presentation, is specifically on spent fuel pool failure frequencies. I want to give some background information just to sort of frame what I think the issues are and put things, I think, in better perspective. Some will be a rehash of what Goutam said, et cetera.

NUREG-1353, this document here, which was the regulatory analysis for the resolution of Generic Issue 82, beyond design basis accidents in spent fuel pools, was the template for that EPRI study. As stated in NUREG-1353, seismic was the dominant contributor to the overall risk. It represented over 90 percent of the risk.

One thing that they -- they also evaluated the systems failure due to seismic, loss of makeup cooling ability, and that was estimated as two-times-ten-to-the-minus-eight in the 1353 study, and it is one-times-ten-to-the-minus-six currently in the draft NRC document.

I'm not addressing that, but there is a huge change between what was published and what is currently being used. The NUREG-1353 results are based primarily -- they are based upon the Livermore 1989 seismic hazard results. In April, I gave a presentation over at Rockville and in that presentation, I said that the spent fuel pool failure frequencies due to seismic would be reduced by a factor of five to ten if you kept the methodology the same as was used in NUREG/CR-5176, which was a Livermore study, which was input, which provided the inputs to NUREG-1353.

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So, again, my position at that time was you would reduce the spent fuel pool failure frequencies, holding everything the same, but just changing the inputs and using updated seismic hazard results.

I also said that if you use the EPRI results, there would be a factor of ten reduction. Using traditional PRA approaches -- that is, as was talked about, where you convolve a family of seismic hazard curves with a family of fragility curves.

I used the -- I performed the analysis, but what I did was I used the seismic hazard results for the 1989 study, the Livermore 1993 study, and the EPRI study, and the purpose of doing the '89 study is to show the -- you want to do the calculation for '89 so you can show its reduction by using the new results.

Based upon this analysis, the mean for the population of plants, we're talking eastern U.S. studies, is less than ten-to-the-minus-six. That's the mean for the population of plants.

You will find that some sites do pop above ten-to-the-minus-six. So with that as a background, go to the next slide. You've got it already, stay right there.

In a PRA for spent fuel pools, there's two pieces to the puzzle, basically, the seismic hazard and the fragility. So I want to quickly cover the seismic hazard, the history of the seismic hazard, Livermore and EPRI. I'm going to just briefly gloss over NUREG-4982. That was a BNL, Brookhaven National Lab study, I guess it was the first one done on the spent fuel pool. Then I'm going to cover 5176, which, again, provides the seismic failure probabilities for NUREG-1353.

I will briefly summarize the NRC approach, as I see it or saw it, and then I want -- then what I'm going to do is I will show you results of running all of the sites using these different seismic hazard curves and different methodologies.

Next slide.

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There is the -- the Livermore methodology goes way back, actually to 1978-79. That's when the systematic evaluation program, SEP, was started. One of the things they were looking for was a quick way to provide a consistent seismic design value in terms of probability at these ten older plants. These were ten older plants in terms of they were pre Appendix A and pre SRP.

In 1982, I believe it was, the Charleston issue came about and that's where you had -- basically, it is that the USGS said that the Charleston earthquake could not be tied to a structure and the way that people decided to handle this was probabilistically. The Charleston earthquake was a magnitude seven earthquake.

And what the NRC did was they used the NUREG-1582, the original Livermore methodology, as the framework for a methodology to handle the Charleston issue and EPRI generated their large study, and these are large studies. They're -- I don't want to say they're continental, but they're damn close to continental. They go from the Rockies to the east coast.

In 1985, 2421, the results of that study were used in the BNL study and a point to -- I'll pass on that for a second. Then Livermore published their final results in 1989 in 5250 and those results were used in the Livermore study, NUREG-5176, where they calculated the spent fuel pool failure frequencies at Vermont Yankee and Robinson, which were subsequently used in 1353.

EPRI also published their results and in 1993, Livermore revised their seismic hazard results. And I can go into why, what the differences are between Livermore and EPRI, Livermore '89, Livermore '93, that's another time.

But one point I will raise is that prior to 1993, the Livermore mean hazard curve was a point of contention. It was a contentious statistic, shall we say. It exceeded the 90th percentile at

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times.

Consequently, when people did PRAs, they did everything they could to avoid using the mean, and I'll just drop it at that.

Next slide, please.

I had one more point here which I considered to be important. On page 6 of SECY-91-102, this is the IPEEE for severe accident vulnerabilities, there was a response by the NRC to a question by industry and it had to do with why are you making us use both Livermore and EPRI hazard curves in the evaluations.

And they said based on the available information to date, they consider both of them to be valid. Therefore, you use both of them, and that's why I used both of them.

Next slide, please.

The purpose of this slide, this is the Brookhaven National Lab study. Again, what they used was hazard results. These were preliminary Livermore hazard results, published in 1985, and they used the 15th, the 50th, the 80th percentile and a best estimate. The best estimate is not the mean, and that's another story.

They also used surrogates for the fragility curves and they were based upon PRA studies at Oyster Creek and Zion.

And remember that when you're performing these PRAs, you have the hazards and the fragilities. You need those two pieces, and that's why I'm pointing them out.

Next slide, please.

In the Livermore 5176 study, this used the Livermore 1989 results. They did not use the mean hazard curve. They came up with a method to generate a family of hazard curves, eleven, weighting and et cetera, and this became the hazard input.

Next slide, please.

The difference between 5176 and the previous BNL study is

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they didn't use surrogates. They went out and looked at the plants and they came up with these -- they came up with fragility estimates of the median capacity and the beta R's and the beta U's, the random and uncertainty and location estimates.

And they used these along with the Livermore 1989 seismic hazard results and they came up with estimates of spent fuel pool failure and that was used in the 1353 study.

And as you recall, in that study, they said seismic represents over 90 percent of the risk, it's a big concern.

So what you have here, the 5176 methodology is basically you generate a family of hazard curves, you have a family of fragility curves, you convolve the two, you have a family, if you want to generate uncertainty estimates, but bottom line, we're looking at a mean spent fuel failure frequency. So that's one methodology.

The next one -- and there is a variation of this where you can just simply replace the eleven hazard curves with a mean, and I've done that, too.

Next slide, please.

This is what Goutam was just talking about, and this is my summary of it. It may not be correct totally, Goutam, but it's probably close.

MR. BAGCHI: The next one, the next slide, that's what you're talking about.

MR. O'HARA: Okay. But what I wanted to -- I thought it was a great write-up, to be honest with you, and the bottom line is what you're saying is these spent fuel pools are inherently rugged to withstand a lot of seismic shaking. And what you're saying, what you said in the report was it was good, .4 to .5. Well, I say that's above .45. And so I used that number.

Next slide, please.

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And then, of course, the NRC approach is to -- and it is a pretty clever little approach, very simple, very easy to check. So what one does is you can take your seismic hazard curve, whether it's a Livermore or EPRI, use a mean seismic hazard curve, go in at .45g, come up with a probability of exceeding .45g, and now you multiply that by a factor of .05, which is their shortcut, and you come up with one-times-ten-to-the-minus-six.

So I have also taken this approach and run the numbers using Livermore and EPRI. And, again, I say one of the beauties of this approach is anybody can check any number that I present here using the Livermore approach. It's a lot more difficult with the classic PRA approach, as we are convolving mathematically the hazards and the fragilities.

Next slide, please.

This shows you, on the X axis is site, and I have a site code and I know the name of each site. All the utility people want to know what their site number is, and I won't tell them that. On the Y axis is annual probability of a spent fuel pool failure. The solid line is the EPRI results and the dashed line are the Livermore results.

What I did here was using the 5176 methodology, you have eleven hazard curves, a family of five fragility curves, and you convolve the two together, do the gymnastics, and you come up with a number. The mean for the Livermore results is nine-times-ten-to-the-minus-seven, for EPRI it's 1.4-times-ten-to-the-minus-seven, and that's across the population of sites.

There are a few EPRI sites that weren't included that Livermore did, because you may see a break in the EPRI line at times.

Next slide, please.

As I said to you before, both approaches are valid,

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Livermore and EPRI, and there are reasons for the differences between Livermore and EPRI. I mathematically took a pure average of the Livermore and EPRI, that's all it is, and whenever you average four-times-ten-to-the-minus-six with ten-to-the-minus-eight, the answer is two-times-ten-to-the-minus-six. So the lower probability numbers don't get anywhere -- unless you do it logarithmically.

Anyway, just a pure average, and what you can see here is that the average of the two is about five-times-ten-to-the-minus-seven and a few pop above the line.

And I want to raise one point here. In the NUREG-1353 analysis, they went all the way to release. In other words, they multiplied the spent fuel pool failure frequency times the conditional probability of release given failure. For a BWR, that was .25. That's not down here. So some of these are BWRs and -- why are you doing that?

MR. BARRETT: I wanted to ask a question.

MR. O'HARA: Go ahead.

MR. BARRETT: I wonder if you could just quickly tell me what did the .25 represent?

MR. O'HARA: The conditional probability -- .25 represented the conditional probability of a zircaloy fire given that you lost your inventory and that was based upon the spacing of the fuel rods, et cetera.

You'll have to go back and ask the authors when they came up with that number, but that's what they used. It's a conditional probability given failure, you've lost inventory, of the fire. Okay?

MR. BARRETT: I'm sorry to do this. Yesterday, this was the procedure that we agreed upon for asking questions, for trying to get attention.

MR. CAMERON: As the facilitator, I think I spoke to you about doing that.

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MR. O'HARA: I was thinking why is he doing this to me.

MR. CAMERON: Are you okay, Tom?

MR. O'HARA: Yes, I think I can handle it.

MR. CAMERON: All right.

MR. O'HARA: So the -- go ahead, Goutam.

MR. BAGCHI: Just one clarifying point. I think the way it has been done, that factor of .25 is not there anymore.

MR. ROTHMAN: It's different.

MR. BAGCHI: It's different.

MR. O'HARA: Okay. I can't debate that one with you, Goutam. We're not using it. It's not in this analysis. I'm just clarifying it because that was what was done in NUREG-1353.

MR. CAMERON: And, Tom, I guess it would be worthwhile saying that what we agreed to yesterday is that we didn't want to get off on discussion during the presentations, but that there might be a need to clarify certain information just to understand a presentation.

So I'll keep an eye out for anybody who might want to ask you a clarifying question.

MR. O'HARA: No problem.

MR. CAMERON: All right.

MR. O'HARA: This is the NRC HCLPF approach and there is one mistake on this slide. On the Y axis, that should not be probability of exceedance. That's just annual probability. I've done too many seismic hazard calculations.

Other than that, what you find, again, it's the same process. The solid line is EPRI, the dashed line is Livermore, and the mean for Livermore is nine-times-ten-to-the-minus-seven, the mean for EPRI is four-times-ten-to-the-minus-seven. What you find is that these are closer together than the previous analysis and the answer -- and the question is, why is that.

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The answer is, you're not -- there is a difference between Livermore and EPRI in terms of the slopes at the lower accelerations and we're not going on out -- excuse me -- the higher accelerations, and we're not going -- we're not convolving hazard curves with fragilities. We're picking a value at .45g. To it's pretty close there.

Next slide, please.

Again, the same error on the Y axis, change it to annual probability. This is the average of Livermore and EPRI using the -- I'll call it NRC approach. The mean is about six-times-ten-to-the-minus-seven and, again, you see some that pop above the line.

Next slide, please.

This is exactly the 5176 methodology, just using the mean hazard curve. The mean for Livermore is 9.6-times-ten-to-the-minus-seven, EPRI 1.3.

Next slide.

The average of the two is about 5.5-times-ten-to-the-minus-seven. And what's of interest is the same plants, of course, pop above the line and you would expect it, so they kind of cross-check with each other.

Next slide, please.

This is a summary of our conclusions here. Based upon the 5176 methodology, in using -- in other words, using your eleven seismic hazard curves and your five fragility curves, I ran the Livermore 1989 results. I also ran the Livermore '93 and the EPRI.

The purpose of the Livermore '89 was just to check my original statement. Is it about a factor of five to ten? It is. It's seven, seven or eight.

Livermore is about nine-times-ten-to-the-minus-seven, EPRI is 1.4-times-ten-to-the-minus-seven, the average is about

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five-times-ten-to-the-minus-seven.

Next slide, please.

Then I took the 5176 and just used the means and what you see is the difference between '89 and '93 is over a factor of ten, and I would expect that.

So Livermore '93 is 9.6-times-ten-to-the-minus-seven, EPRI is 1.3-times-ten-to-the-minus-seven, the mean is about 5.5.

Next slide, please.

If we use the NRC HCLPF approach, you see over a factor of ten reduction going from Livermore '89 to '93 results. Using the revised Livermore '93 and the EPRI, they're pretty close, nine and 3.5-times-ten-to-the-minus-seven, and the mean is about six-times-ten-to-the-minus-seven.

My last slide is the conclusion. I've looked at this a couple of different ways and the fundamental conclusion is that the mean probability of a spent fuel pool failure is less than ten-to-the-minus-seven, using the generic assumptions that were published in NUREG-5176 or using the HCLPF approach that the NRC is proposing.

If one used EPRI, you would say the numbers are about ten-to-the-minus-seven. If you use Livermore, it's less than ten-to-the-minus-six; not much, but less than ten-to-the-minus-six. If you use the average, which is probably the right number, it's around five-times-ten-to-the-minus-seven.

And that concludes the presentation.

MR. CAMERON: Thank you, Tom. We're going to open it for discussion now, and I guess I would like you to think about what you want to get out of this discussion at the end.

The NRC slides identified some areas of concern, do we want to reach some sort of resolution on those. Tom gave us a sort of bottom

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line here. Just think about that so that we might get a sense of where we're going.

But let's go to Glen and open it up with him.

MR. KELLY: I would be interested, Tom, in hearing an explanation of why you feel that the mean or the average is a good number to use for discussing or considering the population, because it reminds me of the story about the statistician who was six feet tall, who drowned in a river crossing that only had a mean of three feet deep.

So what does the mean value or the average of population tell us about the population in this particular case?

MR. O'HARA: The mean value -- historically, I know, from my experience, the mean has been contentious and oftentimes the seismic hazard analyses, we will try to use the median.

But you use the mean because it provides information about the population. Every point is included in the statistic, the mean statistic, and, therefore, you use means to make a statement of inference about a population.

MR. CAMERON: Does that answer your question?

MR. KELLY: My question really goes to, if you're taking the mean of the means here and then you've got the means of -- you've used the mean value for each one of these sites to tell you something about the potential risk at the site, and then you've taken the mean of all of these together or the average of all of these together and you said, okay, now this tells me something about population.

My question is, what does the mean of this mean mean?

MR. CAMERON: Do you want to answer it?

MR. O'HARA: I'll give it a shot. Again, the mean is informative about the distribution. It includes all the values. And I think what you're driving at is no, no, no, you don't want to use the mean, you want to use the highest value.

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And I say I don't think so. To describe your population, you take the mean value.

MR. CAMERON: Let's have some further discussion on this. Goutam, did you want to address this, also?

MR. BAGCHI: I just wanted to point out that I was pleasantly surprised, perhaps not surprised, but I'm pleased that the results came out where they did.

But let's not just take a statistician's point of view of the world. Does it mean that having found this, you don't take into account the potential vulnerability that might exist in plants that are coming in for requests to decommission and do certain things.

In my mind, I don't think so. I think there can be some vulnerabilities that one could develop some very simple methods of checking to get past that, and let us not worry about the statistics now, or maybe I just want to ask the industry, does it want to pursue that by neglecting the potential for site-specific vulnerabilities.

MR. CAMERON: I think we're going to get some comment on that question. Dr. Kennedy?

MR. KENNEDY: Yes. I've carefully reviewed both the industry, your report, and the NCR's report. I'm extremely comfortable with your fragility levels that you used for the two plants, the two plants. But the fact is other plants will have different fragility levels.

Some will be higher, some will be lower. If you had to take a gross number or a generic number, the numbers you used are fine. But I think that you will find, if you looked at other plants, that they could easily vary by a factor of one and a half and that factor of one and a half transfers into risk space, at least a factor of five. So at least a factor of five higher or at least a factor of five lower than sort of the generic average fragility curve would produce.

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In addition, there is the tremendous variabilities from the hazard curve. Now, from the Livermore hazard curve, the Livermore '93, because that's -- I looked through your results real carefully for that hazard curve, the same kind of variation would exist for EPRI.

Twenty-six of your sites were BWRs, for which you used the BWR fragility, which had a HCLPF value, you didn't report it, but there was enough information in your report to back-calculate it, of about .48g, very close to the number that the NRC used.

Those 26 BWRs, the seismic risk ranged from 12-times-ten-to-the-minus-six to .1-times-ten-to-the-minus-six. Just from the hazard curve variability.

So there is a factor of 100 difference in individual plants just due to the hazard curve variability.

You put that with an additional factor of potentially a five due to fragility variability, now you can't multiply these together, because it would be very unlikely you'd be high hazard and low fragility at the same time. But there is a tremendous location to location scatter in these risk results.

I think as a generic average, the one-times-ten-to-the-minus-six number is a very reasonable number using Livermore '93 hazard curves and if you use EPRI hazard curves, it will be a factor of three to five less than with Livermore hazard curves.

But there is this big scatter from site to site that I think you need to somehow consider.

MR. CAMERON: Okay. Before we go to Mike, I'd just like to give Tom an opportunity, if he wants to, to respond to this location to location scatter issue that Dr. Kennedy raised.

MR. O'HARA: What Bob says is correct and you don't argue with Bob Kennedy, because that's the first -- one of the things you don't do.

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But to make the -- the bottom line is you try to get a job done. So you use what you've got. And what we had were estimates of seismic fragility and estimates of seismic hazard and you perform an analysis and you factor in comments like what Bob just raised.

But I think overall, if you're looking for a summary kind of statistic or statement about the seismic contribution to spent fuel pool failure, I contend it's got to be something like less than ten-to-the-minus-six or ten-to-the-minus-six, or with EPRI it's going to be on the order of ten-to-the-minus-seven, or it's in that ballpark range between ten-to-the-minus-seven and ten-to-the-minus-six.

And maybe you factor in things like what Goutam was talking about, that can just get you totally past the seismic hazard issue. That's what I -- that's all.

MR. CAMERON: Okay. Mike?

MR. MEISNER: I had a couple questions, first for Goutam and maybe getting at what we're noodling around here. If I look at page nine of your overheads, you talked about a simple checklist can be developed to screen out plants.

Could you talk about that a little more, what you had in mind?

MR. BAGCHI: In very simple terms, just a walk-down of the site and making sure that the obvious vulnerabilities are not there. I think beyond that, we need to talk to engineers and come up with the list.

MR. MEISNER: Okay. Thanks. The other question I had was maybe a little more general. We've been talking about the catastrophic seismic event, the other portion of the staff's analysis has somewhat equal contribution for a non-catastrophic event that would, I assume, affect structures, systems and components and affect cooling.

I would assume that we'd probably agree that for that kind

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of event, that really reduces to the things we were talking about yesterday, where we get into essentially a loss of cooling event and that any kind of adjustments we'd make, say, in the HRA space or otherwise would affect the probabilities of that kind of event.

So I just want to kind of dispose of that, so we don't have to deal with that anymore in seismic terms.

MR. HOLAHAN: I think that's a reasonable observation. I think the issues may be a little bit different, finding available equipment following an earthquake, but it's basically a human reliability question.

MR. MEISNER: The time periods and all are about the same.

MR. HOLAHAN: Yes.

MR. CAMERON: Is that significant enough to put up here?

MR. BAGCHI: One thing that's really significant is that there seems to be an understanding that the catastrophic failure portion can be taken off the table if a reasonable checklist can be developed. That's a very significant point and I'd like to have that on the table.

MR. MEISNER: Yes. I was just talking about the -- that's a different question.

MR. CAMERON: Okay.

MR. HOLAHAN: What I would suggest is, however you capture this morning's discussion, just say including the seismically-induced loss of cooling.

MR. CAMERON: Rich, you had a comment on that?

MR. BARRETT: I really have a question.

MR. CAMERON: A question.

MR. BARRETT: My question for the people who would have done the analysis here is, I would think that it's certainly reasonable to make the statement that Mike made. I would just ask, is there anything about the seismic analysis or the -- let me put it this way -- the level

of the seismic event that we're talking about that would change our assessment of the human response, substantively, as opposed to the sequences we were talking about yesterday, in which the human response is taking place in the absence of an earthquake event.

In other words, are these -- are we talking about seismic events here that are relatively low accelerations and would not have a significant effect on operator response or are they -- and I -- just for clarification.

MR. CAMERON: Anybody who wants to respond.

MR. ROTHMAN: When Goutam was talking about two to three times the SSC potential for failure of the spent fuel pool, he's talking about fairly significant ground motion. I mean, operators are going to get knocked off their seats, those kinds of things.

Following the earthquake, then you have to talk to somebody in psychology that knows how people react after those things.

MR. BARRETT: I think Mike's question actually deals with a different scenario, and that's a scenario in which presumably an earthquake of lower magnitude, I believe, affects risk by failing the equipment as opposed to failing the pool, and that kind of a sequence then basically becomes just like the kind of sequences we were talking yesterday, in that it requires operator action primarily to recover.

My question simply is, are we talking about earthquakes of a low enough severity such that there will be no concern about impacting those operator actions which we would be able to accept under the circumstances for yesterday's sequences?

MR. CAMERON: Mike, does that capture your clarification?

MR. MEISNER: Yes.

MR. CAMERON: Okay. We're going to go to Goutam to address that.

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MR. BAGCHI: What I had in mind in terms of checklist is pretty much what would encompass Dr. Barrett's concern. Would we be able to bring in portable equipment or equipment that's lying around for pumping water into the pool back? Those kinds of things can be developed by some kind of a checklist and let's remember, no matter how hard the earthquake was, we have a significant amount of time available to respond and make water or water inventory build up.

And people who would react after the earthquake to get involved in those kinds of decisions, it would be significantly after the earthquake has passed away and they have come to their senses and they are ready to make common sense decisions.

MR. CAMERON: Okay. Now, I know there's a lot of cards up. Ray, I see yours, and Stu had his up. But I'd like to follow this through and I think Dr. Kennedy had something on this. And it's always useful to have someone at the table that no one wants to argue with.

MR. KENNEDY: I'll argue with myself. On the issue of these other earthquake events, any earthquake level that is going to damage equipment in the plant, at least anchored equipment, or knock off off-site power from the local switchyard at the plant, is certainly going to be an earthquake that the operators are going to have felt and it's going to be disturbing to them.

I think if you had to have rational decisions made reliably within, let's say, 15 minutes after the earthquake, there would be issues associated with that.

But I think experience shows that for emergency crews in real earthquakes, if you talk a half-hour after the earthquake, good decisions are made. And I think, from what I understand you're talking about here, you have time.

MR. MEISNER: Five days.

MR. KENNEDY: So that I don't think that there is going to

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be any real earthquake influence on whether rational decisions are made or not.

MR. CAMERON: Okay. Thank you, Dr. Kennedy. Let's go to Glen, and then we'll go over to Ray Shadis.

MR. KELLY: When we calculated the ten-to-the-minus-six number for loss of cooling due to a failure of other equipment on site due to a seismic event -- that is, failure of things other than the spent fuel pool -- we assumed that there was no recovery on-site of that equipment; that that equipment was effectively destroyed.

And what we looked at was then recovery using off-site equipment, but with a slightly lower probability than we would give it ordinarily for off-site recovery, based on the fact that we had had an earthquake and there might be demands for off-site equipment in other places.

But we did not -- we're not worrying about the operators on-site trying to repair the equipment. This is a matter of just being able to get in off-site equipment to the site. So that's where our numbers came from.

MR. CAMERON: Okay. Mike, did you have a point on that?

MR. MEISNER: That's all I wanted.

MR. CAMERON: Okay. We're going to revisit that in the next session on mitigation of events.

MR. MEISNER: No, when the staff does their --

MR. CAMERON: Right. Let me -- on that, this is at least my take, and we can revise it as you guys think necessary, of what we have simmering now for later discussion, and I did put up that this point number three, what happens here would include seismic loss of cooling.

Ray?

MR. SHADIS: Thank you. Two things. One, just a layman's question here. I want to inform my ignorance. On these various studies

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that were cited, these analyses, do any or all of them include the fragility of the transfer tube or transfer tunnel on PWRs in the fragility numbers?

I ask that because Venus D'Milo is pretty rugged precisely because their arms are snapped off. We considered that transfer tube an integral part of the spent fuel pool, that big penetration.

MR. CAMERON: Is there an answer from NRC staff or opinions from Tom? Tom, do you want to? Go ahead.

MR. O'HARA: I can't answer that question explicitly, but the documentation for those fragilities is found in 5176, and I guess we can review it and determine if, in fact, your concern is addressed.

MR. SHADIS: Yes. I would think that if the concern with an earthquake is that somehow there is a shear of the wall of the spent fuel pool and you have an opening of a given size at which it can drain rapidly, that that might be in the same ballpark as having the transfer tunnel blown out by stresses put on it.

Again, a layman's view, but it seems to me that's a great deal more fragile than the six to ten foot thick walls in the spent fuel pool.

MR. CAMERON: And we need to get an answer for Goutam. State your name for the record.

MR. FORD: Brian Ford, Millstone Unit 1. On the BWRs, until you get to the BWR-6's, there is not a transfer tube, as such. There is a transfer canal that's up at a higher level, but there is not really the same thing as a tube that you have on the PWRs.

MR. SHADIS: I understand that. I was speaking specifically to the PWRs. But maybe we can -- and if we can get that worked in some way.

MR. CAMERON: Okay. Let's hear Goutam's answer. I put that up there as an item. Goutam, what's your take on this?

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MR. BAGCHI: My view of that NUREG document indicated that it was based on the capacity of the shear wall itself and it did not take into account specifically those kinds of things.

But please remember, throughout '94, the thing that I pointed out are the reasons for various failure modes that need to be considered, and this is the reason why I talked about developing a checklist of things that need to be looked at on a site-specific basis and then once you meet that, take it off the table. That was my approach.

Thank you.

MR. CAMERON: Mike, do you have a comment on the transfer?

MR. MEISNER: I wanted to suggest a wrap-up on this.

MR. CAMERON: Okay. Let's hear Ray's second point and then we'll come back to you.

MR. SHADIS: I agree with Mike, a wrap-up might just be in order. But the conversation went from probabilities of certain kinds of seismic events to the fragility and the -- but then it kind of jumped to mitigating actions and whether or not it would be reasonable if a staff that was knocked off its feet would then get up, dust themselves off, and proceed to take care of things.

Let me just say that if there is an earthquake sufficient to damage, in any significant way, the equipment at a building, never mind one large enough to crack the spent fuel pool, that the spent fuel pool building, not being seismically qualified, has to be draped over this in a large covering, which would prevent an awful lot in the way of mitigating action.

And you might also have your crew either injured or dead in auxiliary buildings that are not seismically qualified, or even in ones that are, depends on whether or not filing cabinets have fallen around people, who knows.

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So I think it gets to be a little bit silly to start speculating about how the crew on-site is going to behave. I think you need to speculate on how the crews coming from off-site are going to behave and respond in whatever timeframe is available.

MR. CAMERON: Okay. Thank you. Let's go to Peter, and then we're going to go to Mike for a wrap-up, and we're getting towards break time here.

MR. ATHERTON: I'm sorry I wasn't here yesterday, but I wasn't able to make it. So I'm trying to catch up as rapidly as possible.

This session went directly to the specifics of the seismic evaluation. The question I have would be more general than that, and I would ask, one, did the seismic evaluation take into account the seismic qualification of the structure at the time the plant was constructed and if so, what would be the effects of the qualification of the equipment and the aging of the facility after a certain number of years that the plant has been or the spent fuel pool has been used and irradiated?

There does not appear to be -- that's question number one. There does not appear to be any concern about the failure of electrical equipment in systems and the qualification of those systems for any specific period of time that the spent fuel pool is going to be in use.

MR. CAMERON: Is that second one a seismic-related?

MR. ATHERTON: It is, and that is I have not heard any talk to the desire or the effort to minimize the probability of the failure of systems that would be required to mitigate the consequences of any design basis or beyond design basis spent fuel pool accident, whatever it is we're considering.

MR. CAMERON: Can we get some commentary on Peter's questions? Glen?

MR. KELLY: When we did our analysis, we assumed, first of

all, that there -- all off-site power was lost and because the -- if there is a seismic event, it's going to -- we're going to lose off-site power, because we also assume that there aren't any emergency diesel generators that are operating, again, in our simplified design that we analyzed. Therefore, there was no AC power available on-site, nor were there any uninterruptible power sources or batteries to power things.

So basically the plant is dead as far as electricity goes.

So really what we're depending on then is being able to bring in things from off-site to recover, and here recovery really means either bringing in something to -- bringing in equipment, to now bring in a diesel generator and cooling equipment to cool the pool, or, if you're not successful in that, bringing in fire equipment or something to provide water to cool.

It's not a matter of -- we analyzed it as if everything on-site was unable to respond. This is potentially conservative, but again everybody -- when I went around to the sites, some of the sites had their equipment anchored; other sites, it was sitting on skids. There was spent fuel pool cooling equipment. Some sites had -- nobody had any diesel generators, but some did have -- that's not true. One plant did have a diesel generator that was specifically going to their spent fuel pool cooling system, but they didn't have it for other equipment, and I believe that one was supposed to be seismically qualified. But that was -- nobody else had anything like that.

And that's not how -- we analyzed it more generically, as if there were no spent fuel pool cooling systems.

About aging and equipment qualification, again, since we assumed that all the equipment that was on-site failed, it wasn't a matter of whether or not it was aging or not. We assumed it wasn't there.

And lastly, about the impact of aging on the concrete and

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the radiation, I don't -- we did not look at radiation, but generally it's our belief that the concrete generally is considered to get stronger over time and that over the periods that we're talking about, at least I think for the first 100 years, if I've got that right, Goutam, and -- so in this case, from the concrete standpoint, since we're really talking about this giant concrete bathtub, that that actually becomes harder over time or stronger over time than it was initially when it was first constructed.

Hopefully, that will answer your comments.

MR. CAMERON: Peter, you have a follow-up for Mark or question on what you asked?

MR. ATHERTON: Philosophically, does NRC consider it acceptable to have a complete blackout of the spent fuel storage area as a general proposition, to have a design such that you would have a complete blackout of the spent fuel pool storage area, without any attempt to prevent the blackout from happening?

I'm getting that vibration from you.

MR. CAMERON: Let's go to Gary to address that.

MR. HOLAHAN: The answer to that is that's what we're trying to decide. We're looking at probability and consequences of those various things to decide what levels of protection are appropriate.

We haven't decided before the study. We're going to decide after the study. And if the challenge frequencies are exceedingly low, then we recognize that, yeah, it may be acceptable to have a complete blackout for exceeding the low probability events. For other situations, it might not.

But I don't think it's a philosophical or a policy question. It's a technical question about what are the safety implications of that situation.

MR. CAMERON: Thank you. We're going to go to Mike for a

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wrap here.

MR. ATHERTON: One last follow-up question. You did not indicate whether or not the liner, in addition to the concrete, would strengthen with time. The question I would have with regard to the hardening of the concrete would be does that necessarily mean that it becomes stronger, as you suggested, with time and is able to withstand a greater seismic motion with an increase in hardening and the lack of the potential for flexibility. I see Mr. Kennedy --

MR. CAMERON: Dr. Kennedy, do you want to address this line or issue?

MR. KENNEDY: I was not involved in the fragility analyses that Livermore did, but I've been involved in many other fragility analyses and various fragility reports that people have used for doing these analyses.

For the liner, for the pool, the strength comes from the concrete and the reinforcing steel in the concrete. The way this fragilities are predicted is as long as the concrete and the steel in the concrete can carry the loads, the liner basically is not part of the load-carrying system. It is a leak-preventing system, because concrete leaks.

And so the fact is that the strength is probably not degraded any over reasonable life and as long as the concrete has retained -- the concrete and the reinforcing steel in the concrete have retained their strength, the liner is not really participating in a load-carrying aspect.

Now, once the concrete goes non-linear and you start developing cracks in the concrete, that's when you can pull the liner apart. So typically these evaluations stop at the point that significant non-linear behavior of the concrete occurs.

MR. CAMERON: peter, we're going to have to move on.

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MR. ATHERTON: We haven't resolved one issue here. If the concrete leaks, for instance, have you then compromised its strength, as such?

MR. BAGCHI: No.

MR. KENNEDY: As long as the liner is there, the liner prevents the leakage. The liner is there to prevent the leakage, but the liner doesn't carry the loads. It's the concrete and the steel in the concrete that's carrying the loads.

Now, when the concrete goes non-linear, that could crack the liner. If the liner is cracked, then you assume that the pool is going to drain. You don't assume that the concrete is going to prevent drainage. It's the liner that prevents the drainage. It's the concrete that provides the structural support.

MR. CAMERON: Dr. Kennedy, could you talk to Peter during the break more about this? I want to go to Mike, but Greg Withrow had a footnote to something that Glen said about his particular situation.

MR. WITHROW: I think that you'll find at a lot of the facilities, that they do still have diesel generators. We actually have two on-site, we have a diesel fire pump, electric fire pump that can be run off either diesel generator. I know Maine Yankee has brought in a temporary diesel generator. So there are a lot of additional capabilities that exist.

Now, that may not be true at every site, though, I don't know that.

MR. CAMERON: Okay. Mike.

MR. MEISNER: Thanks. I guess one thing I was struck by in the two different presentations is that there is a good deal of convergence. I suppose we could argue is it ten-to-the-minus-six or five-times-ten-to-the-minus-seven, but I think what Goutam brought up was maybe the bridge between there, and that's the idea of a checklist.

I think that's quite similar to the concept we were talking about yesterday as far as identifying some commitments that the staff could then rely on to go back and change their model. What I heard were fairly straightforward things like a walk-down of the site and ensure that obvious fragilities aren't apparent.

If we could kind of flesh that out, I think that might go a long ways to resolving any outstanding disagreement we have on seismic.

MR. CAMERON: When should we try to flesh that checklist out? And do people agree that the checklist may be the convergence between any discrepancies? Gary?

MR. HOLAHAN: I think that's a reasonable approach and it seems to me the checklist, if you do it right, will also address this issue about whether, on the average, the plants are okay or some of them are substantially different from the average.

Ultimately, you have to say that all the plants are safe. That's the way we make the decisions. Some of those plants may be higher than others because of things that the checklist could deal with. So I think that's part of developing a useable checklist.

MR. CAMERON: Thank you. Why don't we take a break?

MR. NELSON: Then we'll go on?

MR. CAMERON: Yes.

MR. NELSON: To do the crane heavy loads.

MR. CAMERON: Do you want to discuss the -- is there a need to discuss the mitigation? I think that was next on the agenda for seismic. I think we're done.

MR. MEISNER: We're done, yes.

MR. NELSON: That's what I meant. So we would go on to the heavy loads as a group session and then this afternoon do the thermal.

MR. CAMERON: Let's talk about it. We'll talk about this during the break. Let's be back at 25 to 11:00. That gives you about

20 minutes.

[Recess.]

MR. CAMERON: Dick Dudley is passing out a copy of something. What is that, Dick?

MR. DUDLEY: The industry perspective.

MR. CAMERON: So this is Bill Henry's slides. Okay. Two things I should mention to everybody. One is -- and I checked this with Alan -- is that on the checklist that we talked about in regard to seismic, NEI is going to provide a proposed checklist on this to the NRC and as with the study that you guys are doing, that this will be a public document, I take it.

MR. NELSON: But the things that we commit to, we're not going to necessarily wait till they all get together. Everything will be going on.

MR. CAMERON: Sure. Okay. Just to give you where we are on the agenda. We did make some adjustments here. We're going to do the heavy loads discussion now. It was originally scheduled from 1:00 to 2:30. We're going to do it now. That means we will not have to have breakout sessions. So that after lunch, we're going to move into the thermal hydraulics session.

After that, we're going to go and see if there's any water in this pot that's simmering here, have a discussion of that. There are some other issues that we were going to talk about in terms of process perhaps, but I think this is the most important thing to go to.

But right now, it's heavy loads. After lunch, we'll start with thermal hydraulics. Our heavy loads person from the NRC is George Hubbard. George, are you ready to do your presentation?

MR. HUBBARD: I'm ready.

MR. CAMERON: And is that microphone suitable for you?

MR. HUBBARD: Yes. I'm George Hubbard, with the NRC, and

actually, Chip, I'm going to let Ed do the presentation. He's the one who did the study. I'm just here to kind of kick it off.

As yesterday, in Rich's comments, this was one of the sequences that was identified as credible. So with that, I'm going to turn it over to Ed and let Ed kick off the study that we did.

MR. CAMERON: And, Ed, could you just introduce yourself, and then Brian, and then we'll give Bill Henries a chance to introduce himself before we get started.

MR. THROM: Yes. My name is Edward Throm. I work in the Probabilistic Safety Assessment Branch. I was asked to look at the heavy loads issue when this project first started. So that's basically what I did on this project for this presentation.

MR. CAMERON: Okay.

MR. THOMAS: I'm Brian Thomas. I work in the Plant Systems Branch. My focus there is sometimes on heavy loads.

MR. CAMERON: Okay. Thank you. Bill?

MR. HENRIES: I'm Bill Henries. I'm the Engineering Manager at Maine Yankee. As the other gentlemen, I was asked to look at the heavy loads, too.

MR. CAMERON: All right. Good. Well, let's go to Mr. Throm.

MR. THROM: What I wanted to do was go through where we looked at information, kind of what that information was telling us, and basically how we got to the bottom line of coming up with a risk estimate, and hopefully I'll be able to clarify why things may be different than they were from the NUREG-1353 numbers.

The first -- first of all, we're kind of looking only at cask handling in terms of heavy loads at this particular point. To alleviate Ray right now, I will say, at the end, additional heavy loads is one of the items we'd like to bring up at this meeting. We know that

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NUREG-0612 guidelines would probably stay in effect or would stay in effect, but we don't have a real good handle on the types of things we may need to anticipate or expect as the plant decommissions.

So from the perspective of looking at heavy loads, casks being heavy, and kind of focusing in on this particular study to look at the consequences of heavy loads on pool integrity and loss of inventory.

In NUREG-0612, this was the control of heavy loads in nuclear power plants, this was probably the one of the first studies that tried to quantify the risk of heavy load movements and basically some Navy crane data was used to assess what the drop per lift frequency might be.

There is uncertainty in those numbers because in this area, one knows when things went wrong, they don't really have a good handle on the success rate. OSHA tends to be the governing body for reporting accidents and mishaps and they deal with property damage and injury to humans or fatalities to humans.

So we know what does go on and we do know why it goes wrong. In terms of picking up a frequency of how often does this happen, that's an area that will always probably remain uncertain.

There were two types of handling systems that were looked at in 0612. There was what was called the non-single failure-proof and what was basically touted to be the single failure per system. On the last slide, there is a definition of single failure-proof, so you get an idea of what we mean by single failure-proof.

In the NUREG study, part of the non-single failure-proof system included an assessment of common mode failures. Again, on the last slide, there is a little more information about what was looked at, and that would be basically an operator or a crew who failed to do some pre-operational checks, didn't realize there was a limit switch failure, and -- not yet.

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MR. CAMERON: I was wanting to get to the last slide.

MR. THROM: There are two definitions, just verbiage, to understand what we mean about a single failure-proof system, and what we mean about common mode.

In the NUREG, one other thing they looked at was a common mode failure under a single failure -- non-single failure-proof system, which elevated the drop frequency by about a factor of ten.

Also, in the NUREG, in figure B-3, there was an evaluation of the single failure-proof crane and it came up with the ten-to-the-minus-four, ten-to-the-minus-seven drop per reactor year estimate, and included in that were events that would lead to the crane failure, the so-called tube-blocking event, which is where the lift and the crane hit, failure of the limit switch, overload of the crane, and failure of backup components.

And that was about eight-times-ten-to-the-minus-five or almost a larger portion of that ten-to-the-minus-four per reactor year frequency.

If we can go to the next slide, please.

Another thing we have as background is NUREG-1533, and in that report, although it wasn't necessarily used as part of the evaluation, the drop per lift uncertainty range was estimated to be ten-to-the-minus-three times ten-to-the-minus-four. The specific point used in that report was a six-times-ten-to-the-minus-four drop per lift. It was convoluted or compared with something on the order of 200 lifts per year and a certain frequency of the casks being over the wall.

And that number actually came out to be something on the order of three-times-ten-to-the-minus-four. The A-36 contributor was reviewed, the impact of A-36 or NUREG-0612 was reviewed by the contractors working on that project, and they determined that about a factor of a thousand reduction was expected from implementation of

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NUREG-0612 guidelines.

That came down to the three-times-ten-to-the-minus-seven number. Part of the Generic Issue 82 study included work done by Livermore, which came up with about a one in ten chance of failure of the wall given the drop on the wall. That was the three-times-ten-to-the-minus-eight number, which is being used as what one would call the best estimate number for cask drops in 1336.

What was not considered in 1336 is dropping it into the spent fuel pool. I don't know why it got missed, why it wasn't covered, but we went back and we looked at it and we said, well, you only really looked at wall failure probability in 1353 or as part of Generic Issue 82.

We went back and looked at it and said, well, we really have to contend with the drop into the spent fuel pool, and we're going to get very plant-specific features a little later on the presentation and say why at some plants this is and why at some plants this is not necessarily a problem.

The other set of data we had was a study done at Savannah River for non-nuclear facilities. They looked at about 200 drops in 200 crane years of operations, nuclear plant data, and basically came up with a range of events in the reports, each one of these is assigned to a category. The ten-to-the-minus-three number would be associated with unusual loads, ten-to-the-minus-four would be associated most likely with the type of load we're concerned with, and ten-to-the-minus-five would be a load that was very, very standard.

The question now you have to ask yourself is, is 100-ton lift a standard operation or a typical operation as compared to the databases, which tend to be related to like five-ton cranes or the handling of 55-gallon drums in the pilot waste program.

So that becomes an area where maybe there is better data to

look at what type of crane we should be considering compared to the generic databases. Even the Navy data, when you go over the gamut of the types of cranes and lifting devices, it's open to judgment as to how much of it is really germane.

One more point on this slide is just to point out that when we talk about mechanical electrical crane failure rates in NUREG-1353, we looked at a three-times-ten-to-the-minus-six per operating hour. If you went back and looked at the Savannah River, for example, and drops per operation and said it took an hour to do an operation, you would see that the mechanical electrical contributor to the risk is probably ten percent or less of the overall risk as compared to the potential human component in the drops.

Human errors right now are the issue that are probably of concern or at least they're identified to be of concern. In NUREG-0612 or some OSHA data was addressed that said rigging led to 34 percent of the errors, operator errors were 42 percent of the reported incidents. In the Navy data, it looked like seven percent rigging and operator errors were about 70 percent.

Go to the next slide, please.

Doing an internet literature search, which is one of the easy ways of doing business this day, I came upon some information the Department of the Interior, in their Mineral Management Services, and they did a couple of studies, the details are, I think, covered in the report, and their conclusions were employee negligence, 40 percent of the errors were due to poor maintenance and overloading. There was a follow-up study done and a crane accident workshop to that study and they came up with 35 percent of the incidents were due to human error.

They were looking at 34 specific accidents over -- incidents over about a three-year period.

The last study that we looked at was the DOE study and for

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people who are interested, there is the web site, on the bottom, one can go to that web site and that report, at least as of Wednesday, was still available. People have things that disappear off the internet, you can pick it up.

And that concluded that the human error was 68 percent of the incident rate and work planning led to another large part, 18 percent. An interesting point to make is that training-related deficiencies seemed not to be a specific problem; in other words, they didn't find anything directly related to training as being a contributor to the human error, although they did indicate that about nine percent of the problems resulted from inadequate procedures.

So what we're basically saying is the human error rate, the incidents have not changed substantially from what we were looking at in NUREG-0612 back in 1980.

Next slide, please.

So we took off as a jumping point basically those numbers, not having anything else really to rely on. There are two lines there. There is the non-single failure-proof system. It's on there for completeness. The one that we're really keying in on is the single failure-proof system, and if you go back to NUREG-0612 and you start looking at that ten-to-the-minus-four per reactor year number, what you have to factor in is a couple of additional things.

The load path, the entire load is not necessarily being handled in a critical position. While I would not like to see it happen, if, on the first time on lifting the cask, I happen to drop it, it's not going to lead to a failure of the spent fuel pool.

In the NUREG, they were estimating that between five and 25 percent of the total lift would be near or in the spent fuel pool. We took that number and basically said for dropping it on the wall, if that total period of time or ten percent of that time is over the wall and

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then said, from the old, from the Lawrence Livermore study, that only ten percent of that time would you have damage to the wall you would come up with a ten-to-the-minus-seven number of damage to the wall.

Now, we haven't done any calculations to say whether this is a large leak or a small leak, but that was the number that we came up with for potential damage.

And if you want to look at dropping it on the floor, again, all we did was we went back and used the NUREG-0612 number for the failure of the single failure-proof crane and said that there was a one in ten chance that if it was dropped while it was in the area of the spent fuel pool, that it would cause damage to the pool floor.

If we can go to the next slide.

Things to be considered with the number are we are aware that there are plants out there that have segregated cask loading areas which basically isolate the cask, lay down area inside the spent fuel pool, from the remainder of the spent fuel. If you drop it in that area and you did damage that area, depending on whether the gates were in or out, you would not drain the pool below the fuel, that's part of that design consideration and now we're talking about mitigating or making up water to accommodate any boil-off rate.

The other thing that there may or may not be in plants are these cask crush pads. They seem to be one answer to the situation, if cask handling becomes a problem, is that these things are designable, they can be implemented, they're energy-absorbing devices that basically mitigate the event.

Of course, part of the other consideration that we have in the area is that there have probably been specific cask drop analysis done to demonstrate that the designs are adequate, and I need to make a number of points here.

In these numbers that we are putting out, we were looking at

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something on the order of an upper bound of 200 cask movements per year, and that's where we're up in the ten-to-the-minus-seven or ten-to-the-minus-six probability of a drop, if you want to add in what might or might be reasonable cask handling.

The last slide, this is where we are hoping to open the dialogue. One of the big questions is, is the data that is generally used to characterize drops per lift, and even the data that comes out of looking at crane and hoist data from the industry, is is it really germane to the issue. Most of these cranes tend to fall outside your concept of the nuclear power plant in that they're mobile cranes. These are the ones you see at construction sites where heavy load tips them over.

There is also a tendency for a lot of this information to be related to hoists and potentially lower load lifting devices, I characterize them kind of in the five-ton range. So I don't have a good handle on that.

Another issue that needs to be considered is cask-handling plans, not only the frequency that we might expect for these things to happen, but the load path consideration.

And, of course, if you really look at this particular issue, when do you do these movements in terms of there is a reduction in risk of a release if the fuel has been sitting in the pool for a very, very long time.

I would say that when we started looking at the 200 lifts per year, what was envisioned was a facility that had recently shut down, but had 30, 20 year old fuel in the plant, had just recently discharged and wanted to start getting that inventory out, and that seemed to be like a maximum number of these types of loads that you might want to consider, even while you may have fuel that would be vulnerable if you did lose the inventory.

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So the other two questions that we also have for the industry is -- is the human factor consideration. I mean, in reality, what drives drops per lift is the human involvement. The DOE report, if you read it, it will discuss what they identified as management-related problems and personnel-related problems, and what we'd like to know is -- or have a database that says at nuclear facilities, things are quantifiably better.

When I look at the DOE information, the reason I bring it up is they were talking about nuclear waste. It may have been low level waste, waste pilot program, but nevertheless it's a risk that the operators would understand in terms of releases as far as a mind set would go.

And the other question, as Ray brought up this morning, is at this particular point, we don't have any idea of what other heavy load handling near or over the spent fuel pool people might be considering. We would fully expect that the guidelines in NUREG-0612 would remain in place and that safe load paths would be defined. But the problem is people don't always do it. There are interlocks that can fail, a procedure could be not followed. So these are the areas that we would like to have the dialogue on to see what we can do about better understanding the heavy load drop risk.

That's my presentation.

MR. CAMERON: Thank you. That's great, Ed. Thank you. It sets the stage for discussion after we hear from Bill Henries. Bill, you may be going to put some things on the table that relate to what Ed said.

MR. HENRIES: Thank you very much. Ed, you know, I think we look at the glass and I think we're very close. Ed's presentation and mine meld in many, many areas. It's a question of, from our perspective, are we getting an upper bound or a best estimate again,

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same issues that were raised yesterday.

We implemented the close-out of A-36 by doing all the work for NUREG-0612, the 1353 report quantified these numbers, as Ed touched on, and yet we've done all this work over ten years and we've lost two orders of magnitude on the risk.

So it seems like did we do something wrong or are we just not getting the credit that we had in these past reports.

Human error is indeed a higher failure rate in all of these past studies and one of the things I want to bring out is that I don't think these past studies are that germane to the way we're going to handle a spent fuel shipping cask at a nuclear power plant. These are one of the last rate activities we're going to be doing and it will be truly management and oversight intensive.

Next slide, please.

One thing I think we agree with Ed on completely is there is really only a need to look at single failure-proof cranes. If you're not using a single failure-proof crane, following NUREG-0612, you have to do the consequence analysis, becomes a moot point, you've evaluated the incident, let's just look at it for single failure-proof.

Next slide, please.

Slight, I guess, disagreement between Ed and I is that he looked at some of the newer data, primarily the Savannah River, which brought out some more data, but once again, a generic type of information.

Like Ed pointed out, the five-ton crane out on the barge out in the back. We're looking here for heavy loads over a spent fuel pool as a very specific activity, a very high profile activity at the power plants, and I think it's going to get much, much more oversight, such that the very high human error potential that you saw with wind blowing over yard cranes and things like that.

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It's really not applicable and I think even though Ed looked at some of the newer data, we ended up going back to the 0612 numbers. Well, with the 0612 numbers, does that adequately give us credit for all these things we implemented in 0612 that made the issue go away? It wasn't clear to us that we were getting any credit really in that arena, in that we were once again trying to quantify an upper bound and not a best estimate.

Next slide.

A couple of I think -- I call them somewhat nit-picks, but what I questioned in the report was there did seem to be an increase for the single failure-proof crane of going up to 25 percent over the pool instead of ten percent that was in the non-single failure. That seemed to be a factor of two and a half that hadn't been applied before and was now thrown in; once again, is that an upper bound, because I think you argued it was five to 25. So we have the 25 number.

MR. THROM: I'm not here to defend 0612. One of the things in NUREG-0612 is when they looked at the non-single failure-proof system and they looked at the single failure-proof system, there was some inconsistency in the way the data was presented.

In the non-single failure-proof system, they had the ten-to-the-minus-three, ten-to-the-minus-four drop per load and the way they determined whether or not that load was over what they called hot fuel at that time was done differently.

If you go to the NUREG, I have the fault tree here, if we want to get into that level of detail, and you look at the table or the fault tree for the single failure-proof system and you look at the point at where they came up with what is the probability of that single failure-proof crane failing, it was made up of two parts. It was made up of the tube blocking event, the overload, the failure of the interlock and the backup system failures, and also an assessment of the

double-rigging, if the operator failed to rig properly the first time, the second rigging would also fail, and that came up with that ten-to-the-minus-four number, which is on the upper bound.

And then when you go further through the system, what you do is what was done in 0612, is they tried to estimate how much of the load path was in a critical area, and that was the five to 25 percent. Again, the number on the top is the 25 percent of the operation and then past that, we kind of used factors of ten to quantify, of that total time, when would you be in a mode to fail the pool.

So if it's dropped from the 40-foot elevation, failure; if it's dropped from the 20-foot elevation, not failure. That's where those other numbers -- so that's the specifics of how the numbers were derived.

So I'm not sure where the 2.5 -- I think it addresses the 2.5 in that the non-single failure-proof event tree was done differently from the one we were focusing in on to present what we thought were some relative numbers for the cask drop.

MR. HENRIES: That's exactly where I thought you were coming from and that, as you pointed out, five to 25 percent was the number and the report used the 25.

And I understand what you're doing and I'm just trying to make the case, to the industry, it appears like we're focusing more on an upper bound. That's all.

Similarly, the 200 lifts per year, I can't see anybody doing more than one a week with the activities that have to go involved. I think the original numbers that were in WASH-1400 are in 1453, arguing for 100, you know, one a week type of thing. By the time we prep the cask, get it into the pool, get it loaded, get it out of the pool, get it dried, get it full of helium, get the lid on, get it welded, get it inspected, get it out of the way, we're not going to be rushing to do

two a week.

So I think there's another factor of two in there that one could argue about. It's one of the things that perhaps if it made a pass/fail difference, people could argue whether they wanted that factor of two or not.

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I think the heart of our argument is we did implement 0612. We have worked very hard over the past decade to make sure that lifts, and particularly safety-related lifts in the spent fuel pool are very management-intensive.

The items -- you know, we're controlled either by tech specs or FSAR. We are going to single failure-proof cranes or else it's a moot point, we'll have addressed the drops.

We'll have analysis and procedural controls, all of them checked generally and all of them checked in accordance with Appendix B. Enhanced management oversight. I envision, just as DOE recommends, everybody is going to have a lift director. You will know who is in charge. These things are going to be coming in under very strict controls.

We've always -- well, at least since the institute of 0612, we have safe load packs, we have verified rigging, and our operator training has been ongoing along with pre-job briefings.

At Maine Yankee, this will be considered an unusual event, when we first start out, as a minimum, you know, we have all kinds of procedural controls to have readiness assessments performed.

This is going to be, as I mentioned earlier, the last great activity in a nuclear power plant for decommissioning. So the human error aspect, I think, is, by using generic industry or DOE data, has over-sold, to some extent, to a great extent, in my opinion, the likelihood of failure.

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These are more opinion than anything else, but it's based on my personal analysis of several PWR pools; that the one in ten causing significant damage is too conservative. I don't know how much work went into its development, but it's one of the things that was carried on, so I'm not questioning it.

But it seemed, once again, where we carry some numbers on, but then we take a worse estimate in a few others, starts to lead the industry towards we're getting a more upper bound evaluation.

And as you have mentioned, the timing of the lifts is dependent on the zirc fire. We agree completely on that one.

Finally, the last slide.

As I've probably overstated, and I apologize, it really looks to me like we're publishing an upper bound, particularly when you show 2.5E-to-the-minus-six ranging to E-to-the-minus-eight and we're at exactly one tail. It would seem that a best estimate has to be somewhere in the middle and the middle is probably in to-the-minus-seven range of a number similar to what was in 0612 or 1353.

So I don't think there is a large area of disagreement. It's just a question of are we doing an upper bound versus a best estimate.

Thank you.

MR. CAMERON: Great. Thanks, Bill. Can we go to the NRC team first to get a reaction to Bill's presentation? Then we're going to go back over to Mike.

MR. THROM: I think Bill has plotted out the areas where we have concerns. We were not married to the numbers. What we looked at, and, again, this was a very, very quick review of trying to revisit the issue, was the industry data suggests that the problems exist, still exists, the types of problems that led us to 0612.

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Maybe Brian Thomas of the staff can address the implementation of 0612 and what it really means, and we know there are a lot of benefits to it. In terms of the damage likely, that is a number that is open to interpretation. Of course, it's handled by plants that have done load drop analysis. So you're right in that perspective, that, again, it was just trying to look at not all drops are going to lead to a problem.

To do much better without information in an order of magnitude would not tell much, 20, 50, I mean, that's pretty much where we came from.

So what we'd like to do and I think what we're getting is a better understanding of the care and attention and as you read the report and follow along to what I specifically put into the report was the outcome of the DOE result was that what you really do is have to have a program that instills in both the management and the people actually doing the work that that care and attention needs to be paid to the process.

And basically when we go back and say if you were following those guidelines, then you're really addressing the human aspect of the problem and you're addressing the risk from a risk-informed basis. In other words, you've gone out, you've looked at what causes problems and you've instituted programs and plans to assure that your facility or, as an industry, you're not going to get yourself into that situation.

So that's the kind of information we're looking at, again, also, whether or not what we need to do about any other potential heavy loads, maybe we'll get to that, maybe we won't. But it is a concern and since we don't have a feel for what might be going on, we pointed that out as an area to consider.

MR. CAMERON: Brian, are you going to talk a little bit about -- go ahead.

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MR. THOMAS: Yes. I agree with you, 0612 is a very rigorous document. There is a lot in there that licensees have implemented and taken advantage of.

What I've seen are the licensees that are in decommissioning space is that they have gone -- they have done an exemplary job of utilizing what's in 0612. They have done consequence analyses and where they show the results as being not as consequential as you need to be concerned about, they have utilized the energy absorbers, the impact limiters.

I think Maine Yankee put in a single failure-proof crane. Even after their analysis showed that they didn't necessarily need it.

We are concerned that the guidelines, 0612, there's a phase one and a phase two in 0612. There's all the administrative and procedural measures that you could implement and then there is the need to do a consequence analysis or put a single failure-proof crane in.

We have guidelines out there that say -- and that's Generic Letter 85-11, says you don't need to do those consequence analyses. We are concerned that the licensees may just do that -- not do that consequence analysis. All the licensees out there are not taking the approach that Maine Yankee and Rancho Seco and Trojan are taking and going to that extent to do extensive consequence analyses, and that's where our concern comes around.

The other thing is the predominant contributor to hazards in the plant being the operator error, that is something that we're trying to get our arms around.

Data in 0612, we all agree, was full of uncertainties and, again, the current data that Ed has looked at, as he stated, is loaded with uncertainties.

We think perhaps there is room here to look at better data, look at a way of analyzing it, and also look at the need to do with

other licensees, as is done in the Maine Yankee case, to go beyond what the guideline says.

MR. CAMERON: Let's go to Mike, after he's heard both of you. Mike?

MR. MEISNER: Thanks. I think this is a good test case for us on heavy loads. We've been talking for two days now about crediting licensee commitments and reflecting that in risk reduction.

Here is a case where you don't need a licensee commitment because the licensee already has their requirement in their license basis. 0612 is there, that doesn't change when you go from an operating facility to a decommissioning facility.

And I think this is one where -- that this whole issue should go away by inspection, given that there is credit for 0612 implementation.

As Bill pointed out, what the staff did was they took the numbers that were used to develop 0612 and didn't modify them at all for the implementation.

I think it was stated that in 1353, when the analysis was done, because of 0612 implementation, there was as factor of about, what, a thousand, is that what you said?

MR. THROM: Yes.

MR. MEISNER: A thousand reduction in risk. That's something that the staff should apply right away and we shouldn't be spending a lot more time on this issue. I understand that you need to look at things other than cask drops and, of course, that gets back to the issue of completeness. But here we've got an opportunity to do what we've been saying for two days, and that's credit licensee implementation.

You don't need new commitments from licensees for that. You guys know what we do in 0612 and that's something that we should be able

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to resolve very quickly.

As far as what was brought up about consequence analysis, that goes -- that's a bit of a concern to me, because a licensee over-performs, and almost all of us do, the staff shouldn't be looking to institutionalize new requirements simply because of that. 0612 speaks for itself and it gives you the choice, as it was pointed out, that you can either do your consequence analysis and go with the non-single-failure-proof crane or you can get a single failure-proof crane and dispense with the consequence analysis.

I don't think there is any reason to go beyond that. And we shouldn't be looking for making a search for new staff requirements coming out of this, but like I said, if this issue can't be resolved real quickly and credit given for licensee implementation, then probably none of the rest can either.

I'll throw that over to the staff.

MR. CAMERON: Let me ask you to clarify one thing, Mike. When you said be resolved fairly quickly, do you mean in space today or in staff going back and looking at things?

MR. MEISNER: It seems to me you could deal with it in a breakout session, but we're already at ten-to-the-minus-six level. You should be able to, by examination, I would think, give an additional two to three orders of magnitude credit for licensee implementation of 0612 today. Go ahead and document that in your report and go on to other heavy loads issues.

MR. CAMERON: John, let's go to you first on this one.

MR. HANNON: Just to follow-up and clarify an assertion that Mike made about the level of management attention that's given to heavy loads in decommissioning reactors.

I understand you're saying you've already committed to 0612, but there is a degree involved here for regulatory purposes to enable

the staff to give credit for that, and I think we need to have some more discussion on that.

For example, I know that some operating licensees have a license condition in their license to adopt 0612 while they're operating and then when they convert into a decommissioning mode, that license condition is taken away.

So I'm not clear exactly on what the connection is with your commitment.

MR. CAMERON: Okay. Let's get a clarification on that regulatory point.

MR. MEISNER: When you go into decommissioning, no license condition changes are automatic. They can only be implemented through staff approval. I'm not familiar with licensees having 0612 in license conditions, but regardless, it's up to the staff to approve it if you want to approve it.

I'm talking about the integral part of our license basis has to do with implementation of 0612. That doesn't change going into decommissioning. We can only change that under 50.59 and the only real changes you would see with respect to that is to scope. If we're no longer using any cranes in containment, or, more accurately, if, in fact, we've moved all the fuel out of containment and it's only sitting in the pool, everything else is non-safety-related, then, of course, we'd reduce the 0612 scope for those applicable cranes.

But you surely wouldn't do that with respect to the spent fuel pool system.

The staff has all the commitments it needs to go forward on this and like I said, I think it would be a real good test case of whether we can get anywhere with this commitment and risk reduction approach. We've got everything in all the dockets. You don't need more inspection. You've been inspecting 0612 for years and your inspectors

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go out and look at that at decommissioning plants, just like they do at operating facilities.

The implementation is good. How many cask drops have you heard of in the last five years? You know, I don't know that you need to take a literature search through the nuclear industry to kind of confirm that.

But anyway, it seems like a straightforward thing, to me.

MR. CAMERON: Let's get some responses on Mike's proposition about this being a good test case, should be easily resolved. Stu?

MR. RICHARDS: I think we ought to just take the ball and run with it. The industry is going to be committed to 0612, so let's just assume that they are and that anybody who, for some reason, isn't, would fall outside that category and we'll have to deal with them on a case by case basis.

So as long as they're willing to make that statement, let's just take it.

MR. CAMERON: Do we have some -- when you say -- and what are the implications of taking the ball and running with it in terms of --

MR. RICHARDS: I think what Mr. Meisner said is just assume that 0612 applies to all plants, make that a baseline assumption. So the body coming out of the technical working group would be assuming that a plant is applying 0612 and the probability of this kind of event is whatever, and in the rulemaking process, we would take that into account and just say in order to give whatever, you have to have 0612 applicable to your plant.

MR. CAMERON: Mike, a comment on that or are there other steps or is that good?

MR. MEISNER: I'd just say the last step of saying that in order to take advantage of these, you have to use 0612 is a redundant

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step. We already have to use 0612. And I'd also say that I don't want to minimize some of the other upper bound assumptions either in the analysis and those need to be addressed, as well. But that in conjunction with 0612 implementation clearly drives this down to a low enough level that we needn't spend much more time talking about it.

MR. CAMERON: Okay. That's the issue we're focusing on here. Glen?

MR. KELLY: In discussing 0612 here, I think the staff has some concerns about what we're seeing out in the industry, that there are some people who are not necessarily committed to 0612 and we would certainly be interested in not implementing it as fully as might be appropriate.

But I think that the idea that you have of using the commitment as the adequate determination may be okay. It may be that the numbers that we've calculated here certainly do have uncertainty, but it's not clear that exactly what is the correct number, because the numbers that were in 0612 were highly uncertain and we continue to have highly uncertain numbers.

If we assume that the probability of cask drop is one in 10,000 and we've had a thousand cask movements, which I doubt that we've had, it would have been a very low probability that we've actually had a cask drop event so far.

So the fact that we haven't seen one is not unremarkable occurrence, whether or not it was one in 10,000, one in 5,000, or one in 100,000 cask movements.

But I think that we're certainly willing to entertain that the appropriate implementation of 0612 provides adequate assurance for limiting the risk associated with cask drops, to the point that we feel that it would be potentially not cost-effective to go ahead and to do more work.

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But I think we'd have to sit and caucus some more about that. I think that the potential is there, but we'd have to talk a little bit more internally about it.

MR. CAMERON: So at a minimum, I guess, what the NRC staff should take away from the table is do they have all of the information that they need from the industry to resolve this particular issue. Stu?

MR. RICHARDS: Just to make sure I understand, I think what I heard, and I don't know much about it, but I heard Mr. Meisner say that they would have a single failure-proof crane and implement that part of 0612 that isn't the consequences analysis. Is that right?

MR. CAMERON: I don't --

MR. MEISNER: What I'm saying is 0612 allows you two paths. One is use of a non-single failure-proof crane, but only if you do a consequence analysis. And given the consequence analysis, then this whole issue goes away. It won't result in breaching the pool. That's a plant-specific licensee initiated evaluation.

If you don't do that, now we're into the space you're talking about, and that's single failure-proof crane and implementing all the concomitant things that go along with 0612.

MR. RICHARDS: One or the other then, right? That's your commitment.

MR. MEISNER: Yes. That's what we're required to do.

MR. CAMERON: Let me make sure that we all agree on that. You keep referring to it as a commitment, Stu, as opposed --

MR. RICHARDS: Let me explain why. When you go and look at a 106 licenses, it's not unusual where you won't find that there are outliers out there who somehow, through the regulatory process, don't fall into that category.

To make it simple, let's just make that an assumption. Keep it simple. That's an assumption. Somebody falls outside that category,

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for rulemaking or for processing purposes, then they're dealt with on an individual basis. But that's the envelope. You're inside the envelope, you're dealt with one way; you're outside, then you're dealt with a different way.

MR. CAMERON: Okay. Now, even if you -- then I think even if we accept -- we use that as a starting point, then where are we in terms of resolving this problem, crediting industry with the use of 0612?

MR. RICHARDS: I think you asked do we have all the input we need, and I think clarify what the envelope is and then the staff said they need to go back and run it through the mill. But I think the proposal is pretty clear.

MR. CAMERON: All right. Then I think that's consistent with the way Rich Barrett feels about this, that we need it consistent; that is, we need to take this information and go back and do an analysis. Brian, we'll get to you in a minute.

MR. BARRETT: I think that what we need to do here is to make sure that we have all the information that we need. The last thing we want to is to come -- to find two weeks from now that we don't have information that covers some case. So that would be our very minimum requirement from the meeting, is that we make sure that whatever questions we have regarding this analysis, that we can get information from the licensees about, that we get that information.

Now, with regard to 0612, I've heard it suggested that we just posit full implementation of 0612 and have an analysis that's based on full implementation of 0612, and then any licensee that falls inside of that envelope is covered by the analysis and any licensee that falls outside of that envelope is not covered the analysis.

I don't know if that's the industry's proposal. I just -- my concern is that right now we're at a -- we're going to make a

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technical basis that will allow us to go forward and do what we need to do. If that's the industry's proposal, then we can analyze it that way.

But if the industry -- but if we analyze it that way, then that's the analysis I have and we would have to go back and redo it, if a proposal then for a specific plant was outside of that envelope.

So my concern is the same as Mike's. I want to make sure we walk out of here without any loose threads.

MR. CAMERON: Sorry, Brian, we'll get back to you. But is that the -- what is the -- the industry proposal, as Rich stated, comment, Mike?

MR. MEISNER: I don't know if I'd call it a proposal. I'd call it a statement of facts. We've been talking for two days about what assumptions should we make in the analyses. Here is one that is clear and straightforward. It's not tied to a commitment that's in the future. It's tied to existing license basis of plants.

If you know of any plant, Glen, I don't know who the outlier is you're talking about that isn't implementing 0612, but if you know one, I would suggest that's probably some kind of violation situation. And if you've got some concerns about how well plants are implementing 0612, that's an inspection NOV type situation.

You've got everything you need and I just thought this would be a very simple case where given that, you can use this as a test case to see can you, in fact, credit licensee actions in your analysis.

The 1353 has already established a policy that the staff should follow, and that's give us a three orders of magnitude credit for implementing 0612. We can make it real complex, but that's it.

MR. CAMERON: I think we probably should be careful about talking about outliers that may be in violation space or whatever, but can we -- just assume -- we know that there may -- that the universe may not be 100 percent, but can we just assume that for most, that 0612

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applies, and if 0612 applies, that that could be credited in the NRC analysis? Brian, why don't you go ahead and then we'll go over to Bill Henries.

MR. THOMAS: I like what I hear in terms of the commitment, but what I want to remind you of is that we've got Generic Letter 85-11 sitting out there, Generic Letter 85-11 dismissed the need for licensees to implement phase two of 0612. So when you say there are a lot of licensees out there that are fully implementing 0612, that's where we have our concern. That's where we have some uncertainty.

There are a few licensees that have come in, as I said, in decommissioning space, the ones that I've seen, I was surprised that they went to the full extent to do -- to put in the cranes, to do the consequence analysis and so forth.

MR. CAMERON: Maybe go back to Stu's point, is that we're going to get into an argument about how many plants fully implement 0612. I think there is another question here, which is if they do implement 0612, then what types of credit can we give them in the analysis.

MR. MEISNER: I don't remember exactly the details of phase two, but it revolves around the consequence analysis.

MR. THOMAS: It's an option to do a consequence analysis and take mitigating measures to manage the consequences or utilize the single failure-proof crane, or use the crane and interlocks and so forth to avoid hazards.

MR. MEISNER: I think the general industry understanding of this is that it's an either/or, consequence analysis or a single failure-proof crane. And I think you can count on that as far as the industry implementation.

If what you're talking about, though, is you expect the industry to do both, then that's a new staff requirement I think you

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have to justify. But having done the consequence analysis, you all can feel comfortable that, in fact, this whole issue goes away for a licensee, because you can't breach the spent fuel pool.

MR. CAMERON: Before you answer that, Brian, let's go out to the audience, the gentleman out here has something to add on this.

MR. LAGGART: Mike Laggart, from GPU Nuclear. Brian, I know just what you're talking about, the 85-11, and that it closed down really the phase two portion from further NRC review.

I think there's a couple of other things, especially for decommissioning that you have to consider. One is that when we go into decommissioning, the FSAR or the tech specs are revised. So if you come upon a plant that's not in that category of that doesn't have it in their DSAR, I'll call it, you can attack that issue as it comes up, I think, and say, hey, 0612 is what you require.

But a second point is that issue on 85-11 applies to all operating plants. If it's an open issue with the staff right now for decommissioning plants who have a load lift, it should really be an open issue for all operating plants, as well.

If we have plants out there that don't have that consequence analysis or the safety single failure-proof crane, so to apply it to just decommissioning I think is maybe inappropriate.

The third item I think is that 0612 was generated more for not only for fuel pools, but for safety-related equipment. And most utilities that don't have single failure-proof cranes have very site-specific technical specifications for modifications to their fuel pool, such as we have a cask drop protection system for casks up to 100 tons.

So most of the 0612 stuff that you are concerned about or single failure-proof crane or the consequence analysis was really for all the rest of the safety-related equipment in the plant. That really

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goes away. We're only concerned about the fuel pool and I think they're covered by site-specific tech specs in the mainstream.

MR. CAMERON: Thank you for that clarification. Brian, before we go to Bill, do you have anything further you want to say on this?

MR. THOMAS: We could spend --

MR. CAMERON: You don't have to say anything.

MR. THOMAS: Let me just say that my key point here is that 85-11 exonerates the plants from doing the consequence analysis or installing single failure-proof cranes. What I'm saying is 85-11 says you don't have to do any of that.

MR. MEISNER: One or the other.

MR. CAMERON: Okay. Well, we need to --

MR. THOMAS: So we need to have some dialogue on it.

MR. CAMERON: The NRC, I think, needs to get clear on what our regulatory structure is on that. Stu, do you want to offer anything on that? Go ahead.

MR. RICHARDS: I think we ought to just go with what's on the record. Mr. Meisner said they are going to do the single fail-proof crane and the first part of 0612, they're going to do the second part. Forget about 85-11. It didn't say anything about that.

MR. CAMERON:

MR. CAMERON: Okay. And, Bill, why don't you go ahead.

MR. HENRIES: I just wanted to once again harp or reiterate about the use of continual upper bounds instead of best estimate. I'm sure you can handle this as part of what credit you give for implementing 0612, but I think you can't continually take the upper number on each branch of the sequence and call that a best estimate.

MR. CAMERON: All right. Ray Shadis.

MR. SHADIS: Thank you. I just -- Stu Richards, I'm not

certain what NRC is offering to do in exchange for this commitment by the industry.

MR. CAMERON: Good point. It would be nice to find out.

MR. RICHARDS: I'm not offering to do anything. I mean, the industry just said let's make an assumption, for simplicity sake in doing this analysis, that the requirements or the guidance contained in 0612 are going to apply to a plant in decommissioning. Make that assumption of the analysis.

What does the analysis then say? We're going to get a report from the technical working group and it's going to say based on these assumptions, here's the risk. When it comes to me, then we're going to crank that into some kind of a regulatory framework.

So rather than argue about a lot of different variables that can apply, why not just use that simplifying assumption as a going in point for the analysis and see what comes out the other end.

MR. CAMERON: Let's go to Rich Barrett. The step is, are -- is the NRC staff going to factor in 0612 in to redo the analysis.

MR. SHADIS: What is the drive here to get only one number for each instance or each consideration here? Why are there not two or three numbers? Why not a high number, a low number, a best guesstimate number? What is the push for one number overall to say this is the risk?

MR. RICHARDS: I think the response to that is why reinvent the wheel. There's been a lot of work done in the past and I think it accumulated largely in this NUREG-0612, which is focused on exactly lifting heavy loads.

So as long as we're not going to argue about whether that applies or not for decommissioning, let's use that as a going in assumption, build on the information that's already available, and move forward. Why start from scratch?

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MR. CAMERON: All right. You're thinking about that.

MR. SHADIS: I just did take a minute to think about that. I appreciate that sentiment. For this particular instance that you're going to assume that these things are applied, however, assuming that those conditions are met, in itself, ignores the fact that this wheel was invented before.

It ignores the fact that all of these other assumptions were taken into consideration before.

MR. RICHARDS: I would say just the opposite. We're not ignoring it. We're recognizing it and using it.

MR. CAMERON: All right. Let's come back to that dichotomy perhaps. I would like Rich Barrett to tell me if this is true. We assume 0612 applies, NRC relooks at analysis on this basis. Is that what we're going to do?

MR. BARRETT: We can certainly look at the analysis on the basis of the assumption that 0612 applies. What I've been told here is that we have Generic Letter 85-11, which says, if I understand it correctly, not that we don't expect the licensees to do 0612, but that based on our perception of what the industry has done on its own, we're not requiring -- we're not making that an NRC requirement. Is that what it's all about?

MR. THOMAS: Yes. If I can amplify what you said, it says specifically you do not have to implement the phase two portions of 0612 and those phase two portions address the use of single failure-proof cranes, doing consequence analyses, and using some other compensatory measures.

MR. CAMERON: Okay. We're going to go on here to someone who might have some more information on the 85-12 issue. Yes, sir.

MR. VAN NOORDENNEN: Thank you. Gerry Van Noordennen, from Connecticut Yankee. The one regulation I haven't heard mentioned here,

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which would trigger an analysis or safe load path or upgrade of the crane for operating plants, in addition to decommissioned plants, would be 50.59.

So that you are moving a heavy load over safety-related equipment, before somebody does that, say, for example, moving a steam generator over a reactor vessel, you would do a 50.59 to make -- to look at the consequences.

So that has to be kept in mind, also.

SPEAKER: You're supposed to take things off the table, not put more regulations on, for God's sake.

I guess that the -- we keep coming back to this implications of 85-12 here and I don't know that we've gotten a certain answer about what 85-12 does in terms of the consequence analysis, et cetera, et cetera.

Ignoring for the moment 85-12 -- 11, excuse me. Let's ignore 12, too. Right. Is the staff going to relook at the analysis based on application of 0612?

MR. BARRETT: Absolutely, yes. Yes. The staff will take a look or re-take a look at the analysis based on what you see in 0612. Now, if we -- if that's the only analysis we do, if the only analysis that we have is one in which a licensee is fully in compliance with 0612, then that's the -- that's going to be the basis for going forward with any exemptions or rulemakings.

And any licensee who comes in who is not in conformance with 0612, phase one, phase two, or however many phases there might be, then that licensee is going to have to be treated as an exception.

So what we have apparently here is an opportunity to simplify our analysis. That is to say, to eliminate some of the variability by making the simplifying assumption that all licensees meet 0612.

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That has advantages in terms of simplifying our analysis, but it has a potential disadvantage for any licensee down the line who doesn't meet that 0612. And if the industry is happy with the situation like that, if the industry is confident that that assumption will encompass all licensees, then that would certainly be a simplifying assumption that we could make in our analysis.

MR. CAMERON: Let's go to Gary and then we're going to go to Mike, and then we'll go out to Brian in the audience.

MR. HOLAHAN: I'm not sure this is going to move us forward. It may take us back a step.

MR. CAMERON: Let's go to Mike.

MR. HOLAHAN: It seems to me there is some value in simplifying the analysis and doing it only once and all of that. However, if that analysis doesn't apply to all the plants, you're just leaving yourself with leftover issues that you haven't decided how to deal with.

I kind of like when the analysis was done more than one way, and this is a sort of factual thing. If you are this kind of plant, you get this answer. If you are that kind of plant, you get that answer.

Then I think -- and then whether you're conforming with 0612 or not is simply a question of facts. Otherwise, we have the possibility of getting -- mixing the apple and the orange. You're not a plant like this, but you're applying analysis that doesn't apply, and it seems to me it's a little more work to do the analysis both ways, but ultimately I think it simplifies the understanding where the plant stands.

MR. MEISNER: We're making this awful, awful complicated. Rich, as far as 0612, let me be explicit. It's either a single failure-proof crane or it's a consequence analysis that makes your issue go away anyway. And in addition, it's phase one of 0612 that includes

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the things like safe load paths, the crane operator training program, and the criteria, there are like five or six items in there.

So is that real clear? I'm not talking about pulling in new NRC requirements that you'd like to get in here. It's a single failure-proof crane or the consequence analysis, this phase one, which includes those five to seven items, such as safe load paths.

MR. BARRETT: That's my understanding.

MR. MEISNER: Okay. As far as having multiple analyses, that's fine, Gary, as long as you give us credit for 0612.

MR. HOLAHAN: We should give each plant credit for what they've done.

MR. MEISNER: And -- well, you don't have to do a plant-specific analysis.

Every plant, at least the modern ones that are going into decommissioning, you don't care about the old ones because they're past your zirc fire concern anyway.

MR. HOLAHAN: We said every plant did phase one.

MR. MEISNER: Has, within their license basis, what I just described. That's within their license basis. You can argue over the niceties of exactly what the NRC requires or not, but I tried to be explicit. If you take those assumptions and fold it into the analysis, it should make a big difference.

MR. HOLAHAN: That was not my understanding of what every plant had. However, if that is what every plant has, that's the way you should do the analysis.

MR. CAMERON: Okay. You might afterwards see if this reflects this discussion that's up here. Rich Barrett.

MR. BARRETT: What I'm concerned about in this workshop is making sure that we have a complete discovery of all of the factors that are important to driving these analyses and we've had a lot of

discussion about NUREG-0612 and then I understand that there is a big difference between an 0612 plant and a non-0612 plant or, let's say, a pre-0612 plant in terms of the risk associated here.

And I think with regard to 0612, I think we have enough understanding right now to go back and make a reasonable decision on which way to do the analysis.

My bigger concern is do we have enough information from the licensees about all the other factors that are important to this analysis. For instance, Bill made some very interesting statements here regarding the frequency of events being different from what we assumed. Also, that regarding the timing of the handling of large heavy loads, that, in fact, most, if not all of this cask handling would happen after we've passed the window for zirconium fires.

So it seems to me that there are other things that have been raised here and rather than trying to negotiate how we're going to do the analysis, I want to make sure that before we end this session, that people on our staff have heard and understand everything that the licensees can bring to the table that would be the basis for that analysis.

MR. CAMERON: We're going to go to someone from the community and then Glen Kelly wants to, I think, just make sure that everybody understands what the analysis was based on. Brian.

MR. FORD: Brian Ford, Millstone. Maybe I just got lost in the discussions. The way I understood the world was 0612 came out many years ago to address an issue. There was, I think, a generic letter that said thou must respond within such amount of time, you have to do it on two parts, all the utilities went out and did the first part, sent in responses, that kind of thing.

There is another part that the NRC decided they did not need to respond on or to do additional level. There was a reason for that decision, basically that the practices and the activities that had

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already been done adequately mitigated the risks associated with the condition.

Sometime -- and that was put out in a generic letter, this 85-11 or 12, whichever number it is.

MR. CAMERON: 85-11.

MR. FORD: So you have a generic letter. I heard someone mention that there was a study or something done after that that identified or in that time that identified that there was about a factor of three reduction in risk associated with doing those activities that had been done for 0612 and what I heard other people asking is why did the credit for those three levels of reduction go away and if they had went away, then are you really calling into question the NCR's decision in 85 to stop the activity.

And this came up from someone else. Is this really a decommissioning issue or is this really an issue that the staff is looking back at a previous decision for operating, shutdown, every plant, and saying we think we have a safety concern potentially that we had not previously recognized.

And maybe I just got lost in the discussion.

MR. CAMERON: I think Bill Henries did talk about two orders of magnitude in his presentation. But I think that this would be useful for Glen to talk about what is -- what is in the analysis.

MR. KELLY: When we performed the analysis, the -- we assumed that the plants that we analyzed were 0612 plants. And what I mean by that is that they were basically -- they were following safe load paths. We assumed that they weren't taking the load someplace where they weren't supposed to go.

What we did not do in our analysis was to give the same level of credit for having a single failure-proof crane that 0612 gave. And we did that, in part, because we felt that the more recent

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information that we had did not show any reduction in failure rates and, therefore, we didn't see that as much credit as had been given in 0612 was correct.

Now, it's probably appropriate for us to go back and look at that in more detail and determine what is the correct amount of credit that one should give for having a single failure-proof crane. This is an issue that is not only for decommissioning.

At this time, the Office of Research is looking into whether or not this is an issue that deserves to be raised again.

So the potential is that it may be something of concern for operating reactors. That has not been determined yet. But we're still in the process of looking at it.

I think that, again, as with what we did yesterday, the -- we're not married to the numbers that we have. The question was, what we hoped to do was to point out that our assessment shows that for us, heavy loads are potentially of a concern. And we're interested in understanding what is the practice in the industry or what will industry be doing to help make this concern go away.

And I think we've gotten a good bit of information there and there may be more than industry can tell us that they're doing that we may not be aware of.

MR. CAMERON: Rich, is this an appropriate point for you to discuss the issue that you wanted to raise?

MR. BARRETT: I don't think it helps. I don't think what I would say would help at this point.

MR. CAMERON: Okay. Well, keep thinking about that and let's go to Bill Henries.

MR. HENRIES: Thank you. Two things I wanted to touch on. The newer data, so-called, didn't show any changes from the 0612. Well, you wouldn't expect it to. It wasn't new data based on nuclear power

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plants. It was new data based on DOE and barges and people out in the back 40 with five-ton come-alongs. The newer data is the same as the older data.

You've got to take credit not just for the single failure-proof crane, I think if you look at the error statistics, it's the other things in 0612, like the operator training, safe load paths, the procedural controls, the management oversight, all of the things that make the human errors go away are the reasons we previously got three orders of magnitude.

Now, I wouldn't argue over one to two as long as you didn't use the upper bound on every other number on the sequence. We still get it back into the ten-to-the-minus-seven realm, which was the number that had been coming out of all the previous studies.

And I think that's all we're looking for.

MR. CAMERON: Ray.

MR. SHADIS: I'd like to comment that I was glad to hear Glen's summation, because I think that what you're being asked to do here is to provide the technical underpinning for a regulatory change, and that's important enough to really assess the basic data as well as the recent reports.

A technical evaluation has got to go somewhere beyond a book report and so I'm pleased to see that the staff is still trying to look at what some of these basic assumptions are.

And I hope that they continue on that path. That's it.

MR. CAMERON: Thank you, Ray. It's about time for lunch here. I don't know what more we can say, other than the staff is going to take the information that they heard from the industry and go back and reevaluate the analysis.

Is that at least a true statement, Gary?

MR. HOLAHAN: Sure, that's true. Yes. It's the either/or

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that I'm not sure about under your flipchart.

MR. CAMERON: I think that the either/or is we need to capture all categories, do it for all categories of plant, the 0612 plants and non-0612, and whatever the other category is.

MR. HOLAHAN: I think that's the wrong categorization, to call them non-0612. Everybody did 0612. The question is, what did they do for 0612. Our original study looked at single failure-proof versus not single failure-proof cranes and I think I hear a suggestion that that's not the real issue, that they're all very good, whether they're single failure-proof or not, and they can be put into one category.

MR. HENRIES: I think the results of 0612 is either you're single failure-proof or you've done a consequence analysis, so it's a moot point.

MR. HOLAHAN: What's not clear to me is whether that consequence analysis is relevant to this current issue. That consequence analysis had to do with things like load paths, didn't it?

MR. HENRIES: No.

MR. HOLAHAN: And avoiding, well, I thought --

MR. CAMERON: Let's hear about the consequence analysis.

MR. HOLAHAN: The consequence analysis wasn't spent fuel pool. It was operating reactor safety systems and stuff like that, wasn't it?

MR. MEISNER: Absolutely not. It was specific to the crane involved and the safety significance of what it could do. If we put in a new crane under our 0612 commitments over the spent fuel pool, then we have to do either a consequence analysis specific to that crane's use or make it single failure-proof.

It's spot-on to exactly what the issue here is, and the key -- there would be two key elements of the consequence analysis. One has to do with impacting fuel, of course. The other would have to do with

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breaching the pool. And if we showed that the pool wasn't breached, then whether it's -- you know, there is no probability for this issue.

So the only real thing to analyze is a single failure-proof crane.

MR. CAMERON: I'm going to ask -- we're going to take one last comment from Ray before we break for lunch, but I'm going to ask the NRC staff to consider thinking about this over lunch and seeing if there is anything anymore light that we can put up on the chart in terms of what exactly is going to be done here. Ray, do you want to take us into lunch?

MR. SHADIS: It's a question and then maybe Rich could answer it and then he could have his shot.

MR. CAMERON: And Gary is going to answer that. So okay.

MR. SHADIS: It's just this. It's just this. You have -- it seems that the backup position here is that the licensee is going to do an analysis specific to their crane and whatever and that that is somehow on one side of an equation. On the other side of it is further analysis by the staff for the purposes of ultimately changing the regulations.

And I wonder if the importance of changing the regulation and the fact that it affects the, whatever they are, 106 licensees or whatever, if that can really be balanced against this notion that each licensee, if they have to, would individually assess the probabilities and consequences at their own plant.

Does that question make sense to you?

MR. CAMERON: Rich?

MR. BARRETT: I'm not sure, Ray. Could you just run it by again?

MR. SHADIS: What I see happening here is that it is proposed to put away all further analysis on probabilities because they

are bounded somehow by conformity to 0612 and that in conforming to 0612, there are two ways you can go, one is to put in your single failure-proof crane, the other is to do an evaluation or analysis of not using it.

And it seems to me that what happens is that evaluation of not using the single failure-proof crane somehow gets balanced against the staff going any further to look at the possibilities.

MR. BARRETT: I think your question goes toward the comment I wanted to make, and that is that in a sense, we live in two worlds in this nuclear safety business. We have a deterministic world in which we develop rules and requirements, NUREGs, generic letters, 0612 being one of them, and when we go through that analysis for a particular issue, we come to the bottom line that that issue is resolved.

Okay. It's a black and white determination. So you're either in conformance with that rule or you're not or that requirement or that regulation and from a regulatory perspective, we walk away from it. Of course, we inspect it periodically, but you're in compliance and you're fine.

That's the way we do deterministic rule-based regulation. The business that we're in right now is risk assessment and risk assessment doesn't make that assumption that because you're in compliance with a given rule or because you've met the requirements of a given regulatory guide, that we can walk away from an issue in risk space.

I think everyone knows that we have an ECCS rule and we've had an ECCS rule for a long time, but if you look at risk assessment, you'll always find large LOCAs, small LOCAs, medium LOCAs, and all sorts of LOCAs, as important contributors to the risk for many plants.

What we're looking at is the residual risk of the plant. What risk is left after you've met all of the standards and

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requirements? So in this case, we're not talking about saying that for a plant that meets 0612, we're going to walk away and say the risk is zero. What we're talking about here is in the analysis of risk, do we want to do the analysis under the assumption that a plant meets 0612 or do we want to do the analysis two ways, one for a plant that meets 0612 and one for a plant that doesn't.

And I don't know if that answers your concern or not. But in any event, when you take all of that, heavy loads, and add that along with what we're left with after we've reanalyzed seismic and intermediate and long-term sources, then that becomes the risk basis for what we do in the future on whether it's rulemaking in the future or exemptions in the nearer term.

MR. SHADIS: What it seems like, it seems like that what you all are saying to the industry folks is we don't need to analyze further in terms of risk or consequences because if you're going to be applying, implementing 0612, you're either going to be using this crane or you're going to be providing your own consequence analysis.

And therefore, the fact that they're going to be providing their own consequence analysis substitutes for an overall consequence analysis.

MR. BARRETT: I don't think that's what we're saying. I think we're still going to come down to a final analysis of what is the risk associated with a zirconium fire that might be initiated by a drop of a heavy cask. But we have to put down numbers as to what's the likelihood of that, and those numbers have to be based on analysis and assumptions. And when you do that analysis, you're either going to assume that they've got a single failure proof crane or a consequence analysis in conformance with 0612, or you're going to assume that they don't.

And if you assume that they don't, they're going to get

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somewhat higher numbers, and if you assume that they do, you're going to get somewhat lower numbers. It's just all part of the analysis and it's the way we do risk analysis for any issue.

So it could very well be that when we take into account all of the information we got today about the current status of plants, in addition to the fact that we -- that everyone is in conformance with 0612, as has been asserted here, it could very well be that this particular contributor does fall out as not being important.

But if it does, it will fall out because the numerical analysis shows that it falls out. Not because we have made an assumption that because -- that compliance with 0612 means that there is zero risk.

MR. CAMERON: Gary, do you want to -- let's go to Gary, and we'll finish up with this gentleman in the audience. Then we'll take a break till 1:30.

MR. HOLAHAN: Let me see if I can at least clarify my concern with the issue, and it goes exactly to Bill's second viewgraph, where it states that only single failure proof crane load drops need be considered since consequence analysis must be performed prior to using non-single failure-proof cranes.

It's that equation that I'm having a problem with.

If you do a consequence -- if you don't have -- if you have a single failure-proof crane, then this is all taken care of very easily. We know how to do the analysis and we know where it should come out.

If you don't have a single failure-proof crane, do you mean to tell me that you will not carry over the spent fuel pool a load that is so heavy that the consequence of it would fail the pool?

MR. HENRIES: Yes, that's right.

MR. HOLAHAN: But does that mean that licensees who are

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doing decommissioning and are handling heavy casks, unless there is a way to get fuel into casks that I haven't thought about, who are putting heavy casks in the pool, have necessarily gone to single failure-proof cranes or is there something else like crash pads or something going on that I haven't -- that I don't see here?

MR. CAMERON: Bill, do you want to clarify that?

MR. HENRIES: Exactly as you've said, you have two choices. You have a single failure-proof crane, in which case we discussed it, or you've done a consequence analysis. Consequence analysis can be that dropping 100 ton cask --

MR. HOLAHAN: Doing the analysis accomplishes nothing. That's what I'm trying to get past.

MR. HENRIES: It does tell you if you pass/fail. The consequence could be totally acceptable.

MR. HOLAHAN: Then you'd never get the fuel out of the pool.

MR. HENRIES: No. The consequence -- you're assuming you dropped a cask. The cask drops 40 feet, goes through air, goes through water, impacts the bottom of the pool. If there is no structural damage, no leakage, no off-site dose consequence, no criticality concerns, no zirc fire concerns, the consequence is acceptable.

MR. HOLAHAN: I understand that.

MR. HENRIES: That's the only way they could bring it up.

MR. HOLAHAN: And if we understand that consequence analysis means either the loads are going to be small and you have to use small casks or crush pads or something that makes this go away, then, in fact, it seems to me that --

MR. HENRIES: We have an analysis at Maine and with a 100-ton cask dropping 40 feet, it goes into the concrete about a foot and a half. We assume it becomes infinitely permeable and then what happens? It starts to try to leak into bedrock. We estimate two to

five gpm leak. It's a loss of cooling, loss of inventory.

MR. CAMERON: Okay. I hope that that was -- I think that that was useful.

MR. HOLAHAN: It helped me. I don't know whether it helped anyone else.

MR. CAMERON: Final comment here, and then we're going to lunch. Go ahead, sir.

MR. LAGGART: I heard we're going to go with two types of analyses, Rich, and I would say to make your job easier, and I think Mike has stated, we all believe we're in compliance with both phase one and phase two. Now, the question is, on phase two, whether it involves all licensees or not, because of that Generic Letter 85-11.

If you're looking for a commitment for decommissioned plants, I think we can say, and we know everybody meets phase one, we'll meet phase two, as well, for all the decommissioned plants, because that is our practice.

I think that Mike -- of course, that's subject to Mike's agreement, Meisner, to make that part a commitment.

If there is some uneasiness and the staff says that we're all committed to that, that way it simplifies the analysis, everybody can assume phase one, phase two implementation, which the phase two part is the consequence or -- that would be my proposal.

I think I'd ask Mike to comment on that.

MR. CAMERON: I think what we'll do is why don't you guys talk about that. NRC, based on Gary's understanding from this last colloquy with Bill, if there is anything that we can put up on the flipchart when we come back that provides some clarity to the issue that Mike said should be simple to resolve, we can put that on when we come back and then go into thermal hydraulics.

If we can't, we can't. But be back at 1:30. Thank you.

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[Whereupon, at 12:20 p.m., the workshop was recessed, to reconvene at 1:30 p.m., this same day.]

A F T E R N O O N S E S S I O N

[1:30 p.m.]

MR. CAMERON: We're going to get started with the last push here on these issues and to sort of give you a preview of what we plan to do, I want to quickly close off, finish up the heavy loads segment. We're then going to go into thermal hydraulics, and then we're going to go into a wrap-up. Part of the wrap-up, a very important part of it, is to see if we can get some agreement on this requantification proposal that is simmering, and probably more than simmering now because we do have a handout for you that refines what I have up here and that we'll put on the screen for you as a viewgraph. There are some other lingering issues, too, that we want to discuss in that segment. We're going to lead off that segment with some words from Mike Meisner, and then we're going to go into a discussion of this.

In terms of heavy loads, I'm going to read you a statement that we're going to put, we're going to go with as a commitment from that session. It starts off with assume 0612 applied, and NRC should give appropriate credit for this, that is, 0612, in the analysis. That's where we're going to go with that on heavy loads.

Okay, since there aren't any questions on that or comments, are we ready for thermal hydraulics, and John, are you going to set things up?

MR. HANNON: Yes.

MR. CAMERON: All right, thank you.

MR. HANNON: My name's John Hannon. I'm branch chief for NRR. It's the last session of this workshop. We saved the best for last, the thermal hydraulics part. Ed Burns gave me a good lead-in yesterday. I think it was his slide number nine where he talked about the importance of making a good connection between deterministic part of the calculations and the probablistic analysis. That's part of the

reason we're having this session today, to make sure we have a good, sound technical basis in the deterministic area.

These calculations that we're doing have in the past provided us a definition of what we're calling critical decay time, and I interpret that to be the time period for which the nuclear safety hazard persists such that regulatory constraints are appropriate to protect the health and safety of the public.

Now, in a minute, Diane Jackson and Joe Staudenmeier are going to go into details of what the staff has done and try to identify some of the conservatisms and the parameters and uncertainties of importance and discuss the calculations that we have performed to date and more closely try to approximate the conditions that exist. These calculations rely on computer models that require initial conditions to be set and assumptions to be input.

Another slide that Ed used yesterday, slide number 27 in his package, raised a question on the overly conservatism aspects of certain of these assumptions that we're using. The one that I recall had to do with the onset of the oxidation runaway. There are some discrepancies there between what the literature has and what we're using for our analysis. So, maybe we'll have to -- we'll want to go into some discussion on that, too.

At any rate, these calculations that we did attempted to be near bounding such that we predict the nuclear time line of concern that would accomplish most of the plants for exemption purposes. The goals of this session is to have everybody understand what we did, identify the parameters that are important to obtaining more accurate time estimates on a plant specific basis so that without compromising our safety margins, we can have good technical basis for granting exemptions and in going forward in the rulemaking process. We also want to explore other techniques and methodologies that you all may want to bring to the

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table.

I just would close by saying this is a very technically complicated subject, and we do have a diverse audience, so we need to be careful not to leave anybody behind, so I want to be sure we're clear in our communication, and we can try to reach a line in our thinking. Let me turn it over to Diane for further discussion.

MS. JACKSON: Good afternoon. I'm Diane Jackson. I'm a member of the technical working group, and I'm in the plant systems branch with the staff. For our deterministic calculations, we did two types of calculations, the thermohydraulic analyses and 80 adiabatic heatup calculation. I'm going to talk about the scenario and the existing generic calculations used in the thermal hydraulic analyses, and Joe discussed more of the details of the different types of calculations and analyses that we did in the report.

For the thermal hydraulic analyses, you want to analyze the temperature of the spent fuel when it's exposed and only cooled by air. Depending on the code you use, you can model the whole pool, your specific burn-ups, your decay heat, your configuration that your fuel is arranged in in a pool, and even your pool building, to give you a very good answer on how high your fuel can heat up.

The analyses usually result in calculating a critical decay time, which is the minimum length of time since the reactor is shut down that you have decay heat in your pool or in your most recently discharged fuel that there isn't sufficient heat to raise the temperature of the fuel to the point that you would get runaway zirconium oxidation.

In general, the scenario we looked at is do you have a loss of water? At that point, your fuel will start increasing in temperature. To move on to the next slide, early in this sequence, your increase in temperature is due to just the decay heat of your spent

fuel. As you start reaching higher temperatures, you have an oxidation reaction between your air and your zirconium, which is an exothermic reaction. So, you produce energy as the temperature increases. The heat input from the oxidation reaction dominates what's driving your temperature increase. Then it can increase in temperature very quickly.

Due to the higher temperatures that can be reached, you can heat your fuel to the point that you can have fission products released from the fuel, the solid fuel itself, and at some point you could have a zirconium fire, and this would provide an energy source that could transport fission products offsite, and this is why it's a concern for areas such as emergency preparedness.

One of the things that was brought up early on in our technical working group study is why don't we use the existing information. All the information's there. NUREG 1353 looked at this, so we went back and looked at the applicability of the older thermohydraulic studies to the plants that we've got today or ones we'd see in the future.

In the 80's, like I said, generic safety issue 82, Sandia and Brookhaven National Laboratories looked at the --I wrote probability. It wasn't really probability. It's more like a likelihood. It wasn't a risk analysis like we were talking about earlier today. The phenomena and consequences of zirconium oxidation and a zirconium fire, and this was based only on operating reactors.

We looked at another study that was done by Brookhaven National Lab that was done in 1997 that was done for generic BWR and PWR for decommissioning plants, and it included the potential for a zirconium fire.

In looking at these reports, we concluded that the critical decay times that were calculated were not accurate for regulatory decisions, and that the values that they came up with for their critical

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decay times couldn't bound what we'd see in the future for decommissioned plants or apply to them. It was difficult to match them up, and that's the second point. We'll provide sufficient detail for license amendments. These reports weren't meant to be regulatory guides that you could match your specific plant up to. There's not enough detail. They spoke to an issue, not as a method for regulatory relief or anything.

So, why didn't we find the existing studies, why wouldn't they apply? Generic safety issue 82, they used two codes called F fuel and a modification F fuel 1W, and some of the -- two of the things that struck us mostly clearly was the lower burn-ups that they used in the 80's which were representative of plants then didn't apply to the plants today that can burn up to 60,000 megawatts for megaton uranium. They also looked at the storage rackings that was used at the time. They looked at low density BWR racks, and they looked up to a high density PWR rack, but it's not as high density as we can currently use today. Some plants have a different type of rack than what was modeled then.

We also found that these codes didn't model the actual fuel configuration which some plants wanted to do and we were looking for at the time. It was a stylized calculation that lumped the hottest fuel in the center and then moved them out. It didn't look at any type of configuration that was actual.

For the '97 Brookhaven study, they used their own developed code called the shark code, and the list below that is a mix of things from the study and from the code itself. The first one, the lower burn-up for the BWR that was used today, we find that I think they used 40 gigawatt days per megaton uranium, and BWR's can burn up higher than that. So, that would lower -- for PWR's, it was representative of their burn-ups for today, not as high as they could possibly go today.

Beyond the report, though, we've started looking at the code

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itself, and we found the code, we felt, underestimated, even if it was modeled correctly for a specific pool. They did not have in the code flow losses through the grid spacers through the assembly. They'd only modeled the orifice size. So, you've have a slowing of your air through your assembly that it didn't take -- it didn't account for. So, that would tend to increase your critical decay time that you would need.

We also found that it was unstable for some input, that it would not converge, and that the code had not been verified or validated. This is something we would want before licensees would be able to use that. Additionally, that code could also not model actual fuel configurations. It gave, I guess, a better model than S fuel did. It could model -- you could input how many spaces you had full, how many spaces you had empty, but it homogenized everything so you couldn't tell where your hot fuel was, where your cool fuel was. So, these are items we found in the existing reports that we felt couldn't be used for decommissioned plants today.

Next slide, please. The longest critical decay time that we found calculated in any of the reports was 700 days, and that was in generic safety issue 82 report for a high density PWR, so we think it's something that would be longer than that. We came up with a generic estimate that Joe will talk about later. We do find, though, that the general conclusions in the reports are valid, particularly this one here, the conditions that could lead to an oxidation are dependent on storage configuration and decay power. That's something they came out with and led to our -- helped us lead to the conclusion that yes, we need to look at, if we want a generic solution, looking at thermohydraulic analyses, we need to do calculations that are more appropriate for today's plants or plants that we'll see in the future.

That's the end of my presentation. Joe's going to talk more about the thermal hydraulic estimate and the adiabatic heatup

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calculations.

MR. STAUDENMEIER: I'm Joe Staudenmeier from Reactor Systems Branch. I've been involved in evaluating the past heat-up calculations, we also have some ongoing calculations that I'm coordinating and have factored into our analyses.

The primary reference is for past calculations, or past credible calculations are NUREG CR-0649, which is a Sandia report on spent fuel pool heat-ups, and NUREG CR-4982, which is severe accident studies in spent fuel pools in support of Generic Safety Issue 82. Some additional calculations that we've been looking at, Chris Boyd of research performing with affluent, we've been assuming a full pool for a large BWR, so it ends up being about 4200 spent fuel assemblies, which is I guess the closest plant to that is probably a Grand Gulf sized plant.

We're going to look at high burn-up, or that calculation so far has only looked at 40 gigawatt days per metric ton. We eventually had planned to go up to the upper limits of BWR burn-up. High density racks, we're looking at. I guess one reason we're looking at high density racks is it seems like all the utilities are re-racking their spent fuel pools and putting -- trying to stick as many in the spent fuel pool as they can, putting the racks as close to two inches from the wall, so not allowing much area -- I mean, it's fine for looking at water cooling of the spent fuel pool and will give plenty of cooling, but if you go and look at these type of calculations with air cooling, it just severely reduces the amount of cooling you can get.

The previously determined generic criteria from the two NUREGS I cited above came up with -- that a critical decay power of six kilowatts per metric ton uranium, and that very high burn-ups today, like up in the 60 megawatt days per, or 60 gigawatt days per metric ton. That ends up being about three years for PWR's and I think maybe about

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somewhere in between two to two-and-a-half years for BWR's. The calculations cited in those reports where they come up with two years for PWR's, that was looking at, I think, fuel burn-ups of like 33 gigawatt days per metric ton, so there's -- it's very low compared to the way plants are operating today. I think the BWR calculations were lower than that.

These past calculations also had some missing phenomena based on some observations from some more detailed calculations that were being performed. They are very lump calculations. They didn't include 3D flow and mixing, which can increase the temperature that you're getting down to the fuel racks in the spent fuel pool and has the effect of increasing the maximum temperature. Also, it didn't include grid space or flow resistance, which is also somewhat not --it's a bit of a nonconservatism, although the grid spacer losses aren't dominant, but they can be significant and make significant differences.

All of the above information we considered -- the things I just talked about had the effect of lowering that six kilowatts per metric ton to critical decay times, or critical decay powers. That could be as low as half of that, so it could bring that six kilowatts per metric ton down in the range of three kilowatts per metric ton, which extends the time out for critical decay time significantly.

Okay, next slide. We still haven't finished our calculations. There are still uncertainties in these numbers, and there is ongoing calculations and there will be more in the future to try to reduce some of that uncertainty.

Important parameters that we've seen that these things depend on, rack geometry, obviously, location of the hot bundles compared to cool bundles. Lots of plants have purposely spread out their hot bundles, leaving empty rack spaces behind them, but we've seen other plants that have put all their hot bundles in one rack, which is

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probably not a prudent thing to do if you're worried about zirconium fires. It's the least conservative thing you can do.

Building ventilation assumptions have a large effect on the answer. The more ventilation you have going through the building, the cooler the air is in there, the more cooling you can get.

Fuel and rack flow resistance, down in the laminar flow regime which these calculations are in and with the small distances involved with the tight packing of racks and the small distances involved between rods and grid spacers and things, it's a very high flow resistance configuration.

In many cases, especially up in the range of temperature where we're concerned about, you need all modes of heat transfer to really calculate the problem properly. Convection, radiation and conduction are all important.

Zirconium oxidation in air, there's quite a bit of uncertainty in the data. It's, in fact, even between different alloys of zirconium, there's factors of four difference in zirconium reaction rates.

Okay, 3D flow mixing, our calculations so far, especially our CFD calculations have high sensitivity to actually where the fuel is placed in the spent fuel pool. You can get pressure stagnation effects that are small, like on the order of five pascals but then when you figure the whole pressure drop you have available or the whole gravitational potential you have available is less than 40 pascals, it can become significant and can actually end up showing that the hottest temperature fuel in the heat-up calculation is not actually the highest power fuel, and it just happens to be because where it's placed in the hole.

As you get to higher temperatures, clad ballooning and severe accident phenomena can become important. Up above 565C, you

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start getting clad ballooning. That's a ten hour clad ballooning rupture criteria, so that's the most relevant experimental data we have for clad ballooning in this type of configuration since we're talking about long heat-up times. Something longer than ten hour clad rupture heat-up time would be a lower temperature than that even, but unfortunately, we don't have any data on that.

You start getting into severe accident phenomena at temperatures as low as 640 or 650C where you start getting melding of aluminum, which the aluminum is in the bore outplates. You start melting that down, I mean, calculations -- none of the calculations take into account that so far. There's, I guess, a possibility, depending upon how the plates are in there, that it could cause flow blockages when the aluminum relocates after the melt. That's an additional uncertainty.

Oxidation, as I mentioned before, there's some uncertainty in that data, but since we're concerned only -- and there's many more severe accident phenomena. Once the oxidation takes off, I mean, you get into places where zirconium starts dissolving steel, uranium starts dissolving zirconium, get into clad relocation, start releasing fission products up in the range of 14 to 1500C. You start driving off the more volatile fission products from the fuel, but that's way beyond the criteria that we're considering.

I want to say something about the adiabatic heatup calculations that were performed. We realize that not allowing heat removal is unrealistic. I think the adiabatic heatup calculations are misunderstood as to why they're performed. They were performed to give a timing estimate only for an unknown fuel configuration after an accident. I mean, the fuel could have been on its side. Something could have been laying on top of the fuel, and then when you start getting that type of fuel configuration, suddenly the adiabatic heatup

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calculation isn't real conservative at all. So, that just came as a timing mechanism for time available for evacuation or ad hoc evacuation if you got rid of emergency planning. Our emergency planning people told us that ten hours was adequate at the time, and we took the simplest way possible to show that ten hours was available for a specific plant, and that's the basis of the adiabatic heatup calculation. It came about between probably 5:00 one day and 11:00 the next day. The concept came out and the calculation was performed for an exemption.

Okay, next slide, dominant uncertainties. The dominant uncertainties and critical decay time estimates are the actual fuel rack geometry itself, the type of racks you have, geometric criteria such as the orifice, size going into it. How the fuel is arranged in the racks is another criteria that can make a big difference in plant specific calculations. Building ventilation, as I said before, flow resistance and mixing and oxidation rate models.

Next slide, I just have some examples of models that we use, orifice loss coefficients, you can see, that as a whole, get smaller, the orifice loss coefficient can become very high. Rod bundle friction is much higher than pipe friction for the same type of flow conditions. Some people have brought in calculations using pipe friction models. Apparently, they didn't look at the code very well they were using, and didn't realize the code didn't have an adequate friction model for what they were doing.

Grid space losses, a lot of people have come in originally using grid space loss coefficients from turbulent flow calculations, which are lower than the laminar flow grid space loss coefficients. The flow resistance through the bundle is dominated generally by the rod bundle friction. That's probably an order of magnitude higher than the orifice loss coefficients and grid spacer losses put together.

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Okay, next slide. Okay, zirconium-air oxidation, there's a very high energy release in the zirconium oxidation reaction. What's assumed is a parabolic rate equation reaction rate, that's what the data was fitted to. It's the same type of reaction equation that we use in LOCA calculations for oxidation reaction, although the constants are different. Oxidation is worse in air than it is in steam. It has a reaction rate quite a bit higher.

Once you get into the significant oxidation regime, or the zirconium fire, pretty much the total energy release is dominated by the oxidation energy and the decay heat becomes insignificant. Oxidation energy becomes orders of magnitude higher, like two to three orders of magnitude higher.

Next slide. Actually, that's not my slide. There are some back-up slides up there that I want to get into. Okay, that's a critical of temperatures versus decay time. This is from the early 1980 study by Sandia from NUREG CR-0649, showing how sensitive temperatures can be to things such as geometry in the pool. You can see back then, the calculation was done at 33 gigawatt days per metric ton. PWR's now are pushing 60 gigawatt days per metric ton. Since then, just the racking practices alone would push everything to the right-hand side of the plot, so these were configurations done in the early 80's. Now, everything would probably be to the right of the far right curve if you had a plant that didn't shut down prematurely and ended up with a full pool, and you'd be pushing it out to three years and possibly longer the critical decay time.

Also, if you could hold that previously slide. No, don't put it back up, but I'm going to be referring to it again later on. Okay, this is basically a cartoon drawing of the problem that you're looking at, also from NUREG 0649. You can the spent fuel pool. You want to get heat out. This is all ways that you can get heat out, and

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it's just a cartoon to show this is the problem we're trying to solve. The building and the spent fuel pool itself both have important effects on the problem. Next slide.

This is just a sample example of an energy balance. Going through in time, this is a -- I mean, each detailed configuration will have its own energy balance but you can see heat is being put in through decay heat, and it's different ways that you can remove heat. You can see in this calculation anyway that dominant heat removal is just convective heat transfer. There's some radiation down further, so that's how you get heat out of the pool. Next slide -- there's also stored energy in the pool from the heatup.

This is a drawing of what these temperature calculations look like. Also, you can see an example of how the diameter of the hole can make a significant difference in the temperatures you rise up to. That's basically a change in the flow resistance. As you increase the flow resistance, the temperatures go up. You can also see the difference between having oxidation there and no oxidation. You can see that oxidation probably starts to become important, or where you really need to include it at about 600 degrees C, and you can see once you get up above that 800 degree range, I mean, your curve starts to get almost vertical going up. You don't have much time between eight or 900 degrees, and when you're heating the pool up to where you release vision products.

Now, there was a lot of talk yesterday, or there was something in the NEI presentation about that how it was an overly conservative temperature criteria and oxidation criteria that was used. This is an oxidation compared to data that was used in 0649. I mean, you look at this, and compared to data, I don't see that as being conservative at all and if anything, I would say it could be a little nonconservative. Next slide.

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So, it's the Sandia curve is also on there, the previous curve. This is from NUREG 4982. It's comparing the Sandia data and another curve where they tried to make one parabolic rate equation fit over the whole temperature range as opposed to the few region Sandia curve to some more recent data. Still, I really don't see the overly conservative oxidation numbers for this Sandia curve. You can see also, there's some steam oxidation curves which are in there to compare to. You can see that air oxidation is much higher than the steam oxidation. Next slide.

It's back to the one that I had before. Okay, you can see up there, this is another example of why 800 isn't conservative. You can see that once those temperatures get up to 800, they pretty much go straight up. Your increase powerages slightly, and they're going up to infinity or up to fission product release, so, in fact, looking at this type of information, I would say if I was going to do anything to the 800, I think you would want to lower it to give yourself a little more margin, especially considering all the configurations that are going to be coming up in the future are on the far right hand of that plot. I mean, you start going vertical below 800 in those cases.

That's all I have to say now. I guess if there's any questions about it, I can answer them in the discussion period later on.

MR. CAMERON: Okay, thank you, Joe, and thank you, Diane. Are there a couple more slides that you guys need to go through?

MS. JACKSON: There's one more slide, and we'll go through it now, but it's really for the discussion period. Currently the staff is looking at doing a few more generic calculations towards this, but we're asking industry, we're asking the public, are there alternates to the values of the parameters we've put in. We assumed a fuel pool because we can see plants in the future going to a fuel pool and shutting down. We didn't think that was conservative for looking at

rulemaking.

Also, if you look at the items on Joe's slide that's important parameters and phenomena, if you'd let us know what you think industry practice is or will be that's representative, we'll consider those in our future generic calculations.

If you have an alternative calculation to the adiabatic heatup that would give us just a metric for sufficient time for the progression of the scenario, we're certainly willing to hear and would like to hear what else can be used. These are just something that we came up with that would give us an appropriate answer. If there's something else that you think would be more appropriate, we would certainly like to hear them.

That's the end of the staff presentation.

MR. CAMERON: Okay, and Phil, if you could just hold that last slide ready for when we're done with the next presentation because I think we'll be going back to that. Dr. Niyogi, are you ready for your presentation now?

MR. NIYOGI: Yes. My name is Kalyan Niyogi, director of technical division. I think NRC's presentation, Diane and Joe's presentation are pretty good introduction to what I am talking about. My discussion will be based on our evaluations of a couple of plants we already did. For example, CY and Millstone 1 and also some of the generic information we developed for our work.

We will discuss the scenarios we considered to evaluate the consequences of various accidents. We will discuss methodology used for each of these calculations. I'll present some evaluations of specific cases and try to draw some conclusions.

I have not tried to develop any generic conclusion out of it because the plans we have considered are typical plans which have gone through years of fuel in their pool. This is not a plan which has very

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high burnup. These are not plans which are just shutdown and ready for decommissioning.

There are several scenarios we look at. Two of them are important -- spent fuel pool heatup with no spent fuel pool cooling. That's one scenario. The second scenario, the loss of cooling water. In the first scenario, which is spent fuel pool heatup with no spent fuel pool cooling, we considered the consequences when you have the ventilation system available, and also we considered when the ventilation system was not available. By ventilation system, we mean the forced ventilation, and the cooling is done by natural circulation of air.

For all these calculations, one thing is common, the calculation of decay heat. As it has been pointed out in various discussions that the calculation of decay heat varied from method to method. We used ORIGEN as our basis for all our decayed calculations, and we found it's consistent and reliable.

Another thing which is very important, the pool evaporation model. The information in the industry, available information, based on air conditioning, handbooks and stuff, sometimes they don't cover the range of temperature we are interested in. So, what we did, we did an actual test, and also we developed some basic information for evaporation rate and we found these are much better -- these correlations are much better than what you can do from the extrapolation of HVAC kind of data available in the industry. Also, we did some actual tests with Millstone Unit 3. They are benchmarked, and they're pretty good there.

The spent fuel pool and fuel building temperatures, that these are calculated to find how high the temperature of the building gets because there are equipment that should survive, and as Dan pointed out, the building information on how the circulation is allowed whether

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you have opening or you have other means of having circulation in the air in case that we have no forced ventilation -- very important. Sometimes we calculate what if kind of situation, like you open the hatch, see how the temperature is brought down to acceptable limits.

The loss of cooling water part, we used a CFD model for the pool. We considered heat transfer within the racks and the sounding buildings. Also heat transfer between the fuel assemblies and the racks. Just to show schematically, when you have drain down all water from the pool, the only thing that is remaining to circulate around the racks and cool. Also, it is important how the building is ventilated.

Just to refresh your memory, these are typical racks, but there are a variety of racks in the industry, and they are very important. We could not develop any generic information for that. There are racks with flux straps and side holes and things like that. They play a very important role in thermal hydraulics.

The computer program we used for the problem in the industry or find that element calculations, we found the core has sufficient flexibility to incorporate all the factors of elements which are important to our problem. At low temperature range, the dominant factor for heat transfer is the convective heat transfer. At higher temperatures, the radiation conduction becomes important.

MR. CAMERON: Would you rather use that? That looks comfortable.

MR. NIYOGI: Thank you. There's another thing used with the porous media assumption. What it means, the acts and the fuel pool assemblies were considered as porous media, and the resistances are calculated for the flow path of the air very meticulously and converted to the porous media parameters. Since we designed the racks, we have all the details of the information. We have a pretty good handle on that and can calculate the losses fairly closely to the actual value.

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One other question comes back and forth, is it 2D or 3D assumption, whether we should make it 3D model or 2D model, what is acceptable. Like any other thing, I believe it's engineering judgment, if you can idolize a 3D pool with 2D assumption, should be good enough. At the same time, I believe you'll be penalizing yourself a little bit because additional conservatism will come into that. It's not that 2D is unacceptable. The other way, it should give a higher number, but if you get lower number, something is wrong in the engineering judgment.

We have done both 2D and 3D and compared the results. When there are significant difference, we found the engineering judgment was wrong, but you have to develop some kind of intuition how the flow field looks like, or that the flow will come to the volume first or mix to the top. These are the things which are not sometimes very straightforward.

Again, we have done significant amount of work to come to the conclusion that 2D could be equally acceptable but with some penalty. What do we do with that calculation? We calculate the maximum local temperature and then on the basis of the maximum local temperature, calculate the fuel cladding temperature.

Before going into the effects of it, let me show you schematically how we used to do in the past the calculations. The thermal chimney effect is schematically shown by this. The hot channel go up, the cold channel go down. Many years ago, early 70's, we used to calculate all these by hand calculation, and I still remember doing it for operating plants still running. Now, we have the advantage of high speed computer and PC's are very powerful, and we can simulate millions of grade and simulate very precisely the actual geometry and all the details of this. The codes of the industry are much better now, very reliable, and they're based on solid theoretical bases, and they give results.

Let me show you some of the 2D analyses we did. One thing

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you have to remember, to make a 3D geometry into a 2D, you have to distort things. You have to put the hottest flow in a certain way that it is representative. Also, it's not too much penalizing.

This is -- the color is a little different there, but this shows the temperature distribution and I see the hot spots shown. As I mentioned, we do quite a bit of 3D analysis. A pool could look like this with all this small geometrics there, and this is the flow field. You can see the cold fluid coming from this end going to the bottom and coming back, and because of the higher resistance in the racks, the velocities are smaller. There's a lot of circulation on the top and the sides and the bottom, and because of friction, the velocity drops.

This is the temperature profile in one cross section through the middle of the racks to the hot flows. This is just to show how I've taken now the highest range of temperature and distributed in the lower range more accurately in this one.

This is the velocity vector in the diagonal plane. This is the surface which is interfacing with the building air. Sometimes the question asked, how far do you go? It can make the whole building as a part of this model, but we found we can find a reasonable boundary and still get the results fairly accurate, and that cuts down the number of grids.

Again, I have a lot of pictures to show. There's another question whether thermal radiation is important. It is very difficult to accurately model the thermal radiation because in a traditional way. So many surfaces are here, and we believe there is significant radiation between the fuel rod, the surrounding and so on, and also there is significant conduction at high temperatures. We found a way to get around that. Rather than going into details of each and every surface, which is impossible, we developed some technique to incorporate the radiation. I don't want to get into the details, but of course, fluent

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has a capability to incorporate some of it, but you have to be careful. Definitely, radiation is important when your temperature goes above five, six, 800 centigrade.

I mentioned about 2D, 3D, and again, what do we do now in order to the time you spent arguing that 2D is good enough, you can as well do a 3D analysis, and at the same time, you are not penalized. So, we have started doing 3D analysis irrespective of whether it's needed or not, and let the argument go away.

Fuel shuffling, for many plans, we found fuel shuffling give significant reduction of temperature rise, especially the tendency has been to put the hot fuels in one place, as somebody mentioned. We found that by shuffling the fuels and spacing out, putting in a checkerboard way, it relieves alot. On the other hand, the plans which will be having very limited room for shuffling will have difficulty to shuffle and so again, for plans which don't have much room, we have limited success in shuffling.

Rack design. As I mentioned briefly, the rack designs are important consideration because especially the ones which have the flux trap which is the space which you can take credit for air circulation. There are racks, the channels are not continuously welded, but welded in spaces only. That relieves some of the cross -- that allows some of the cross current of air and gives much -- leave to temperature rise. So, I think your observation, NRC's observation that the variety of racks may give significant relief, it may not be significant when it comes to high density and packed situation because in that case, by allowing cross air flow doesn't help much, but when you have room available, it changes the picture.

Conclusions, CFD techniques provide acceptable predictions, and we have verified that by means of various other means of calculations, and they're pretty reliable. Plant specific analysis is

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necessary to factor in burnup, fuels, its history, discharge history, rack design details, etc.

I think this is contradictory to what we are trying to achieve today, to come up with some generic answers, but what I'm saying, the plants which I'm investigating would be penalized if you use some upper bound analysis. The burnup of the half of 60 from 30, 40, even worse sometimes. The full history based on history I found, that the significant conservatism in the burnup built-in with that too, because the way it is kept record and then you take upper bound of that, basically is conservative estimate by itself.

As I mentioned, fuel shuffling may provide significant advantage. Again, it's qualified for plants which have a lot of space you can think of shuffling. Then you get into significant problem of shuffling between hot fuel and cold fuel, contaminated fuel. So, you found that there is definitely some advantage if you can do that.

Now, as I mentioned, I have not tried to develop any generic information here, just to give what you do and what you have done for several plants and what tools are available, and the sensitivity of certain parameters be observed. I believe to develop something generic and applicable, it is not going to be very easy because the plants are of different categories, but still, it can be developed to some extent and then left to the variety of the plant design and other parameters. Some generic information can be developed, but for the plants I'm involved in, I found they would be somewhat penalizing.

That's the end of my presentation.

MR. CAMERON: Thanks a lot, Dr. Niyogi. I'd like to go to Diane Jackson and Joe Staudenmeier. Do you have any questions or comments on Dr. Niyogi's presentation from the perspective of what you've done on the NRC part of the study, including the need for further information that you mentioned at the end?

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MR. STAUDENMEIER: I guess we would be interested in discussing some of his CFD calculations in a more detailed manner at some time, because I guess what we've been seeing in our calculations is that these CFD calculations aren't real straightforward all the time, and they can be very sensitive to even things that you would think of as small things like turbulence models that you use in the code, and also, you're really pushing, I think, the node size that you are able to use in these models and especially in 3D models, is probably at the upper limit of what you'd want to use, and you have difficulty performing convergent studies and things like that to make sure you're truly getting converged results, I think, when you're pushing the limits in these 3D calculations.

I guess also, we'd be interested in I guess more details about the radiation calculation that's being used since it's not a standard thing, if it's like a diffusion approximation or something like that, that you could maybe implement in that type of model and compare it to some results. PNNL out in Richland is doing some calculations for a decommissioning group with COBRA where they're doing detailed subchannel modeling and detailed radiation modeling over quite a few bundles in their calculations and seeing how accurately this simplified model is predicting things compared to a more traditional way of doing radiation from surface to surface view factors.

MR. CAMERON: So, you're suggesting that it would be useful to sit down and talk further about this with Dr. Niyogi?

MR. STAUDENMEIER: Yeah. I don't think we have time in this forum to talk about those type of details.

MR. CAMERON: For we laymen out here, it may not be a question of time, but I think that would be a good idea. Gary?

MR. HOLAHAN: I'd like to pursue a little different question, which is how do we expect the thermal hydraulic calculations

to be used in our study or in any licensee activities with respect to spent fuel pools. One example is we heard we had some difficult using the ANS decay heat model. We heard that you were happy in using the origin code, but then yesterday we heard that, in fact, licensees are in a position to do measurements on the pool to get a realistic assessment of what decay heat is. In my mind, this raises the question of how much should we be calculating and how much should we just, you know, allow the licensee to rather then sort of keeping track and doing calculations, just make a measurement or a realistic assessment of what the heat load is in the pool.

The other issue I'd like to put on the table is there are really two rather different thermal hydraulic calculations. Joe talked about heat-up time. If the water is gone from the pool, how long does it have to heat up to self-sustaining oxidation calculation. Are we really going to use that in any of the likely regulatory decisions? Do we need to be able to calculate such a thing?

The other calculation is, I think, what Diane mentioned earlier, this critical time after which you don't expect that even without water in the pool, that the temperatures will get up to oxidation. It seems to me from all the other things we talked about, what we may be saying, that the risks for the spent fuel pool appear to be relatively low, and we're sort of trying to settle out how low is low, even for the period of time for which Zirc fire is possible. If I think of this as a time dependent calculation, then a few months, few years after shutdown, presumably you could have a Zirc fire, but it's unlikely. If you go out further past this critical time, it becomes unlikely to be out of water in the pool for a significant period, but even if it were, there might be a, you know, worker and shine dose issue, but we don't really have an offsite public health and safety role. So, what role is the thermal hydraulic calculation, or any of the

thermal hydraulic calculations, going to play in selling out these issues? Which ones do we really need to focus on? What do we need to calculate? How well do we need to calculate it?

MR. CAMERON: And Mike, do you have something to say in response to that?

MR. MEISNER: Surprisingly, I was going to say almost the same thing as Gary.

MR. HOLAHAN: That is surprising.

MR. MEISNER: I think -- well, one obvious problem after hearing both of these discussions is it's one thing to use -- get out of using bounding values in probablistic space, but boy, it's really rough in deterministic space. Like several people have pointed out, the plants you're talking about now are well below various of these parameters, for instance, on burn-up and the kinds of time periods you're coming up with are very, very conservative for them.

I think maybe the red herring in all this is, and I think is the direction Gary was going, was that the flow is using these kind of criteria is that they're not risk informed, and when you apply risk, I think they go away. So, what's the need for those calculations? I'm not sure there's any need at all if we focus our time and attention on the risk side because this isn't giving us consequences. It's not giving us any insight as to probability of these events, and I think that's the role of the risk evaluation.

I'd also like to make a comment on the -- so we don't think it's an appropriate criterion at all, the time beyond which a Zirc fire can happen. Similarly, the same thing as far as this adiabatic heatup, but for a different reason. This is more of a policy and optics issue. That was first applied, I believe, at Maine Yankee, wasn't it, the adiabatic heatup? I can tell you, in talking to some of the folks there in the community, here's the impression that they got.

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The NRC said that the licensee doesn't have to have an off site emergency response capability anymore. The NRC says they don't even have to worry about it anymore, and what they've done is, they've essentially thumbed their nose at the public and said, it's your problem. Now you evacuate. You can do it in ten hours. That's the impression that was given. I don't think that's good policy, and for that reason, I don't think that's at all an appropriate criterion to be considering for resolving any of these issues.

MR. CAMERON: Gary?

MR. HOLAHAN: I'd like to follow up on a few of the things that Mike said. I would disagree with one point, which is you said that these calculations don't really have to do with consequences, and I think they have a lot to do with consequences. In other words, if you were comfortable that after a certain period of time, you were not going to get a self-sustaining Zirc fire, I think that very greatly affects, you know, the public dose consequences.

MR. MEISNER: Yeah, sure.

MR. HOLAHAN: Some of the stuff we talked about earlier and whether it's how the operators are trained or how much instrumentation is available and those sorts of things, I think we have to ask the question about whether the things that utilities talked about yesterday or that will be in our follow-up discussions are special precautions that ought to be kept in place early after a plant shutdowns until this critical time when you don't have Zirc fire concerns, or whether these are -- I done know how you want to term it, but are the, you know, normal sort of precautions that a utility would propose to keep in place at all times.

So, for example, the level of training and the instrumentation licensees, the licensees are going to keep that level of protection in place before and after such a critical time, then it

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doesn't become so important to figure out what that time is. If you wanted, for example, say after five years, just arbitrarily, say Zirc fires aren't possible, that at that point you wanted to reduce some of the requirements because the consequences very substantially drop off at that point. Then I think that thermal hydraulic calculation and the consequence calculation play an important role. If that's not in the mix, if that's not the way the utility proposes to run its shop, then this becomes -- the details of this become a lot less important.

MR. MEISNER: That's a very good point, and while we haven't gotten on to specifics as to what those requirements or commitments are, you know, and the rule of thumb is to what level do they reduce risk. I would say that all the stuff you heard from us yesterday is just good common sense, and I don't believe -- I can't think of anything that we discussed yesterday where we would want to remove it simply because we had gone past the point of a Zirc fire possibility. We have those in place, not for Zirc fire, but because we don't want to have loss of cooling events. You know, we don't want to have drain downs, and if we do, we want to be able to respond to them. So, I don't see that that -- that anybody in the industry would be well served by removing those things.

The other thing I wanted to say, too, if you're talking about periods now of five years for potential Zirc fire, you know, I think most plants that decommission now and in the future, at that point, they've gone to infancy. You know, they don't even have pools anymore, or they're just about to get to that point.

MR. HOLAHAN: Five years was just a number. You know, I believe the calculations are whatever the calculations are. I guess at least some, most, and maybe all of the utilities who spoke to us yesterday are beyond the point of Zirc fire, or at least they certainly feel they are.

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MR. CAMERON: At some point we need to get it on the record what the answer is, so just speak into the microphone one at a time.

MS. JACKSON: I can answer that. Oyster Creek, who was there yesterday, and they haven't shut down. They're just looking for future, and Zion is here today and they're undergoing the exemption process. They're on a case by case basis. Oh, and Millstone.

MR. HOLAHAN: Did Big Rock yesterday?

MS. JACKSON: Yes, and they had an exemption. Big Rock spoke, and they had an exemption, emergency preparedness.

MR. HOLAHAN: The point was, is there any difference between the way the utilities are treating their spent fuel pools, whether they think this is early after shutdown or substantially later, or would they want to treat it differently?

MR. MEISNER: The answer is no.

MR. HOLAHAN: Okay. I think that plays a role in our thinking.

MR. CAMERON: Is it premature to -- is that something that rises to something we should put up there as a neither action item nor a commitment is perhaps the right word for this, but do we want to make a note of the importance of this issue?

MR. HOLAHAN: Yeah, I think it's a significant point and, for example, Mr. Lochbaum's comments yesterday about, you know, beyond the public health and safety issue, there's an issue of worker protection for the people who are on site. I think if utilities are providing the same level of protection, you know, later as they are earlier, I think it goes at least partly to cover that issue. In other words, you're not reducing the level of protection just because it's been three years, if that's more comfortable to you, because, in fact, all you're really saying is if you have one of these very serious events, you would have a serious on site source to deal with, and

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avoiding that, you know, is important to the workers, even if there's no off site consequences.

MR. MEISNER: And that's why we do it right from the beginning, not because of Zirc fire.

MR. HOLAHAN: Okay.

MR. CURRY: Jim Curry, GPU. I think you were asking about utility input. You know, basically at Oyster Creek, our philosophy is simply we don't change the design basis of the fuel pool as long as there's fuel in the pool. So things like NUREG 0612, heavy load restrictions, administrative controls on chemistry, to maintain the integrity of the Boraflex level, to prevent a draindown event of any nature, that's really our design philosophy. For us, the calculation of the Zirc fire window is an interesting one, but our philosophies don't drain the pool. So, really, the administrative controls to prevent that, and physical constraints and staffing and training to prevent that event is really our design objective.

MR. CAMERON: George?

MR. HUBBARD: I've got a clarifying question on that, Jim, just from the standpoint, because I know with most BWRs, you would have an RHR assist mode in the cooling and that, I believe, you know, some plants are -- as the heat load gets down, they would be reducing or taking out that part of the system. Now, could you address, you know, Oyster Creek's approach to -- you know, because in the operating plant, that is a backup system to assist, you know, when you do an off-load. But, how would you factor that in?

MR. CURRY: I think -- the first thing, I think you're on to a good question, when you talk about Oyster Creek and other plants. But, our philosophy, again, is to not change the likelihood of a draindown event, not introduce any new hazards, just because we go into decommissioning. So, when we design our spent fuel pool cooling systems

that are sized to the load that we have, we probably won't put in alternative systems the day after we shut down. We'll pick a time that makes sense; probably, a year or so after shut down, when the decay heat loads go down to a certain point. Now, we -- and that curve begins to flatten out a little bit.

At that point, the amount of redundancy that we have in those systems and the amount of support will be designed into the system, such that the probability of a draindown event -- and, again, our thinking is don't drain the pool. You don't drain the pool, you don't have zirc fire, nor do you have any other consequences associated with a draindown event, which just seem fairly nebulous and difficult to define. So, we will -- our intent is to design a system of adequate robustness, to make the probability of a draindown event essentially negligible or incredible.

Just a follow-up event, I think when we -- a follow-up question, when we talk about analyzing zirc fire, and we don't want to forget about the embedded assumptions that we have in here. I mean, we talk about this model and that model, but each of these models has key assumptions; for instance, the gap between, you know, the fuel elements and the wall. So, you have to make sure that those embedded assumptions don't change. So when you get into the consequences business, it's not just, you know, agreeing on zirc fire and how to calculate zirc fire in a given geometry; but all those assumptions that you made when you did that calculation, you begin to spread out and you have to enter those regimes, as well, to make those -- to make sure those assumptions remain valid. So, we think that's a real tough thing to do.

MR. CAMERON: Is there a -- is there a question there that you would like any response form the group on?

MR. CURRY: No, I think that was just a comment, as we talked about the different ways to calculate the duration of the zirc

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fire window, don't forget that you're making embedded assumptions and you have to keep track of those assumptions or the analysis really isn't any good.

MR. CAMERON: All right. Gary?

MR. HOLAHAN: I presume if it's difficult for the licensee, who has the pool and knows what the rack design looks like. If it's difficult for you to do the calculation, it would be really difficult for us to, you know, have a hundred different ones well established. However, it seems to me that we've been talking about, you know, how low is the risk, spent fuel pool, decommissioning. When you go past this point, difficult to calculate as it may be, there is, in fact, a very substantial drop in the public risk, or you could call it a very substantial increase in the safety margin or whatever.

So, I think even if we don't have to have a precise value because it plays a specific role in a decision, you know, we're not going to grant this exemption until three weeks from Thursday, because that's what the calculation says. From a fuller understanding of what the risk and the safety margins are, I think at least that part of the calculation, we ought to continue to pursue, even though we would recognize that maybe you -- there's quite a lot of variability from plant to plant, situation to situation. I think it would be important to understand, in general, what these time period are, even if they're not specifically determining the licensee decisions.

MR. CAMERON: Annie, we're going to get to you right in a second. But, it would be useful to get some reactions to what Gary just said.

MR. CURRY: There is one comment or question. When you talk about the duration window, that's one thing. Can you comment on what you feel the consequences are, if you did have an ignition of the clouding -- an oxidation -- rapid oxidation of clouding?

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MR. HOLAHAN: We did some preliminary dose calculations, and I think Brookhaven did some in a previous report. We didn't include them in our study, because I think they're not -- they're not quite the same level of readiness for comment. But, if somebody could comment generally on it --

MR. KELLY: This is Glenn Kelly from the staff. Can you help me understand what specifically about the consequences you want to know?

MR. CURRY: I think the question is, in terms of how they compare to reactor accident consequences, because if you think of comparable risk profiles, things like that, again, I think our view is, look, we want the probability of this accident to be -- or this event to be negligible. That's really the objective here. But, from what I heard Gary say at an earlier presentation, look, we're interested in the consequences, because if the consequences are so onerous and if I think in terms of the risk profile, that's really what I want to try to compare. So, I think we -- we hear that and that's fine.

So, the piece of it is, well, how do the consequences compare to consequences associated with a reactor accident or things like that. Because, if we try to compare comparable risk profiles, well, that's the other piece. And as you ask the question, Gary, gee, how much -- how much calculation should I be doing, I think you need that piece.

MR. BARRETT: Let me say a couple of words in response, if that's okay with you, Chip.

MR. CAMERON: Oh, yes.

MR. BARRETT: And then for more detail, I can leave it to Glenn Kelly; but, I think just to provide some context. Qualitatively speaking, how does this compare with a core melt type of accident? The major features that you have to consider are, first of all, on the

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positive side, you generally are at a point in time where the iodides have decayed away. And when the iodides decay away, what that does is significantly reduce the potential for early fatalities, because early fatalities tend to be driven, to a great extent, by the iodides. So, that's a very positive factor.

On the negative side of the ledger you have -- you have much larger inventory of fuel than you would have in the core. You have multiple cores present and available for release of radiation, and you don't have the containment -- the level of containment that you would have for a core damage accident. So, in a qualitative sense, what you -- those are the major factors that you see in the consequence analysis.

For -- when you look at the actual consequence -- those consequences, themselves, what you see is, on the one hand, the integrated person rem calculations. And as you probably know, the calculation of latent fatalities is essentially directly proportional to the integrated person rem and those tend to be on an order of magnitude similar to a large release, okay. On the other hand, when you look at the early fatality calculations, because of the absence of the iodine, you tend to see -- and also because you generally give a lot of credit for evacuation in these sequences, although we did calculate cases with and without effective evacuation. But even without effective evacuation, because of the absence of the iodine and because early fatalities tend to be a threshold effect and tend to be sensitive to the iodine, the early fatality calculations tend to be much lower than you would see in a spent -- in a core damage accident, resulting in a larger early release.

And I'll ask Glenn if that's fair and ask him to expand on that.

MR. CAMERON: Thanks Rich. Glenn?

MR. KELLY: That's correct what Rich said about the

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characterization of the risk results. Again, these were based on our assumption that in the pool, two full cores worth of material burned up in the zircaloy fire and that there was no effective containment by the building that the spent fuel pool was in and that we had -- looking at the building -- the heat -- the temperatures from the zircaloy fire sufficiently high that will melt the building. And we determined that looking at 95 percent effective evacuation, you got around -- these are numbers off the top of my head -- right around 2,000 -- 2,200 latent fatalities. That's not -- that is not a -- that has not been conditioned by the probability and, basically, like three quarters of an early fatality. So, when you look at those times the probability of the event, it's a very small number.

MR. CAMERON: Okay, thank you, very much, Glenn. Let's go to Ray Shadis.

MR. SHADIS: I will remark, Glenn, that that's just human lives. The property loss stays about the same and, of course, that's always a concern. The question was raised here as to -- and Gary may have to help on this, because it was his question, but it got lost in the circuit here, is to whether the utilities would maintain the same operating characteristics for their spent fuel pool after what, after the rest of the plant was down or after a certain period of time that expired? I don't recall.

MR. HOLAHAN: I think what I heard was so long as there was -- at least from Oyster Creek's point of view, so long as there was any fuel in the spent fuel pool, they would maintain the quality of programs in the vigilant, or however you want to characterize it, as when they had first shut down.

MR. SHADIS: I see.

MR. HOLAHAN: Or, in fact, perhaps as they -- I'll take a picture while I'm pushing on my nose --

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[Laughter.]

MR. HOLAHAN: -- as during normal operation.

MR. SHADIS: I see. I misunderstood --

SPEAKER: Are we paying for these pictures? Can I veto some of these pictures?

[Laughter.]

MR. SHADIS: Okay. But, I misunderstood your question. I thought that you were asking if everything remains the same during this period, and the fact is everything does not remain the same.

We were discussing yesterday whether or not to give credit in the safety analysis to the safety culture, whatever you would call it, of the companies maintaining these spent fuel pools. And in that same vane, the culture at the site changes radically during decommissioning and, in fact, may be out of the hands of the parent company, the owner company that's maintaining the spent fuel pool.

Because, you have an influx of contractor workers. Many of them don't have any specific nuclear training. They may not be, you know, brought up in that same nuclear safety culture that the ordinary workers that come in for refueling projects would have. You know, they're not there to meet specific tolerances and they're not conscious of the regulations or the interactions of components. We had at -- at Maine Yankee, we did have an incident in decommissioning with asbestos workers. It was just hard to find workers. A lot of these guys just didn't have the training.

And so, what I'm getting to is that that impacts -- if there's any work being done in the vicinity of the spent fuel pool, if you're replacing that crane when you're getting ready to do those heavy lifts or doing modifications on any of that stuff, if you're removing asbestos from any piping that may be in that building or electrical worker, any of it, you would have to pay special attention to questions like -- and I don't

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want to discourse on this, but questions like foreign materials exclusion. Because, if you -- if you drop a sheet of plastic, whatever it may be, some insulation into the spent fuel pool, that's going to adjust the numbers that you have, in terms of the flow through on these fuel assemblies, if you wind up with any amount of that stuff under a rack, and especially under a rack that has a freshly discharged fuel assembly. So, it does play into it.

And, you know, if there are any -- when you're looking for inputs tie into what might affect the heat up, then I think you really need again -- and I made this point earlier today, you really need to look at what's going on during decommissioning, what are the activities -- other than the guys who are sitting there watching the monitors and walking the perimeter of the spent fuel pool, what are the other activities that are going on around there. And I think that you may find that there are other activities that are going to affect whether or not that fuel is going to heat up.

MR. CAMERON: I think we're going to have a comment from Mike on one of the point you've made, at least. Mike?

MR. MEISNER: Yeah, Ray is exactly right. But, it's a bit of apples and oranges. Things do change when you go into decommissioning. And recognizing that, I think all decommissioning facilities make a clear distinction between spent fuel management and the D&D work that's going on out in the plant.

You don't have contractors coming in, who are responsible for fuel management. In fact, what I think most plants are doing now, and come on out and look, is we're purposely putting in place what we call nuclear islands, so that we clearly isolate the fuel management function, not only procedurally, but physically, mechanically, electrically, and everything else, from what's going on in the decontamination effort. When you have asbestos workers out there removing asbestos in the plant,

surely, you've got -- you don't have nuclear trained workers. But, that's, in fact, why you isolate your pool and don't allow those folks anywhere near it.

Another thing I think almost all decommissioning plants do is they carefully refrain from doing any decommissioning around their spent fuel. You know, the spent fuel pool building at Maine, for instance, is about the last thing that gets D&D'd. Once the fuels out of there, then we move in and start doing the decontamination, dismantlement work. So, while Ray's exactly right, that's one of the things that decommissioning management has to be on top of and identify ways to isolate the non-nuclear workers from fuel management. It's a real straightforward thing to do and you don't have -- in fact, all of those folks don't -- can't even get access to the -- to our fuel pool building. So, I think, in that sense, it's not really a factor at all, what we're talking about.

MR. CAMERON: Thanks, Mike. Ray, do you have anything?

MR. SHADIS: Just briefly. We had foreign materials exclusions problems with the reactor cavity. I mean, it's not like these things don't happen, don't get ahead of us, and it may well be that Maine Yankee is an exemplary plant; but, I'm raising this as a generic question.

MR. CAMERON: Thank you, very much, Ray. I think we're probably ready to go to our wrap-up session. And we do have some mechanical things to do, right, Vonna, that you need to take care of before we do that. I was going to suggest originally that we just forge through. But, we might as well take a break, since Vonna has to do some things. Okay, so it's now 25 after 3:00. How about a quarter of 4:00, is that too much time for everybody?

Okay, we've got a request for 20 to 4:00. That's 15 minutes.

[Recess.]

MR. CAMERON: Okay, are we all set? All right.

All right, we're going to start our wrap-up session now. And

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to give you a little preview of that, we're going to start off with a few comments by Mike Meisner. Then, we're going to go to Brian Sheron, one of the top managers in our Office of Nuclear Reactor Regulation for some comments. And then, we're going to have an open discussion of what someone called the path forward, about where we're going to go from here, to try to resolve this issue and how it might fit into future regulatory context, whatever. But, we have an immediate task before that. And we did redraft the so-called requantification proposal. I think you have -- all have copies of it. But, I think we need to revisit that, based on what Mike and Brian have to say.

So, let's start off with Mike Meisner. Mike?

MR. MEISNER: Thanks, Chip. I do have more than a few kind of -- I want to maybe ramble a bit, because it's hard to pull all of this together without some preparation. But, I want to start back at the beginning, after the Commission meeting and the first time we met with the staff, to get a feel for what the technical working group was coming up with. Remember, we met back in the ACRS room and the staff gave us a presentation about their preliminary results. And in their presentation were a series of sequences with very high numbers in it. And we probed a lot in that meeting, trying to understand what was behind it, what drove those high numbers.

And I think it was the next day, then, we're in talking to senior NRR management and tried to come up with a success path forward, based on what the staff had done to date. And what we had agreed to, I believe, was this workshop. And the -- what we brought up at the meeting developing that workshop was the willingness on the part of the industry to come up with commitments that would address those things that seem to drive the high numbers in the staff's preliminary results. And, of course, to do that, we needed to have some information about how that model worked and how it was put together and what the assumptions were.

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So, we came prepared to do that at this workshop. We have talked about a number of commitment areas, and I'm going to go over those again, just to be clear of what we're talking about. And, you know, in return, we're looking for some explicit reduction in risk that resided in the models and that were tied to these areas of commitment.

So, first of all, and we may have lost some of it in passing quickly through it yesterday, when Ed Burns talked on the risk insights. We were looking at four areas of commitment -- hardware commitment: one that has to do with seals, to the extent they're included in the design, and committing to the notion of either redundant or soft loading seals; the second had to do with anti-siphoning devices associated with the spent fuel pool, both in the -- I'll call it the permanent design, as well as when you use temporary pumps and the like for one reason or another, that you would incorporate the same kind of safeguards; and then, finally, the idea of pre-staging or providing a connection for the diesel fire pump to the spent fuel pool floor, so that that can be aligned outside of the refueling in the middle of an event. I didn't want those things to get lost in the shuffle. And I want to be able to understand that, to the extent those provide a risk reduction, those are areas the industry is willing to commit to.

Then, we had a longer discussion about -- I'll call it the software, the procedural aspects of things. And we're looking at things like -- things that really are already required to be in place for, say, internal fires, work controls, combustible controls and the like. I think you can probably verify through our license and design bases that those things are already part of our FSAR. And then to the extent that it's not included in the SSAR, for detection purposes, operator and security rounds, as an example, and various detection devices. And, of course, central to all of this is if you should ever get into a situation where you've lost cooling or you're in a draindown situation, then the idea of

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clear procedures in place that will identify the various water sources, means of getting water into the pool, and power sources that are available to the operation staff, to mitigate that event.

Now, we don't think there's any benefit in going into detail, like we heard, for instance, when level goes down two inches, you do this; when it's down one foot, you do that, whatever. I think what we're talking about is insuring, as they already are, that operators are aware of all the potential paths for recovery, that they have a procedure that directs them to not focus on a single path, and that they have some training and ability to respond to these very long-lived, long-term events.

There was also some discussion about training. But, I think in that area, clearly, there's no need for additional commitments, at least that I'm aware of, because that's part of Appendix B and our license basis in what we're required to do, given the NRC approved certified fuel handler training program. I think there shouldn't be any concern about lower quality training, for instance, than we had when we were operating. The quality remains the same and it has to remain the same. And there are a number of regulatory hooks, I'll call them, that you have to come in and if you're not comfortable with the quality of training, make sure it gets back up to snuff. But, the regulatory framework, we believe, is already there.

And if I've missed some, somebody can correct me later, but that was kind of a general discussion of those areas that we're willing to provide additional commitment. And the appropriate place, seems to me, to be incorporate that into our license basis through the FSAR. That insures that you've got all the controls associated with 50.59 and 50.90, should there be, for instance, an unreviewed safety question and us wanting to change some of that.

We kind of throughout the workshop, asked staff for feedback

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on which ones of these commitments would make a difference. And I guess I thought that was going to be the major portion of the two-day discussion, and I believe we've gotten back very little feedback in that area. So, I don't know the degree to which any of these things could be credited or the level of possible risk reduction that could be achieved. What we did get from the staff was, you know, that you'll look at it; you'll take it back and look at it.

Heavy loads was a bit of a concern. We thought that would be the seminal issue that would be real easy to identify; that, in fact, licensees have commitments and requirements in place and have always had them there, and there should have been -- we've had a pretty direct reduction in risk, as a result. I'll mention two that -- although it wasn't emphasized too much by Bill Henries, our position on heavy loads, cask drops, is that the NRC has already resolved that issue in 1353. It was -- we feel it was inappropriate to open again. The 1353 resolution for cask drops makes absolutely no distinction between operating and decommissioning plants. And when you're talking about the probabilities of those cask drops, given that the 0612 requirements are maintained constant, that, in fact, we think you should have just adopted the 1353 results, or, at a minimum, taken the assumptions in 1353 that credited magnitude risk reduction associated with 0612 implementation.

As far as the -- what we call the HRA requantification issue, let me talk about. First of all, because I think it was misunderstood, I want to clarify a statement that Ed Burns made, when he was talking about this proposal, and I've spoken to Ed about this. Is he still here? And Ed can speak for himself, if I misstate it. But, it's -- it will be real nice for the PRA community to maybe understand better how to deal with human error events and maybe develop new techniques to do that. That's something really good and probably something we should all pursue, as a result of this.

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The point is, though, that it's not needed to deal with the issues that we've been talking about the last two days. We -- in fact, it's absolutely unnecessary. We believe the ground rules coming into this was for the staff to take our areas of commitment and adjust their assumptions in the model, which we've told you, time and time again, is a very good model, and to then requantify the model. We don't believe it's at all necessary to embark on a new research project, to advance the state of art of HRA for the PRA community.

And related to that is -- buried in the requantification issue is the fact that, in fact, we may not requantify a lot of stuff pursuing this approach. The industry feels strongly that it's absolutely necessary to requantify the staff's model. It doesn't serve anyone to take a sequence and say, well, it's less than ten to the minus fifth or ten to the minus sixth. We need to show some continuity with the draft report that's already out and follow through and requantify it. And the reason is we really do need to risk inform this. We need to know where to apply our resources. And if we're talking about a situation where the probabilities are in the order or ten to the minus seven, ten to the minus six, then it's not good enough in prioritizing our resources to say that a particular sequence is less than ten to the minus six. We, also, believe it was the intent of the Commission to do just this and to really face up to the issues and resolve them once and for all.

I think -- you know, being cautiously optimistic, I think we made a lot of progress the last two days, but we don't have anything in our hand to show that. You know, we've got -- we've got, I think, a lot of good intentions to take information back and revisit a lot of issues. But, I don't think that we got what we expected to get out of the workshop, and that was much clearer commitments on straightforward issues, for instance, like heavy loads, that we felt were achievable in the workshop. So, we're kind of looking for something early on, to give us

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continuing confidence of the fact we're making progress. So, I have a series of proposals here that I want to lay out, from the industry point of view.

First of all, we think it important that the staff provide, in a very short period of time, a detailed near-term plan: what's going to happen in the next one, two, three, and four months; how are we going to resolve these outstanding issues, like in HRA; how are we going to show that there's some credit for heavy load issues; how do we know that we're really bridging the gap on seismic. And we hope that that schedule will include all of these different discussion topics that we've had in the workshop.

We think it would be constructive to have periodic management meetings, then, between the industry and the staff. We've done this a lot on larger issue type things, where we took, you know, some NEI industry executives that met with NRR executives on a monthly basis. And I think those meetings could then take a look at this schedule, track progress, and see if we're really getting to where we'd all like to be.

On the HRA issue, I repeat our position that we feel it's absolutely not necessary and that we came in with the understanding that the model needs to be requantified, based on changed assumptions from the workshop. On the other hand, the biggest concern we have with this is turning it into a research project that's open ended, and that you all are already talking about March of next year to complete the report, and that's pushing that out even further, and rulemaking, as a result. The industry is more than willing to participate in this kind of activity, if we can do it on a very early start, and actually work through things quickly and get some resolution. We would be happy to provide our experts to participate and look at HRA, maybe a new way to do it, as long as it -- as long as we get some early indication that we're actually being successful.

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As you know, we've submitted a letter to the Commission yesterday, asking them to delay their vote, which is due today on the staff SECY. We've asked them to delay it for 30 days. And the reason we did that is we wanted to have a good feel about how positive or negative this workshop was going to be, because once the plan is approved, it goes completely out of the staff's draft report and this workshop. I think the jury is still out, so we're looking for some positive feedback and getting a face-to-face meeting on HRA, say, in the next two to three weeks. And working our way through these issues to some level of resolution would give us that kind of certainty that we need to respond to the Commission before that 30-day period is up.

On heavy loads, again, we're looking for something in hand, some actual final decision. We still believe that that's an easy issue to deal with and we would ask the staff, you know, to maybe even as a show of good faith, to get back to us in a couple of weeks and give us the details of the credit that they intend to give for not only 0612 implementation, but those areas of upper bound concerns that Bill Henries talked about, as well.

On seismic, I am optimistic there. The industry has an action to propose a screening checklist, like Goutam suggested, and Bill Henries has talked to Goutam and will work with him. We hope to have a first cut of that to you in a couple, three weeks tops.

I've heard, maybe more inside discussions than anything else, that perhaps there are some resource restraints, as far as, you know, having to risk inform decommissioning, as well as doing other risk inform work for the Commission and the staff. I'd like to offer that if the staff will provide us with your model, we will be happy to do the leg work of requantifying that on whatever inputs you give us. And we, as we said at the beginning of the workshop, are going to provide you a report anyway that talks about the substance of what Ed Burns provided. He's already

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done requantification, to the extent that we can, in understanding the model up to this point. And even if you don't want to take advantage of the offer, I think it will still be nice to give us the model, so we can provide a more accurate response to the -- or more accurate report on what we think is an appropriate requantification.

And along those lines, in general, whether it's a seismic or heavy loads or HRA or whatever, I think we might all benefit from identifying what you might call a tiger team or something to -- composed of the industry and the NRC and any other stakeholders that are interested. Let's attack these problems and run them to ground right away. I don't think it serves anybody to let it drag out. We'd all hate to get to the point six months down the road, where we've not converged, but, in fact, diverged on our support for what's in the staff's final report.

So, in summary, we feel that we've provided sufficient information, in our minds, to provide a more accurate assessment of the risk presented in the staff's draft report. And we think that that risk, or those probabilities anyway, are on the order of a couple of orders of magnitude below what the draft report says today. We think that the staff model is good. We think it's real good, as a matter of fact. But, as we indicated up front, that the assumptions, themselves, have some severe flaws associated with it. But, you know, nonetheless, rather than waiting for going out to peer groups or independent review or something, to get it corrected, that's why we came into the workshop with these commitments, so that the staff can feel comfortable in modifying the assumptions that make up the model. And we think that's fairly straightforward to do and achievable.

We will reluctantly support an HRA approach, if we can do that quickly; but, we really believe that all that needs to be done is to go back and understand what we're willing to commit to and then plug that

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1 into the existing model. And we would hope that we could continue to work
2 with the staff and very closely, to get some early comfort level. What
3 seems to be the positive strides we've made in this workshop are really
4 there and we keep achieving those as quickly as we can, to provide a real
5 risk informed basis for decommissioning.
6 Thank you.
7 MR. CAMERON: Okay. Thank you, Mike, and thanks for some
8 detailed proposals here. What we're going to do now is hear from Brian
9 Sheron.
10 MR. HOLAHAN: I'd like to hear some more public input, before
11 we go to the staff.
12 MR. CAMERON: I think we -- I think it might be better to hear
13 from Brian and then let's get input -- and Brian, you be the judge of this
14 -- and then to go into a discussion on these issues. I mean, we can use
15 the industry proposals to frame the discussion. But, you might want to
16 offer some general thoughts first. But, we can go into a general
17 discussion of this, if you'd like.
18 MR. SHERON: No. Let me -- yeah, let me, I guess, give my
19 perspective. I did not have the benefit of being here yesterday afternoon
20 or early this morning. I do want to thank everyone, the industry, their
21 stakeholders, for participating. I guess I had a little different
22 perspective on this than Mr. Meisner did. First off, is that, you know,
23 having been in the agency for 23 years, the way we operate is not to make
24 instant decisions at meetings like this. We never had and I doubt if we
25 ever will.
We have just received the industry information at this
meeting, I think, or I think shortly before. It's not a matter of
somebody coming in and giving us numbers and the staff going, yeah, you're
right; we'll fix everything. We need to look at it. We need to test it,
make sure that it can withstand technical scrutiny. At the point when we

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are -- we can accept it, then, yes, we can, obviously, use it.

My understanding of going into this meeting, from the previous -- when we had the meeting down in Rockville, in the ACRS meeting room, was that this was going to be an information gathering meeting. We provided the draft report that we had at the time. The idea was that this meeting was for the industry to provide us information, where they felt, for example, some of our numbers or the like were wrong or they had other numbers, as well as other stakeholders, if they had comments. The way we operate is we take all this information, we go back, and we will look it over. And to the extent that, as I said before, that we feel it's valid and defensible, we certainly will use it. In areas where I think there are still question marks, I will propose that we need to pursue further how to resolve what the differences are.

I guess, basically, I don't share the optimism, in the sense that the industry has -- you know, all of your numbers are right and all we have to do is stick them in. We perform an independent assessment. Obviously, we disagreed with the industry in the past in areas and there's nothing wrong with reasonable people disagreeing.

Nonetheless, I think a lot of progress was made, in my mind, at the meeting. We got a lot of information. We learned where some of the hard spots are. We learned where there may be areas of where we do agree. I think that basically what we need to do now, as Mike said, is figure out how we go forward, to try to either resolve these issues or agree to disagree on certain issues. The areas I think you've pointed out -- I do want to make one observation. I kind of picked it up when I was sitting in the back there, and that is that when the NRC resolves a generic issue, such as heavy loads, in the past, you need to understand what that resolution means, in generic issue space, is that the staff assessed it and either could or could not support some sort of a backfit. And if there was a backfit that was required, typically what that does is

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it reduces the risk to an acceptable level, based on a cost benefit analysis, if it's not a compliance issue, for example. It doesn't make the risk go to zero. And in my mind, I guess, that the fact that we may have resolved some generic issues in the past doesn't mean the risk is zero from them.

And when we're looking at a risk informed approach, we're looking at an integral here. We're not just looking at heavy loads, we're looking at seismic, we're looking at a whole bunch of other things. And you've got to add them all up and see what the integral risk is. And so the fact that one issue may have been resolved doesn't mean that the risk is zero. And unless it's something where you might say the risk was so low that it's down in that truncation error with the PRA, we just can't say that because it was solved, we don't have to consider it. We consider it. If the risk is indeed low, then I think the PRA, itself, would probably show that it's a no, never mind. But, it's not something that we can a priori right off and say the staff resolved this in 1985 with some generic issue; therefore, we don't even consider it. We still need to look at it, and that's true for all the issues.

With that, I think I don't agree that we're going to turn HRA into a research project. I'm not sure where that perception came from. While there may be more confirmatory work needed, that's NRC's business whether we do that or not. Our plan right now is to try and figure out a way to gather the experts, the HRA experts, in a short period of time, within 30 days or so, a couple of weeks, as fast as we can get them, you know, in the same room at the same time, to address this -- that issue. And, hopefully, they will achieve some sort of resolution, what the right numbers are and the like. Our plan right now is to still complete this report by the end of the year, as a draft -- as a final draft.

I think that where we need to go now is to identify where are the other hard spots and how do we -- how do we deal with them. Do we

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convene, for example, a group of experts on thermohydraulics, if there are thermohydraulics issues? We need to define what the specific issues are, what the specific disagreements might be, and then convene the right group of experts, to sit down and try and either come to a resolution and agreement, or to at least identify where the disagreements are.

But, you know, in closing, I want to leave on a positive note, that I think this was a very valuable workshop. I think it produced a lot of information, a lot of understanding from both sides, where each side is coming from -- I should say both -- all sides, where everyone is coming from, what the concerns are and the like. And I think we should use it as a stepping stone to identify the specific issues that need to be resolved and go forward from there. And I think the next steps in the meeting would be to try to identify those and try to identify what are -- what is the right mechanism to go and address those.

I guess that's really all I had to say, Chip.

MR. CAMERON: Thank you, Brian. I'd like to give Ray and Peter a chance to talk here and, again, along the same vane. I mean, we've been talking about process, okay, and how we move forward. And, of course, Mike put several proposals on the table. I think that Brian has already -- I think, generally, this proposal of requantification, I think we're generally in the same ballpark on how to -- how to handle that, it seems. And we can have -- we can -- people can agree of disagree on that. But, that's one thing that I heard Brian say already that seemed to match.

Let me ask -- let me ask Ray for any comments that he has, at this time, or Peter, in terms of these process types issues of how we move forward. Ray?

MR. SHADIS: Thank you. There's been a good deal made of what the Commissioner's expectations are, in this process. But, I don't find anything written anywhere, as to what their expectations are. If there's a memo or letter or whatever, however you folks communicate, I'd love to

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see it, to see what the Commissioner's expectations are. I have the feeling that what they've done is they sort of ordered up an underwater blimp, difficult, difficult project.

And the realities are that maybe the Commissioners, themselves, need to take another look at what's happening here. Because, this is a construct that is -- that is out of context. You know, we spoke earlier about the narrowed focus of this effort and suggested that there are a lot of other areas that are as important, if not because of their consequences, because of their probabilities, things you're more likely to run into and should be dealt with. But what it really comes down to is trying to get rid of some of the exemptions and it really is only a few of those.

So, I think -- I think what the situation is, is that the regulations and regulators did not anticipate the decommissioning mode of life and we've been trying to, you know, hammer regulations intended for operating plants into a fit for decommissioning. And, you know, if I had an opportunity to meet with management on an individual basis, you know, what I would want to say is maybe you really ought to take a look at the project, potentially deciding to can this project altogether and open up the notion that there really needs to be a special categorization in regulation for decommissioned plants, starting with the data -- fuel.

That's our point of view out in the field. We're very, very confused by the way that Part 50 is being applied in places where Part 72 might be more applicable. So, that's our perspective after all. It's been a series of meetings and it's been, you know, highly educational. I'm sure there's been information that's been exchanged. But, maybe, you're going down the wrong track altogether.

MR. CAMERON: Okay. I've noted your comment. We're going to get a response from Stu.

MR. RICHARDS: There is communication from the Commission. I

1 don't remember, Ray, if you were at the March 17th meeting with the
2 Commission or not, but we sat and told the Commission what we intended to
3 do. I think we're following out that mandate. You can argue about the
4 details, whether we're doing it fast enough or whether we're doing it with
5 the right groups of people. But, nonetheless, we told them that we'd go
6 look at the risk and we'd go look at the process. I can't speak for the
7 Commissioners, but if you read the transcript, I don't remember them
8 having any objection to us doing that.
9 They did ask us to get back to them with a plan to speak of
10 and we did that, with a Commission paper, which we made available to the
11 public, that lays it out, and it's under review by the Commission now.
12 They, also, have responded to us on previous Commission papers. The
13 so-called staff requirement memorandum, I believe those are also made
14 available to the public. And to the degree they have communicated to us,
15 they've encouraged us to look at this integrated approach.
16 I'm a little bit vexed by your comment about your being
17 confused on the regulations and you think we need to go to a -- you know,
18 a new regulation framework, so all the decommissioning regulations are in
19 one place. Because, that's exactly what our Commission paper proposes.
20 We've told people in a couple of meetings before that's what we were
21 proposing to do. So, I think we're doing what you say we need to be doing
22 and, yet, you don't seem to acknowledge that.
23 MR. SHADIS: If I can clarify it for you. It is segmented
24 and, you know, we're now engaged in something that's pretty narrowly
25 focused, as opposed to addressing that whole issue, as a package. That's
the difference in what you're saying and what I'm saying, I think.
Let me ask if -- just to -- maybe you can put my concern away:
is it your perception that the Commissioners would be disappointed at the
pace and schedule of this process?
MR. RICHARDS: I don't think it's proper for us to speculate

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on the Commission's pleasure or displeasure.

MR. SHADIS: Well, I mean, given what -- given what instructions you've been given, you've been told that this is supposed to be a fast track, fast trained production, and -- or, you know, how are we -- how are we approaching this? I don't understand --

MR. RICHARDS: I think the answer is, is that we -- you know, we told the Commission we'd do this in a relatively fast manner at our March 17th meeting. Perhaps, we can get you the transcript of that. Again, I don't remember anybody objecting. But, at the same time, I'm sure that the Commission expects that the staff produce a quality technical product. So, we're not meeting some time frame just to meet a time frame. We're going to do the job, to the degree that we're satisfied with the technical product, whatever that takes.

MR. SHADIS: I appreciate that. I mean, I'm reflecting what I heard from this side of the table earlier, in terms of what Commission expectations are, and I just want to have that clear.

MR. RICHARDS: I want to make sure you understand that this meeting, the last two days, is to address the risk question. There's other efforts going on. I'll say again, it's spelled out in the Commission paper, that we have a separate effort, looking at the framework, the rulemaking, all that is going on in parallel, and is simply not the topic of this workshop.

MR. CAMERON: I think this will be -- this issue will become clearer, in terms of the Commission's response to the paper that was sent up. Peter James Atherton, do you have any process points to say, at this juncture, or do you want to wait until we get into discussion?

MR. ZWOLINSKI: Excuse me, Chip.

MR. CAMERON: Yes.

MR. ZWOLINSKI: May I add to Stu's comments --

MR. CAMERON: All right.

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MR. ZWOLINSKI: -- for context? We proposed to the Commission in the SECY paper some time frame. And it's our expectation that the Commission will come back to the staff with what's called a staff requirements memorandum, and they'll either what we've provided or provide different direction to us. So, their response back to us is rather important, as to are we fulfilling their expectations of us. So, right now, we don't know, and this is the vote that Mr. Meisner alluded to a little bit. That paper was a proposal from the staff that had the larger framework of a game plan. One piece of that, of course, relates to the technical issues that are being today. But, we were talking in macro, as far as the overall game plan in that Commission paper.

MR. SHADIS: Okay. I didn't know. I have a copy of the transcript. I have a copy of the SECY paper. I didn't know if there was some other, you know, written statement regarding the Commissioners attitude toward this. So, I'm pleased to have that -- to have that cleared up.

MR. CAMERON: Okay.

MR. ZWOLINSKI: Very good.

MR. CAMERON: Thank you. Thank you, very much, both of you. Peter, do you have anything to add, at this point?

MR. ATHERTON: If I could, please. Over the last several meetings, I've raised a number of concerns. I've tried to keep them on a generic basis. And I haven't had the opportunity to attend this full two-day meeting. However, I -- it is not obvious to me that these concerns are being looked at. And so, I would like raise them, at this point in time, again, and I'd like to begin with what I talked about concerning the seismic issue, and that is the aging requirements and the qualification requirements for the spent fuel pools concrete and liner and the racks. This issue was raised by Mr. Kennedy and we discussed it earlier today.

Per your suggestion, Mr. Cameron, I spoke to him out of -- off the record, in order to try to identify the possibility that there were concerns, which needed to be addressed. And Mr. -- I do not like to paraphrase somebody else's comments off the record, but let me say that there is a concern with the aging requirements upon concrete, especially when it comes to temperature. Concrete does not cure continuously over a hundred year period. It does cure over several years, at the most. And as a result of that, the -- what is NRC doing to take into account the degradation of this spent fuel pool with time, in developing its probabilistic numbers? And I would ask NRC to take this into account.

MR. CAMERON: Okay. We -- I'm going to note that. Do you have some more?

MR. ATHERTON: I have; if I could, please. My concern, when I lend my services as, which are in the nuclear engineering and electrical engineering end of the line, to the citizens, who seek that type of help, on whether or not there is a danger of radiation to the environment. And I tried to work towards the radiation danger from the environmental point of view. I have raised the issue of criticality, which was not a subject of this session today, and I'm in the process of communicating with a member of NRC about that very issue. It doesn't appear to be a major concern with anyone, at this point in time, except that I'm trying to find out why that is the case and I'm looking for written sources of information, which make criticality in the spent fuel pool a non-issue. And I'm working on that separately.

The scenario of approaching the accident analysis and the consequences or the failure modes and affects analysis, as it used to be in my day in the 1970s, when I worked for the Commission, took into account first and foremost the worst case criteria. And it appears that one of the worst case scenarios, in this case, would be draining of the spent fuel pool, and despite some people's attempts to keep -- to keep the

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spent fuel pool covered with water. The consequences to the public of the worst case accident that could occur, as a result of that, needs to be addressed from a probabilistic perspective, taking into account what the causal factor is and taking into account appropriate probability numbers that are more realistic.

It would seem to me, from a purely logical perspective, that in order to make probabilistic numbers real, it would help to know what, for instance, the probability was or is, depending upon how many different calculations you would perform, at the Three Mile Island nuclear power plant partial core meltdown in 1979 would have occurred. I have not spoken to some people and I have not seen any number or series of different numbers, which tell me what that probability is. Now, that accident did, in fact, happen and that probability would be a real life number that we could use as some sort of a basis to determine what probabilistic cutoff point would be for something that would be negligible and didn't have to be looked at. The number ten to the minus six was put forth for the first time, as I learned it in the Rasmussen study and is being bounced around here today. But the Rasmussen study in the mid 1970s was before the Three Mile Island accident.

We've also had several other accidents, nowhere near as serious in this country, and we could also determine what the probabilistic numbers would be for that type of an accident. We would then have probabilities of real time accidents, which we could then use as some sort of a basis to set a cutoff point. I haven't -- I haven't seen a basis for the ten to the minus six number. And so, I question why we're accepting that, or we seem to be accepting that, and I have been informed that NRS is not set on that number, ten to the minus six, if I interpreted Mr. Kelly correctly.

MR. CAMERON: Okay. There's some -- because, we do -- I'm not trying to minimize your concerns. In fact, we're putting them up there

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and I think that these are going to be addressed. But, I really do want to make sure that we get back to these process issues, in terms of the path forward here. So, if you have some other issues, could you just give them to us quickly and I'll put them up there.

MR. ATHERTON: I am concerned that nobody else seems to be concerned about whether or not the NRC would accept a total blackout condition, as an acceptable scenario, considering any kind of an accident, without having some sort of a process whereby you could get at least some lights made available in the spent fuel pool area.

The philosophy behind that, without looking into the numbers, has me -- we have, for instance, station blackout condition requirements specified in the code. The instrumentation and control branches, when I used to work at the NRC, would not permit, without safety system backup, any sort of power loss requirement in a safety-related area.

They didn't have jurisdiction over the spent fuel pool at that time, and it seems to me that you would want to have -- you would want to be able to see what is happening in the spent fuel pool in the event of any postulated accident.

MR. CAMERON: Okay. I think that what I would like to do, Peter, is have Rich Barrett one constructive word of response to you, and then I want to get on to this process issue again.

Rich.

MR. BARRETT: Peter, I have been listening very carefully and taking notes here, and I know that, as you said, you are dealing with other members of the staff regarding criticality. But the issues that you have raised, you raised after the criticality issue. The issues related to worst case, draining of the pool, where the 10 to the minus 6 number comes from the relevancy of the TMI, the probability estimates, and the question of whether or not the NRC would accept a blackout condition, I think we have a lot of discussion in the report on that issue, and we had

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a fair bit of discussion yesterday that was relevant to that issue.

And I think what might be useful is, you know, after this session, if we could spend a little bit of time, I could certainly spend some time with you and at least give the NRC's perspectives on those -- current perspectives on those questions and how those questions relate to what we are proposing to do as next steps, if that would be useful to you.

MR. ATHERTON: Whatever you suggest would be helpful to me.

MR. CAMERON: Okay. Thank you very much. And thanks for putting those concerns on the table, Peter.

I guess I would like to find out now, so that -- because I think that it is fair when there is a proposal on the table to find out what the perspectives on that might be. We have some proposals that Mike made. Can Gary or Brian, John, the NRC staff, what do you think of these proposals?

And I have already tried to, and maybe wrongly, say that there was some convergence between Brian and Mike on looking into quantifying -- requantifying the HRA aspects of the model. There may be a difference in the time schedule, though.

Gary, can I go to you for this?

MR. HOLAHAN: Yeah. I took notes and I marked mine as to how I thought we ought to proceed. I will turn back and forth to see whether yours are lined up with mine.

With respect to near-term step-by-step plan and schedule, I think that is a reasonable thing to do. We normally do these sorts of things. I think what you are suggesting is you want to see, you know, that sort of thing. We don't always publish that level of detailed plans. But since this is a rather interactive exercise with stakeholders, I think for planning purposes, I think that is fine, we should -- we will go ahead and do that.

I captured a separate issue that said you were thinking of

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periodic meetings with management and I think you ought to take that up with Brian or Sam, because I don't think you mean me. So, it is okay with me if you meet with them. And whatever --

MR. SHERON: I don't think we have any problem with periodic meetings.

MR. HOLAHAN: Yeah. If those are going to be technical meetings, then I presume stakeholders and notices and all of that ought to be -- the normal process will be followed.

MR. CAMERON: HRA aspects.

MR. HOLAHAN: No, heavy loads. Are you going to -- okay. Well, okay, let me go to the HRA.

What I heard was Mr. Meisner say that the industry was reluctantly willing to support the HRA effort. It is not what he wants, but he is willing to do it.

MR. MEISNER: Given that it is done in a short period of time. Although we still believe what you need to do is just go back and change the assumptions in your current model.

MR. HOLAHAN: Yes, that is my understanding. And I think I would propose, therefore, to go ahead and do what we proposed on this stage, which includes attempt --

MR. CAMERON: Put there up on there, please.

MR. HOLAHAN: Yeah.

MR. CAMERON: All right. Here, give everybody a chance. You had a handout. Take a look at this. The only difference might be here the timeframe in which it is done.

MR. HOLAHAN: And there is a timeframe on the bottom, basically saying we would like to take whatever requantification or re-evaluation of the non-PRA issues, any other input like thermal-hydraulic analysis, information that the -- particularly about the licensees, about their programs and how they run the plants, and provide

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that to a collective of HRA experts, which we will take the initiative to bring together, and to the extent that it is possible and practical, we will take the results from those experts and as they advise us to requantify or to put bounds on given values, we will go ahead and do that, and reflect that in our final report.

As it says, you know, we will make an attempt to get that started, or as far as we can get within 30 days, and as a goal, we would like it not to derail, you know, our ongoing effort to get this report done. We would like it to be done as an integral part and on the current schedule. If that is possible, you know, we will attempt to do that.

MR. CAMERON: Let me ask -- let me go to Mike now. Mike, your response to that, to the staff proposal.

MR. MEISNER: I think the key area we disagree is in Number 4. We think requantification is feasible under all conditions and that the staff's model in the draft report needs to be requantified.

MR. CAMERON: But do you have any objection to having a panel, a collection -- I guess I always wanted to know, like a covey, I guess HRA experts are probably travel and collections, but do you have any objection to -- I mean it is sort of similar to yours, to convening experts to try to talk about it.

MR. HOLAHAN: They travel in random patterns.

[Laughter.]

MR. CAMERON: Random.

MR. MEISNER: Sort of like Brownian motion.

MR. CAMERON: All right.

MR. MEISNER: No, and I think, you know, I am sure the staff will make an effort to get truly independent folks, objective people in there. We would like to participate with our experts.

But, again, if this -- if the first meeting leads to, geez, we need to make a long-term study of this, then we miss the point. And we

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think any results need to be factored back into the staff's draft model.

MR. CAMERON: Okay. So noted. I put a deviation up here, HRA staff proposal acceptable.

Gary. Any notes?

MR. HOLAHAN: Yeah. You can say reluctantly, if you like. But I think that is the path we are moving down.

MR. CAMERON: All right.

MR. HOLAHAN: Okay. Heavy loads, I understand that you would like some final feedback on your proposal to -- or early feedback, a few weeks, on coming to closure on use of the, you know, work that was done under 0612 and, you know, whether we can close the issue on that basis. And I think that is a fair request. We ought to be able to decide shortly whether that is the path we are going to go down, or whether that is closed or not and give you feedback.

MR. MEISNER: Just to be clear, Gary, I am not looking to close any issue. What we are looking for is the explicit credit in the model, both for 0612 implementation and the upper bound concerns that we proposed. So we would like to see -- we would like to see the model requantified for heavy loads.

MR. CAMERON: And is that what you are saying, Gary?

MR. HOLAHAN: I am saying we can give him that decision in a short period of time, yeah. I can't tell you today what the numbers are going to be. I hear your input and, you know, we are going to go back and look at 0612.

MR. CAMERON: Okay. I am going to put a caveat on there then.

MR. HOLAHAN: The caveat is that Kelly wants to comment.

MR. KELLY: The comment that I wanted to make, because I think -- I actually got an opportunity to speak to Mike at lunch time, and I wanted to make clear one of my concerns about these numbers, which I haven't had the chance to communicate to Gary, and I just wanted to put

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everybody on the same page here so we have an opportunity to understand.

In performing the 1353 analysis, that analysis was performed on the basis of looking at whether there was enough risk such that on a -- there would be enough money there in order to perform a backfit analysis. Now, it turned out that the basic case came in at something like 10 to the minus 6 per year. It ended up being like $33,000 per man rem, which was way too high, and there was no way that at that point it was going to be worthwhile doing anything.

So if you gave a person three orders of magnitude, one order of magnitude, or 22 orders of magnitude credit for doing 0612, it made no difference because if you said the risk went to zero, there still wasn't enough money there to do anything. So the fact that we came up with a number of three orders of magnitude is not necessarily reflective of the real worth of the -- as far as decades of reduction and risk for heavy load. It might be four orders of magnitude, but the values that we did there did not have to be done to any great precision. The fact that we gave, you know, one order or 22 orders of magnitude made no difference to the final result.

So, therefore, it is going to be hard -- you know, I don't know how quickly we can go back and look at that and determine that number. And that is the only thing I wanted to caution you about from my standpoint.

MR. CAMERON: But certainly that would factor into -- the staff is going to take a look at that and come back with a decision or we need the longer period of time, or whatever. Is that correct?

MR. HOLAHAN: What I heard from Mr. Meisner was a desire for early feedback on how we were going to close that issue, and I think he said within a few weeks. And, you know, I still think we ought to be able to do that. I mean I understand there are some questions to go back and say, why were the numbers picked the way they were? Yeah. But, you know,

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we ought to be able to identify the closure path.

MR. CAMERON: So, it is not a decision in terms of how much -- necessarily a decision on how much credit is going to be given, but a decision as to how this will be closed?

MR. HOLAHAN: Well, but the number might fall out immediately on that. If we look back and, in fact, we say, oh, now I understand why they did, and we are comfortable with that answer, then the numbers are immediately available.

MR. CAMERON: All right.

MR. HOLAHAN: Okay. And if they are not, then I think all that is being asked for is to, you know, tell people what our story is.

MR. CAMERON: Okay.

MR. HOLAHAN: Okay.

MR. CAMERON: Proposed checklist for seismic.

MR. HOLAHAN: Yes. I think we said this morning that that was a good idea. That would be a welcome proposal as part of the addressed the seismic area.

MR. CAMERON: Okay. And, Mike, if you have -- we have one more issue, which is the tiger teams. Do you want to wait till you hear --

MR. HOLAHAN: No, I have two more issues.

MR. CAMERON: Oh, you have two more.

MR. HOLAHAN: I heard a reiteration that there would be the PRA reports sent to us in a few weeks. I think, in fact, we would like to get that. That would be useful, which I think you referred to as the Ed Burns report.

Then I heard a request to have the PRA model available so that you could manipulate it or in fact use as a way of looking at the probability numbers. I don't see any reason why it can't be made available. I don't know whether there are any questions about

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compatibility between, you know, what versions of the code, who is running which sort of codes these days on which sort of machines.

I would just suggest that, you know, this is public work that we are doing. Anyone who wants to do this sort of thing, let's get together with Mr. Kelly and look at the practicalities of, is this a matter of data on a disk to hand back and forth?

You know, the structure and the numbers seem to me to already be in the report. Right. The models.

The reality is that we have the fault trees on NUPRA and the event trees are all hand-calculated.

MR. CHEOK: No, it is not.

MR. HOLAHAN: Well, did I get it wrong, Mike? Okay. Mike did it.

MR. CAMERON: Mike, just identify yourself for the stenographer.

MR. CHEOK: Mike Cheok from the staff.

MR. CAMERON: Thank you.

MR. CHEOK: The event trees and fault trees and everything else is in the NURPA model. It is all quantified using the model. What we can provide to you guys is a sets compatible format that you can import to any code you want. Or you can use the NUPRA input, if you like.

MR. HOLAHAN: Okay.

MR. CAMERON: Okay.

MR. HOLAHAN: Okay. So anyone who is interested in having that level of detail so they can manipulate the model or do sensitivity studies or that sort of thing, just let us know and we will work that out. I might try it myself just for fun.

Well, the data is not proprietary, okay. You know, it may require someone to have one or another version of a PRA code, okay. We are not going to give them a PRA code, we will just provide them the data.

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Tiger teams, I thought was the next issue.

MR. CAMERON: Yeah, it is.

MR. HOLAHAN: I don't know whether I agree with that or not, because I am not sure what it means. If it means that we are going to work hard on this and have contacts available so that we will meet periodically or share information, that's fine. If it means that we are going to send people off, industry and the staff, privately, to resolve these issues, we don't do things that way. So, in concept, focusing on the issues and getting them resolved early, yes, we are interested in that. I am not sure exactly how you envision that to work out.

MR. CAMERON: Mike.

MR. MEISNER: I think it was closer to the former that you mentioned, which implies some level of communication.

MR. CAMERON: And it was inclusive of other interests, too, as you stated.

MR. HOLAHAN: Yeah. I think, you know, we I think have already identified or we can identify key staff who are working on individual areas. You know, if we want to have, for example, Mr. Atherton is interested in the criticality, and we have set up, you know, meetings on that subject. You know, we can go ahead and do that. Okay. We can have targeted meetings on individual areas where -- you know, to resolve issues quickly or to identify what it needs to do next. You know, it doesn't need, you know, for all the management to get together and have a big workshop just to go to the next issue.

MR. MEISNER: Right. Until we meet.

MR. HOLAHAN: Right. That's fine. Okay.

MR. CAMERON: So it is -- the understanding is targeted meetings on specific issues.

MR. HOLAHAN: Yeah.

MR. CAMERON: All right.

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MR. HOLAHAN: And what I would expect is that we would notify, you know, various stakeholders. In fact, most of us, I would think, wouldn't want to show up at the technical meetings at this sort of level. We will just let the technical people do their job and report back on whatever they found.

I think most of the other things I heard I think are already captured one place or another on their flip chart from earlier. I am not sure what was said about the issue of potential aging degradation in the seismic area. I think that topic can be addressed in the report. You know, whether or not we consider an important area that makes a difference, there is no reason why it shouldn't be addressed.

It can be discussed. The issue of concrete and its strength over time, and degradation mechanism, I think can be addressed. I am inclined to commit to do that, even though the people who would do it are not here.

Criticality, I think we have already made a commitment to have discussions with Mr. Atherton, and I think his other issues, Dr. Barrett is going to speak to him about. And maybe we should go back and look --

MR. CAMERON: Yeah. Let's run through these. That is a good idea, because there were a whole bunch of things that I think we agreed to on our way here.

The first points involve Citizens Awareness Network, New England Coalition on Nuclear Pollution. We do have New England Coalition on Nuclear Pollution, but we will make sure that on this list is Citizens Awareness Network.

We talked about security safeguards. And, Gary, we talked about including a safeguards section in the report to explain how we treated that. The same thing with the design basis accident, explained how we treated that, possibly something along the same lines on worker safety.

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MR. HOLAHAN: And, in fact, that may be something similar to what we would do on aging degradation of the spent fuel pool, to have a discussion of why we do what we do. It may not in fact change the numbers.

MR. CAMERON: All right. NEI technical report, well, you just covered that. They are going to send that in within I guess the next couple of weeks or something like that. All right. NRC will evaluate the NEI report. I mean that follows.

Areas beyond the working group study will be addressed in future public meetings, such as organization, QA plan, fitness for duty. These are some of the issues that were raised in a letter from Paul Blanch and I think John put that on there.

SPEAKER: That would be part of the rulemaking process.

MR. CAMERON: And that would be part of the -- let's make it clear, this would be part of the rulemaking process. These broader issues, the broader look that Ray was concerned about.

NRC will notify interested stakeholders of relevant information. In other words, there is going to be things that come out, keep coming out of this process, including meetings, whatever. We will keep people informed.

Stu.

MR. RICHARDS: We are doing it.

MR. CAMERON: All right.

MR. RICHARDS: It is all -- there is a tremendous amount of this stuff on the web site. We have made it available electronically. You know, if you are missing something, let us know, but there has been a tremendous amount of this material made available.

MR. CAMERON: Okay.

MR. RICHARDS: On the web site, send individually to people. I just am --

MR. CAMERON: We are going to keep doing that, and we are going to add Citizens Awareness Network to that.

Stu, if we are sending out information to specific people, put Citizens Awareness Network on that.

Industry, this is Bill Henries will submit information on the pool heatup test for the three New England plants. And that is where we sort of fell off at the edge of the earth, I guess, yesterday.

Then we got to today. Okay. Seismic analysis should include consideration of the impact on the transfer -- I put tunnel -- I think it is tube. Okay. That will be done.

We agreed that the checklist -- now, this is the checklist on seismic that we just talked to. That is the convergence between the differences and estimates of seismic probabilities. It also addresses the -- I put the mean average issue that we were talking about. Does that make sense? Okay.

And NEI is going to provide a proposed checklist. We just dealt with that again.

Heavy leads, assume of 0612 applies and NRC should give appropriate credit for this in the analysis. We have --

MR. HOLAHAN: With early feedback.

MR. CAMERON: With early feedback. Okay.

MR. HOLAHAN: They are also supposed to address the upper bound.

MR. BARRETT: I'm sorry. Would you clarify what you meant by that?

MR. HOLAHAN: In heavy loads analysis, will we address the issue of realistic value versus upper bounds.

MR. BARRETT: Yes.

MR. CAMERON: So we will address realistic values versus upper bounds. All right.

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MR. KELLY: This is Glenn Kelly. I am thinking particularly what we will do there is probably better define why we choose the values that we do choose, and explain what the basis of those values. It may not be that we take -- we have upper bounds 200 and a lower bounds of 50, that we add the two and take it in the middle and say that is a realistic number. It may be that 200 is still the best number, or that 50 is the best number, or that 125 is the best number. But whatever it is, we will explain why we think that is the best number to choose.

MR. BARRETT: Or that 200 is the best number for one kind of plant and 50 is the best number for another kind of plant.

MR. CAMERON: All right. Then the last thing besides our very important industry proposal, NRC response that we just went through, and this is probably very inartfully done -- thermal-hydraulics concerns decrease if licensees intend/are required to maintain procedures, et cetera, et cetera, after the time of the hazard has passed. In other words, like do you need to worry about what the time limit is if these procedures are there? And I think everybody agrees with that, but there is another shoe that is left to fall, which is -- are they going to be applied? I think that Mike indicated yes.

MR. MEISNER: Yes.

MR. CAMERON: All right. John.

MR. HANNON: Yeah, I think if my memory serves, we did say that we would intend to go ahead and attempt to our best ability to complete those thermal-hydraulics calculations, for other reasons. They may be needed to indemnification or, you know, other purposes. So we do intend to complete the thermal-hydraulic calculations.

MR. CAMERON: Okay. And I wasn't trying to send a message otherwise, so that is good that is on the record.

Alan Nelson.

MR. NELSON: I guess we are kind of wrapping up, but I just

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want to, you know, express our appreciation. But in the same vein, I guess the first thing that we will be seeing from you is a form of matrix of activities, and then we can work with you after you have identified teams to be certain things and we can support those with expertise. And we will be working on those actions that have been -- we have agreed to and provide you with them as they become available, such as the seismic checklist, a white paper. And if we can go ahead and have some of the PRA material by Ed Burns and Aaron developed, we will be working toward that.

MR. CAMERON: Let me ask a question of the group. Is this, all of this matrix, okay, how we are going to go forward on all this, will this be in the near-term plan? I mean that would be efficient, but I don't know if that is the intent.

Gary? Anybody, any response on that?

MR. HOLAHAN: It sounds reasonable.

MR. CAMERON: All right.

MR. HOLAHAN: It seems to me we have to right these down anyway for some sort of meeting summary and to use them as part of the planning process.

MR. CAMERON: Okay. Alan, I am sorry I interrupted you here.

MR. NELSON: Well, I am glad you asked that question, because what we have kind of laid out here in the last half hour or so, or hour, in this process seems to be a little disconnected from what your opening remarks were, Brian. So I was I was wondering if it does --

MR. SHERON: In what sense?

MR. NELSON: Well, you had said that this is not typical of the way you do business. You usually take the information in. You thought this was a fact finding and then we are going to go ahead and do what we normally do, and then we will get back to you with some sort of, you know, kind of results, unless I misinterpreted what you had to say.

MR. SHERON: Yeah. I was not trying to imply that the next

step might not be follow-up meetings. Okay. What I was trying to say was that we don't take information that is presented at a meeting and make an instant decision, i.e., yes, we agree, we will put this in our model and our data is no good or something like that. Okay. We just don't -- we don't operate like that.

We have got to go back. Okay. We assess, we analyze, et cetera. What I am kind of looking for is, in terms of the next step here, I guess what I am hearing is that the staff is to put together sort of a plan with a matrix of what issues need to addressed and how, and that is fine. I think what we need to is know who the contacts are that want to be involved then, because, obviously, the next step will be to set up meetings to discuss these specific issues, you know, whether it is thermal-hydraulics, heavy load, you name it, okay, and we are going to get, obviously, experts in smaller meetings.

Do we know how fast we can get this plan out on how to proceed? That is what sort of bothers me. Getting anything out of the agency sometimes is a, you know, bureaucratic nightmare. And I am wondering whether we should identify what these meetings are right now and identify contacts, and then they can start the process. Even though we are developing a plan, if we can agree that there are certain meetings that ought to go forward fairly quick.

MR. NELSON: Let me just ask if you can put out a draft plan to me. I will put the assignments from at least the industry's side on the plan, so that when it is published -- well, I mean officially, you know, as a final plan, then you will have all the names, part and parcel part of the plan.

MR. SHERON: Yeah. Well, I mean if we put anything out it will in the public documents and so forth, and we will make sure that all stakeholders get it. But, again, is there something we should be doing right now? That is my question.

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MR. HOLAHAN: Well, let's see, the people who are going to have to do the work have something to say. It is always good to listen to them.

MR. HUBBARD: George Hubbard. Brian, with regard to your question, is there something we should be doing right now? I think the answer is no. We have a meeting scheduled Monday with the staff, those that have been in attendance at the workshop to see what are the things we need to do, what are the next steps, and see how that affects the schedule that we had set up previously.

MR. NELSON: We can wait till Tuesday.

[Laughter.]

MR. CAMERON: Okay. Thank you, that was a useful clarification.

Gary, you have something else to say here?

MR. HOLAHAN: Yes. There is an issue that came up more than once, and it never got on the board. And it is maybe because it was very general and not a specific issue, but I am not sure I want to walk away from without thinking about it a little bit. And that is, Mr. Shadis commented a number of times that in order to do any of this you really need to understand what goes on when a plant is decommissioning. And I think most of us who are working on this don't have that complete an understanding of everything that goes on during decommissioning.

We sent Mr. Kelly out to look at a collection of plants. I think that was a very valuable activity. He brought back some information and some ideas about what is going on, and an understanding of the context of all that. I think it was valuable.

So I think we may need to do something to make sure that the staff, and maybe even some of the management who are dealing with these issues really do have a full understanding of what it really means for a plant to be in decommissioning.

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MR. CAMERON: Mike, do you have a suggestion on this?

MR. MEISNER: Yeah, I do. The people in the NRC that really know almost day-to-day what is going on out at the plants are regional inspection staff. You know, while we may not have a permanent resident inspector at some of these sites anymore, we get people coming out all the time, teams of people, and they know intimately what we are doing. So my recommendation would be get those guys involved. If you have specific questions, have them check it out. And I think you would get a real warm feeling as to what goes on at the plants.

MR. HOLAHAN: Thank you.

MR. CAMERON: All right. It has been I think a productive two days, and I think you have really worked hard to get some really specific proposals here for a path forward. And in my view, it looks like we are pretty much done. I don't know if anybody has any pressing items.

And, Rich, you are going to get together with Peter James Atherton after this?

MR. BARRETT: Yes.

MR. CAMERON: And I guess I would just thank you for being a good group of people to work with. And I was going to say we are adjourned, but George has some pressing need to do something here. So --

MR. HUBBARD: The one action item, and it may have come up when I went out and down the way, was yesterday I think there was some discussion with regard to heat loads and that some of the plants had done actual heat balances.

MR. CAMERON: It is on.

MR. HUBBARD: Okay.

MR. CAMERON: Yeah. Bill Henries is going to get us that. All right.

Gary.

MR. HOLAHAN: I think before we go, we ought to thank Mr.

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Cameron for putting up with all of us for two days.

[Applause.]

MR. CAMERON: All right. I guess we are adjourned then.

[Whereupon, at 5:13 p.m., the workshop was concluded.]