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NUCLEAR REGULATORY COMMISSION

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MEETING OF THE SUBCOMMITTEES ON HUMAN FACTORS

AND RELIABILITY AND PROBABILISTIC

RISK ASSESSMENT

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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WEDNESDAY

JUNE 28, 2006

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ROCKVILLE, MARYLAND

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The Subcommittee meeting convened at the Nuclear Regulatory Commission, Two White Flint North, Room T-2B3, 11545 Rockville Pike, Rockville, Maryland, at 8:30 a.m., George E. Apostolakis and Mario Bonaca, Chairs, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

GEORGE E. APOSTOLAKIS	Chair (PRA)
MARIO BONACA	Chair (HFR)
THOMAS S. KRESS	ACRS Member

SUBCOMMITTEE MEMBERS PRESENT (CONTINUED):

WILLIAM J. SHACK	ACRS Vice-Chair

ACRS STAFF PRESENT:

Eric A. Thornsbury

NRR STAFF PRESENT:

Susan Cooper	RES/DRASP
Erasmia Lois	RES
John Monninger	RES/DRASP
Gareth Parry	DRA
Nathan Sae	RES/DRASP

ALSO PRESENT:

John Forester	Sandia National Lab
Bob Fuld	Westinghouse
Jeff Julius	Scientech
Alan Kolaczkowski	SAIC

AGENDA ITEMS

P R O C E E D I N G S

(8:34 a.m.)

CHAIR APOSTOLAKIS: The meeting will now come to order. This is a meeting of the Advisory Committee on Reactor Safeguards Joint Subcommittees on Human Factors and Reliability and Probabilistic Risk Assessment.

I am George Apostolakis, Chairman of the Reliability and Probabilistic Risk Assessment Subcommittee. Members in attendance are Mario Bonaca, Chairman of the Human Factor Subcommittee, William Shack and Tom Kress.

The purpose of this meeting is to review issues related to the Agency's current research on human reliability analysis, including the ATHEANA User's Guide, the application of ATHEANA to pressurized thermal shock, public comments on the HRA methods evaluation NUREG and the treatment by HRAs of the time to complete tasks.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full Committee.

Eric Thornsbury is the Designated Federal Official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on May 25, 2006.

A transcript of portions of the meeting is being kept and will be made available as stated in the Federal Register notice. It is requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have received no requests for time to make oral statements from members of the public regarding today's meeting. We have received a written statement submitted by Mr. Zouhir Elawar, a PRA engineer at Palo Verde Nuclear Generating Station concerning treatment of time in HRA.

We will now proceed with the meeting and I call upon Mr. John Monninger from the Office of Nuclear Regulatory Research to begin the presentations.

MR. MONNINGER: Good morning, Professor Apostolakis and fellow ACRS members. I'm John Monninger. I am the Deputy Director for Probabilistic Risk and Applications in the NRC's Office of Research.

We are very pleased to be here this

morning to discuss with you the staff's continuing efforts to improve or advance the sciences in the evaluation of human performance.

Back in December, December 2005, we had a meeting with the Subcommittee to discuss various HRA areas of interest including the HERA Project, the methods evaluation, and research ongoing at Halden.

Subsequently in February of `06 we had a meeting with the full Committee to discuss the evaluation of HRA methods against the good practices.

You know in that regard, I'd also like to mention that we were very appreciative of the ACRS's review and evaluation of the programs being completed by the Office of Research on support of operating reactors and advance reactors. And in particular, in the areas of PRA risk informed performance-based regulation and a subpart of that, human reliability analysis and human factors.

We very much appreciate the comments and are evaluating them. And look forward to further interactions with the ACRS on those areas.

You know in regards to the discussions of this morning, we have the three topics that you mentioned. Dr. Alan Kolaczkowski from SAIC will present the staff's review or the staff's use of

ATHEANA in evaluating pressurized thermal shock followed up by Dr. Susan Cooper covering the development of the ATHEANA User's Guide and followed up by Dr. Erasmia Lois on the public comments we have received on the evaluation of HRA methods against the good practices.

Anyway, we look forward to a productive meeting with you. And with that, I'll turn it over to Dr. Kolaczkowski from SAIC.

MR. KOLACZKOWSKI: Thanks very much for the title but I'm afraid it is unearned. I only have a masters degree. So I'm not a doctor.

We thought we would start off -- by the way, my name is Alan Kolaczkowski. I work for Science Applications International Corporation. I am a subcontractor to Sandia National Labs who, in turn, is working on a number of the human factors projects for the NRC Office of Research. And I will be presenting the example application of ATHEANA and the pressurized thermal shock analysis.

But first, this will help, I think, also set the stage for understanding the next talk on the ATHEANA User's Guide because you will already have seen an example before that. And it should help in that discussion.

The purpose of the presentation is really multi-fold here: to respond to requests, first of all, by some of the members of the ACRS to see such an example. But as I indicated, its primary purpose is to illustrate the use of ATHEANA and I will show its use both from the qualitative aspects of using ATHEANA as well as the application of the quantitative approach in ATHEANA.

And as I indicated already, it will provide an illustration to better understand the next topic -- the next talk that we will have which is on the ATHEANA User's Guide.

A little bit of historical perspective just as a reminder to the members of the Committee. The NUREG-1624 Rev. 1, which is the current published document on the technical basis in implementing ATHEANA, was published back in May 2000. I can't believe it has been already six years ago.

One thing I should mention about that is that the human error probability quantification technique, as it was used for PTS, was not yet incorporated in that document. The quantification method sort of evolved after that and, in fact, was first tried on the PTS analyses over the course of 2001 to 2005 at various levels of implementation.

Again, a reminder, the pressurized thermal shock work has to do with looking at the risk impact of over cooling -- severe overcooling events. Human plays a role in controlling those overcooling events. And we applied ATHEANA at, again, varying levels on three plant analysis, for Oconee, Beaver Valley, and Palisades. And what I will be talking about today in terms of an example is really illustrative of all three analyses for the most part.

Now the ATHEANA User's Guide is coming along in 2006. What we are trying to do is simplify much of the guidance on doing a prospective analysis that is found in NUREG-1624, making it hopefully easier to use, and one of the things we are trying to do is make sure that the lessons learned from the PTS work are implemented in the guide.

Now this is a very busy slide and I don't -- certainly I'm not going to go through all the points here but it is just illustrative of who was involved in the HRA work. And this just happens to be an example from the Palisades analysis among the three although it is indicative of what also occurred on the other two plant analyses.

The HRA participants are those people that played a role in performing the HRA for the PTS work was a rather wide breadth of personnel and disciplines, PRA/HRA experience operator trainers, et cetera, et cetera. The key point here is that multiple perspectives were used from different people to enrich our knowledge about the scenario context that we were looking at that we had to then apply human failure events to and ultimately estimate human error probabilities.

The other point I want to make is that from an information source perspective, again, a lot of information was gathered in order to perform the HRA aspects of the PTS work. I particularly want to call attention to the fact that we did, for instance, at Palisades go on a plant visit and observed a number of overcooling scenario simulator runs with the actual crews. And, in fact, that was done at all three plants and even at Calvert Cliffs, a fourth plant that at the time we were going to do an analysis on and then decided that we would just generalize the work after that.

But the point here is that considerable detail, including firsthand observations were used to enrich the knowledge to be able to do the human reliability work for the PTS analysis.

The final point I want to make about just the -- before I get into the specifics of the use of ATHEANA, the final point I want to make here is that for the PTS work, the HRA work was done when it could and, in fact, did influence the PRA model structure.

While we started off with PRA models that had come from the early `80s work, the HRA and the PRA work was done in very much of an integrated fashion, hand in hand, and things that came out the HRA work directly effected the actual PRA model structure itself, which was a very good experience. It worked very well. And I think it was beneficial to both sides as far as that goes.

Okay, the first thing I want to do is talk about the first four steps as a group in the ATHEANA process. Much of this -- maybe not all of it but much of it are the type of things that you would do in any HRA analysis anyways.

First we had to, as is indicated in the ATHEANA process, one of the first things you do is sit down and say okay, I've got to define and interpret the issue. What is it I am trying to do? What do I need from the HRA work in terms of, in this case, to assess PTS risk? And in a nutshell, what that really boiled down to was the need to identify, model, and quantify the human failure events for PTS-challenging sequences. That WOULD really sort of set the overall scope of what it was we were trying to accomplish.

In Step 2 of the ATHEANA process, you refine the scope a little bit. For instance, are you going to rule out certain kinds of initiating events for this particular application? Are you going to do internal only? Or are you going to do external events also?

And you can see here a statement of essentially what was involved in terms of the scope of the analysis, again in terms of applying ATHEANA and evaluating the human failure events for the PTS work. We were primarily focusing on internal event initiators but we were looking at both full power as well as at hot zero power types of scenarios.

Now this third step is somewhat unique and I will try to indicate what we mean by base case scenario in a moment by the next slide more by illustration.

But the idea here is that when we are first building the model, you tend to describe what ATHEANA calls base case scenarios. By that we mean sort of simplified scenarios of the basic ways that in this case overcooling could occur. And they would be things like well I understand that obviously a steam line break could cause it. I understand that a LOCA could cause it. And so on and so forth.

And you begin to develop scenarios into your PRA models. Now because overcooling can occur in so many different ways, we didn't have any single base case scenario that we could talk about. Some involved transients with complications such as stuck open atmospheric dump valves or other secondary other kinds of faults, overfeed events, and so on.

Some involve loss of coolant accidents because they, by themselves, cause an overcooling event as far as the primary system is concerned. Steam line breaks can cause severe overcooling. Steam generator tube ruptures depending on the nature and size of the rupture can cause some amount of cooling.

And so we didn't really have any single base case scenario. Really we had a number of them. And because in the case of the Palisades PTS PRA model, which I'm going to talk about in somewhat more detail in this example, because it was already built on previous work coming out of the Oconee analyses, the Beaver Valley analyses, as well as the earlier 1980 work, a lot of the sequences in the models that we started to construct already had what we would call in ATHEANA terminology deviation scenarios.

That is they were scenarios that include the major elements of the base case scenarios but somehow are different. And I want to try to illustrate that point with the next slide.

If one is building a PRA model in this case of an overcooling-type scenario, one might start with what is shown here in the upper event tree, with the simple concept of yes, if I have a steam line break and let's say main feedwater does successfully isolate, which means that I go up this upper branch of the event tree here, then what is going to happen is auxiliary feedwater is likely going to come on. It is going to begin to feed that failed generator that has the steam line break in it.

And one of the things that the operators have to do in typical PWRs is to isolate and terminate the auxiliary feedwater flow so that we don't end up feeding the steam line break and causing a severe overcooling situation.

So a human failure event that we are going to be interested in for these kinds of scenarios is this failure to isolate on the down branch of this event called operator fails to isolate and terminate auxiliary feedwater. Because this is a very simplified representation of sort of a general, if you will, steam line break, what occurs, we would call this, using ATHEANA terminology, a base case scenario.

However what we did, and I will get into this a little bit later in my talk, and that you will see in subsequent steps, as we get into Step 6 or so into the ATHEANA process, we begin to look at this scenario and we begin to ask ourselves the kinds of questions that say could this scenario evolve in different ways that would effect this operator failure event here fail to isolate.

And in the case of -- for instance in the case of the Palisades analysis, after we get into Step 6 and 7, et cetera, we learn that yes, there are some things that the way a steam line break can actually occur that in our judgment would effect how the operators are going to perform given that event and ultimately how that is going to get reflected in the human error probability for that failure.

And, for instance, in the Palisades event tree where we did start off with this basic structure as we were building the PRA model, that structure ultimately turned into this structure which makes some distinctions as to whether the steam line break is occurring inside or outside the containment, whether one or two steam generators are effected by the steam line break because if you look at the cues, what is going on in terms of the plant status, what steps and/or, for that matter, even what EOPs may be involved, emergency operating procedures may be involved, there can be some differences here depending on whether that steam line break is occurring inside containment or outside containment and whether one or two steam generators are effected.

So we actually take this scenario, and because we argue that these two events, the inside or outside containment or one or two steam generators, is going to effect, at least in our judgment, a potentially significant way, what the human performance is going to be in terms of this failure to isolate event back here, we break up the structure and actually develop it and show the structure rather explicitly in the PRA model so that now what was one human failure event turns out to be, if you will, four versions of that human failure event where you would then analyze the first human failure event on the tree, given the context that the steam line break is occurring let's say inside containment to only one steam generator and main feedwater has isolated as opposed to looking at the same human failure event again but in a different context, in this case it is inside containment but two steam generators are effected by the break, and so on.

These are what in ATHEANA terminology we would call deviation scenarios. That is they are deviations or they are different representations of what was a simple model structure initially making some clear distinctions, in this case, as to where the steam line break is actually occurring and how many of the steam generators are effected by the break all because in the ATHEANA analysis and the judgment of the analysts, there is going to be a difference as to what the human error probabilities are going to be. And maybe, for that matter, what may even drive those probabilities because of the different contexts.

CHAIR APOSTOLAKIS: But, I mean, this is all very good but is there an implication here that other methods don't do things like that?

MR. KOLACZKOWSKI: Well I don't think I can give a general answer to that. Clearly though the thought is that to the extent that other methods, when analysts apply them, to the extent they may not think about that there are different ways that, in this case, steam line breaks can occur, certainly there is a chance that people will tend to keep the PRA model structure, as is indicated in the top picture here, will decide a context in terms of what this scenario looks like and then calculate or first of all estimate what are the driving performance-shaping factors given that context and what is the human error probability associated with that. The point is they will assume a context for this.

CHAIR APOSTOLAKIS: But it seems to me though that it really depends on who is doing it. I mean an experienced analyst will probably see the difference of having a break, you know, inside or outside the containment and will consider it. So I'm not trying to diminish the significance --

MR. KOLACZKOWSKI: Oh, no, no, no, no.

CHAIR APOSTOLAKIS: -- of what you doing but I think it will be important also to point out the real differences as we go along.

CHAIR BONACA: Because also, I mean, I would like to say that at the plant, I mean, they are familiar with these scenarios because for deterministic purposes, these kinds of sensitivities are done. I mean they are done in the accident analysis.

MR. KOLACZKOWSKI: I think what is different here -- and I don't know if Susan wants to make a comment -- I think the difference here is that what the ATHEANA process is trying to do though in terms of Step 3 of forcing you to first define what are your base case scenarios and then later on in Step 6 -- so I have sort of jumped ahead a little bit but I want to illustrate the difference between base case scenario and deviation scenario -- I think what the ATHEANA process is trying to do is formalize this process.

It is basically trying to say look, you must think about these sequences -- that the way the PRA illustrates the sequence, maybe really there are multiple ways that can occur. And if one if going to evaluate this human failure event, what ATHEANA is trying to do is formalize the process of think about those different ways that this one sequence can, in fact, occur.

And you have got to think about then when you are going to estimate what are the shaping factors that drive this human failure event and ultimately what is the human error probability. So while other analysts and other methods may or may not do this, the more you leave it up to the analyst to take the method and extend as opposed to in ATHEANA all we are trying to do is say here is a formal step that says you must think about deviations to this scenario.

And I think we are trying to formalize maybe what some very good analysts do anyways but on the other hand what maybe other analysts don't do.

CHAIR APOSTOLAKIS: That's fine. I mean I just wanted to understand better.

MR. KOLACZKOWSKI: Yes?

DR. COOPER: If I could just comment, Susan Cooper, Office of Research.

Alan is correct in the sense that, you know, this is sort of leaping ahead a little bit. But the point is with the top event tree that is shown there, that is typically what is sort of handed off to the HRA analyst. And along with that event tree will be, you know, some information.

The top event tree will be handed off to the HRA analyst. And along with it, they might get some information -- thermal hydraulic information, timing information, so on and so forth -- and as Alan said, typically what the HRA analyst then does is use that information, sort of construct a scenario -- an idea of how things will occur and what is going to be important so far as performance. And then go ahead and quantify.

Now it is possible that the analyst will sort of stumble across, if you will, the fact that there are important subcategories of that scenario that ought to be addressed with separate human failure events. But again, as Alan said, there is no formal process for that. It is basically the experience of the analysts, how closely maybe the HRA and PRA analysts or the thermohydraulic specialists are working together and discussing these kinds of issues.

As Alan said, we formalized and really forced that process on somebody who wants to make that kind of investigation. Because we have a process that doesn't go and say well how, you know, how could this scenario unfold and just leave it at that. We say well, how could the timing be slower or faster for the operator. You know focus in on the things that could change the performance environment for the operator.

How could the cues come in differently? You know what kinds of things would make it more complicated? And so that process then results in, you know, identifying these kinds of breakouts.

Now here the way Alan has shown it, it has become part of the PRA model because, in fact, that is what we are doing. We are adding to the PRA but from the human performance perspective. Those distinctions there may have no relevance, you know, big significance. From the systems point of view, the outcomes could be the same. From the human, the operator point of view, they can be very significant. So that is why they are added.

But if, for some reason, the PRA was already done, they didn't want to modify the event tree structure, that structure would then be taken into part of, you know, directly into the quantification --

CHAIR APOSTOLAKIS: Okay.

DR. COOPER: -- as opposed to being broken out here as parts of the event tree and then basically be the responsibility of the PRA analyst to quantify that.

But here again we are getting into a PRA/HRA modeling issue. What is part of the error forcing context that ATHEANA quantifies versus what is put in the model. But the basic thing to recognize is that we are basically adding to the PRA model. We are adding context to the model.

How it is treated, whether it is put formally and explicitly in the event tree versus folded into the human failure event really doesn't matter because it is the scenario in the end that matters. Make sure you have all the elements.

CHAIR APOSTOLAKIS: Okay. Well, Alan, as

you go along, maybe you can point out where you are formalizing things that others might also do and where you are really different.

MR. KOLACZKOWSKI: Okay. I will try to do that. Clearly, though, again coming back to the point of forcing a base case scenario and then later on jumping ahead trying to then look at, as ATHEANA language deviations of that, is we are trying to formalize that process now.

And, in fact, when we developed in this case the Palisades PTS trees, we did take this basic tree structure and did turn it into this. So we actually did change the model.

CHAIR APOSTOLAKIS: I understand.

MR. KOLACZKOWSKI: Okay.

MEMBER KRESS: So you would then add up those probabilities on the end?

MR. KOLACZKOWSKI: Well, I mean yes, you could. Now if you have actually changed the structure, each one of these is going to have a human error probabilities associated with it and maybe one or more of these will be particularly risk significant and maybe others will not.

MEMBER KRESS: I see.

MR. KOLACZKOWSKI: To some extent it is

going to depend, obviously, thinks like what is the probability of the break being inside versus outside effecting or two steam generators, how much does, in fact, the HEP change what those different context. But maybe one or two of these end up being just the dominate scenario. And that is the one we are really most interested in.

MEMBER SHACK: Well, when the PRA person does this whole thing, I mean he has to decide when to truncate these scenarios because he can keep looking at different scenarios.

And if you are driving the breakdown into the human events kind of thing I mean what is his general statement of -- you know when does he decide he can live with a simplified scenario like the top and, you know, when does he have to go to that finer scenario at the bottom? You are not arguing that the breakdown is always driven by human failure events.

MR. KOLACZKOWSKI: No, not necessarily. I mean obviously the breakdown is dependent somewhat on system overall plant response. And that is how a PRA person kind of does it anyways. I mean otherwise, if main feedwater fails, if the person decides auxiliary feedwater plans an important role in whether core damage occurs and I want to model auxiliary feedwater, well, they model it.

All we are doing here is that we are saying that is fine but to whatever extent you have developed that model, I think what ATHEANA is trying to do is formalize the process of think about the sequences from the operator perspective. And decide whether some additional structure is necessary because you think it is really going to matter. And I think that is the point that we are trying to get across and formalize here.

CHAIR APOSTOLAKIS: By the way, I'd like to keep this as informal as we can so Jeff Julius is here from the industry, I guess, or EPRI. Jeff, feel free to jump in anytime you want and make a comment or whatever, okay?

MR. JULIUS: Sure, thank you.

MR. KOLACZKOWSKI: Okay. So enough on the base case scenario. The point is that there wasn't any single base cases, a lot of ways to cause overcooling. We did start with simple structures. As you will see in later steps, but as I tried to illustrate here now, that those structures became somewhat more complicated when we developed those into deviation scenarios because we were trying to account --

CHAIR APOSTOLAKIS: Alan, would you please remind the people what is the difference between human failure events and unsafe acts?

MR. KOLACZKOWSKI: I will do that, in fact, in a coming slide.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: Okay.

MR. KOLACZKOWSKI: I will.

Now as part of building the structure, of course we have to start deciding well what human failure events are we going to put into the model. And in applying ATHEANA and in terms of its application directly to the PTS work, the approach we used, largely following the ATHEANA process, is we decided what functions of interest are really important to overcooling events.

And it turns out to be these four functions: primary integrity control, secondary pressure control, secondary feed control, and then primary pressure and flow. They kind of go hand in hand control.

And what we did is that at a very high level, we first developed what were the general types of ways that the operators can interact with those four functions. And I don't want to go through these in any detail here but I do want to indicate that in developing these high level general ways that the operator can influence these functions, we thought about them not only from errors of omission point of view but we thought of them from errors from commission point of view.

And just to illustrate that, and using the first column as an example, in terms of primary integrity control, the classic one most people would worry about is the operator fails to isolate an isolable LOCA in some timely manner such as closing a block valve to a stuck open PORV. And, in fact, that kind of event is a classic one we see in core damage type PRAs all the time.

But we also looked at it from the standpoint, we said well how else could the operator interact with this function? Well, the operator could induce a LOCA such as opening a PORV that induces or enhances a cool down. Now eventually you are going to try to make decisions about when might the operator do that in an inappropriate way, et cetera, and so forth. And then those become potential errors.

But the point is we looked at each one of these functions both from an error of omission point of view and an error of commission point of view in developing these -- I'll call them high level, general human failure events that we are going to potentially want to put into the model.

Now ultimately as the process evolved and as the model was constructed and it evolved, these general classes of human failure events eventually became specific human failure events. And I will try to illustrate this by an example.

One of the general HFEs, if you look on the previous slide, is operator fails to stop or throttle or properly align feed in a timely manner. That is a general description of a human failure event. Ultimately as the model evolved, that became, for instance these three very specific events -- the first one, failure to isolate auxiliary feedwater to a faulted steam generator by 30 minutes following a small secondary depressurization event.

Obviously there is some context here that we are talking about. We are talking about a single-faulted steam generator. We have a time now with which we are saying if they fail to do it by this amount of time, the cool down begins to become quite serious. And so it could be a real pressurized thermal shock challenge.

And we are talking about a context that

involves still a small secondary depressurization event such as a single atmospheric dump valve is stuck open or something like that. We are not talking about a huge steam line break.

That event also became in another part of the treat structure, or the overall PRA structure. That event became failure to isolate auxiliary feedwater to a faulted steam generator by 30 minutes following a small secondary depressurization event in conjunction with a primary system LOCA.

Here, the context is changed. We have a primary system loss of coolant accident going on and at the same time, we have a secondary depressurization event occurring. It is a somewhat different context and, therefore, the feeling is is that the drivers that may be the performance-shaping factors that may drive the failure probability and what the failure probability would be, at least there is some potential that it could be significantly different in this context than in this context.

And then finally, failure to isolate auxiliary feedwater to a faulty steam generator by 15 minutes following a large secondary depressurization event. So, again, we start off with these very high-level human failure events and those became very specific, applying to specific context. And the expectation would be that the human error probabilities and the drivers of those may be different depending on which one of these three events we are talking about.

CHAIR APOSTOLAKIS: Who gave you the 15-minute estimate?

MR. KOLACZKOWSKI: That came from the thermohydraulics work.

CHAIR APOSTOLAKIS: And is that cast in stone? I mean is it precise? Is it certain?

MR. KOLACZKOWSKI: No, obviously it has uncertainty. But we had a criteria -- and I don't know if I can recall it offhand but basically what would be the time at which the temperature in the primary in the area of the downcomer would now be going below 400 degrees Fahrenheit or the rate of decrease was dropping at a rate greater than 100 degrees per hour. I believe that was the criteria.

And so these times told us when we had to worry about isolating the auxiliary feedwater because we had exceeded one or both of those criteria.

CHAIR APOSTOLAKIS: Now I remember from the presentations from the overall PTS project that there was a very systematic approach to the uncertainties and all that. So I'm wondering I mean could the 15 minutes be 12 minutes?

MR. KOLACZKOWSKI: Certainly, yes.

CHAIR APOSTOLAKIS: They told you this is a mean value? Or what?

MR. KOLACZKOWSKI: At the time, I think I would say that this was a point estimate curve, a best estimate curve that was developed in terms of what the downcomer response was going to be. A lot of the uncertainty that was done on the thermohydraulics quite frankly came after some of these initial set times were established for modeling.

And the bottom line, as I recall, of that thermohydraulic uncertainty is that a lot of it did not matter that much. But could this, in fact, be 12 minutes or could it be 18 minutes? Yes. Is that kind of preciseness critical to, in this case, the drivers that were calculated in the human error probability? No. I mean because our human response models are not so refined that we could probably tell.

CHAIR APOSTOLAKIS: So it is not critical because the model is not refined not because in real life it might not make a difference.

MR. KOLACZKOWSKI: No but in the sake of the user example, whether it was 10 minutes or 15 minutes from -- well, first of all, from a thermohydraulic -- no, from a human error standpoint, let me back up.

Yes, in terms of our ability to model those differences or our expectations as to whether that would be a big difference, generally these times are not critical. We did run into a few cases where the timing was critical. And in those cases, we would very often have to go back to thermohydraulics and indicate that we needed a more refined analysis, et cetera.

And I think that happened like once or twice where we thought the timing was very critical because whether it was 20 minutes to 30 minutes, for instance, might make all the difference in the world from the human reliability perspective as to whether there was a high likelihood of success or a high likelihood of failure. I think that happened just once or twice.

But there was a feedback mechanism that if we felt that this time was right on the ragged edge of whether something could be significantly successful or fail, then we could go back to thermohydraulics and indicate that we needed an enriched whatever, better estimate, better description of the uncertainty and then typically what we would do in the case of the PTS work, is go with something that was more conservative or, in this case, quicker.

CHAIR APOSTOLAKIS: Well, I mean based on what you just said, it would be interesting to try to understand when and why you decided that in some instances 20 minutes or 30 minutes made a big difference.

MR. KOLACZKOWSKI: I think the short answer to that is that if we were given a time and then later on in the process as we go down into the ATHEANA process we finally get to try to quantify the human error probability or understand the drivers, and we felt that we were at a time where it was going to be -- like I say, we are on that edge where boy if it was much -- if it was just a little longer than this, it would significantly change the success or add to the success rate.

If it was just a little bit shorter than this, the experts felt like boy, all of a sudden, it would just flop the other way and there would be no chance of getting this done in this time, then we knew we were at a very critical time. And then HRA would feed that back to the thermohydraulics and say the time you gave us is -- it is critical that we really understand whether or not you think that it is more likely that you have given us a conservative time and, in fact, it is actually much longer than that or you have given us an optimistic time. And, in fact, it could be shorter than that.

Ask them to re-analyze and have them come back to us with a quote, if you will, a better analyzed estimate so that we knew on which side of that critical point were we on and then go and re-analyze the HRA event. It was a feedback mechanism between HRA to thermohydraulics.

CHAIR APOSTOLAKIS: Okay.

MR. KOLACZKOWSKI: Okay, now talking about unsafe acts. One of the things that we did not do, did not feel the need to do in the PTS work was model the human failures at what ATHEANA calls a more detailed unsafe act level. And, again, I've tried to indicate what the difference is between a human failure event and an unsafe act event in terms of the ATHEANA terminology by an illustration here.

What we did generally in the PTS work was we modeled these human failure events at an overall system or train level such as failure to isolate auxiliary feedwater. You just saw examples in the previous slide of three events. And they start off with failure to isolate auxiliary feedwater in 30 minutes, dah, dah, dah, dah.

And that is at the level that we did the modeling for the PTS work. And, in fact, that would be the level that most PRA events would model the human failure event if this was a core damage type of event tree or PRA.

We did not model at the so-called unsafe act level that by illustration would maybe take this failure to isolate auxiliary feedwater and may break it up into, as an example, failure to close the steam paths and model that separately as failure to close the feed paths because from the auxiliary feedwater perspective, in order to entirely isolate the system, especially if you have a turbine-driven system or turbine system pump in the system, which most plants do, in order to fully isolate auxiliary feedwater, you have to do both.

If you felt that for some reason the operator's failure to close the steam paths was driven by different performance shaping factors, different cues, whatever, than the failure to close the feed paths, then you may in fact model these as two separate events. And using ATHEANA terminology, we would then call those two unsafe acts, they are representative of the overall human failure event, failure to isolate auxiliary feedwater. But because you believe that the operator's ability or success rate of closing the steam paths is somehow different than closing the feed paths based on maybe the cues they use, whatever, then you would potentially model those.

We found little reason to do that in the PTS work. And so I don't know if I can think of any cases but if there were, there were only one or two cases where we might have taken the human failure event and, in fact, broke it down into this finer level of detail which ATHEANA calls unsafe acts. We did not do that, generally speaking, in the PTS work.

Now, the other thing that I should point out is that -- and again, this application of ATHEANA I indicated was at varying levels in the analyses, one of the things that ATHEANA has in it is some tables to help the analysts look for and model potentially important errors of commission.

As I pointed out a couple of slides ago, we have the analysts think about the way the operator can interact with a function not only from an error of omission point of view but from an error of commission point of view. But in reality, we did not, in fact, model a lot of errors of commission largely because the way the procedures are written, the way that most EOPs are written, there are already procedure-directed actions that would cause a cool down. The operator would actually be following the procedure and they would cause a cool down.

Now, of course, what the procedure, if followed correctly, what you are supposed to be doing is performing a -- I'll call it a somewhat a controlled cool down, but nevertheless there are procedure-directed actions that would already cause a cool down, so they are not errors per se, the operator is following the procedure as the procedure directs, but because there were already such acts, we felt that to go through the extra effort of trying to come up with scenarios or versions of scenarios, deviation scenarios, if you will, where it would actually be an error to where the operator would be inappropriately causing a cool down because of some fooled instrumentation or something like that, we did not do a significant search for those because we already had sequences that by their nature procedures would direct the operator to cause further cool downs just following the procedure.

So rather than looking for errors per se, the fact that these are already procedure-directed, we made sure that these procedure-directed actions were modeled and we only did -- I'll call it a limited search -- for errors of commission that we might also want to put into the PTS model.

Now we did put a few. I have some examples here of the types of commission-type events that we did put in the model. The first one is a procedure-directed action and it is one that classical PRAs always have in it and that is initiate once-thru-cooling or, if you will, feed and bleed as some plants call it.

By nature, once you do that, you open the PORVs, you put high pressure injection into the primary system, you are causing a depressurization cool down event by its nature. It is procedure directed. The operator is doing that. Those type of scenarios, those type of events we made sure that those were in the PTS models.

Here is an example of an EOC that we did put into the model, an inappropriate trip of primary coolant pumps or that is what they are called at Palisades, other plants call them reactor coolant pumps, an inappropriate trip of those pumps, that would be an error of commission. It is inappropriate.

They really shouldn't trip the pumps. But we looked at possible scenarios where the operator might do that inadvertently. And that has to do with whether or not you have force flow in the system or whether you have close to stagnant conditions in the system because if you do have stagnant conditions, that worsens the potential for PTS. So we are worried about such events.

Okay, so we have defined our overall scope and, you know, what is the problem we are trying to solve. We have thought about base case scenarios. We have thought about the human failure events that we are going to put into the model. We are beginning to evolve the model, et cetera.

And in Step 5 in the ATHEANA process what we do is we search for factors that could lead to potential vulnerabilities in the sense that what we are really doing, and maybe search is perhaps a little bit of a misleading term here, we are gathering knowledge of the procedures, crew characteristics, operator expectations, plant response, cues that are expected, when they are going to occur, et cetera, operator action tendencies, we are gathering information about all of this, which is going to ultimately have an effect on how the operator is going to perform in various contexts.

And what we are going to be doing is trying to see if in terms of the way the scenario is going to unfold, and particularly later on as we look at deviation scenarios, if we can begin to see what ATHEANA calls mismatches between what the operator would normally do either by following a procedure or because of some operator action tendencies that they have because of the way they have been trained, the differences between that and what is actually required by the scenario, we begin to see some mismatches.

Those are places where aha, maybe, in fact, the operator may have a higher operator failure rate because the scenario is unfolding and the characteristics associated with the scenario is such that it is something outside his normal expectations or it is going to take some advantage of some tendency in an inappropriate way and maybe cause the operator to take an action that we wish the operator did not take.

So this is really a knowledge gathering step basically is what really is involved. And I wanted to try and show what was done by an illustration. And, again, I'm going to use the Palisades analysis as an example.

I want to highlight here that I am indicating only possible concerns. When you are gathering all this knowledge and learning about how the procedures are written, what types of situations they can handle, what are the operator tendencies, and so on, you find out so many positive aspects about operator performance as well. But I'm going to focus on what were our potential concerns when we carried out this step on the Palisades analysis for the PTS work.

And I won't go through all of these in detail but I'll touch on a couple of them for illustration purposes. For example, on Palisades we learned that there is an automatic main feedwater runback system at Palisades. But it is known to be too slow. That is by the time it runs back the main feedwater pumps, it still has caused a considerable amount of cooling in the primary system.

Now they have tried to make up for this by inserting a step very early in the Emergency Operating Procedure 1.0, which would be the initial EOP that they would enter upon a transient situation where the reactor is scrammed, that directs the operator to manually isolate. Basically get ahead of the auto main feedwater runback and manually isolate it on your own because auto feedback just occurs too slowing at Palisades plant.

So this puts greater reliance on main feedwater controlled termination on the operator than it does at some other plants. That is something you recognize. That is something you start thinking about in terms of deciding what human failure events you are going to apply to the model and ultimately how you are going to analyze them.

Another example, entry into other EOPs occurs only after EOP 1.0 is completed. Now this is offset somewhat by some of the steps in the procedure but basically the operators have to go through the entire EOP 1.0 procedure before they then go on to other EOPs which are going to take or direct specific actions that would deal with a potential severe cool down situation.

That means that if the scenario involves in such a way that it could delay the operators getting through EOP 1.0, it is going to delay their getting to these other EOPs, which are going to direct some further actions to take to avoid a very severe cool down event.

So clearly one set of deviation scenarios, if you will, that you are going to want to look at are things where the scenario gets somewhat complicated, causes them to potentially get bogged down in some of the steps in EOP 1.0 so that they don't finish EOP 1.0 until maybe five minutes later than they normally do or ten minutes later than they normally do.

And so that is a class of deviation scenarios they are going to be wanting to potentially pursue to see are there ways that some of these cool down scenarios could evolve that would delay the operators getting through EOP 1.0 so that they don't get to other steps that are still important to PTS.

There are other examples here. I won't go through them in detail. But again, they are illustrative of the kinds of things we learned going through this step that told us something about what are some potential kinds of deviation scenarios that we ought to think about pursuing because they might cause some of these concerns to happen that would slow down operator response or maybe even, in fact, make for an inappropriate operator response at Palisades.

Some more examples, I do just want to indicate a couple here. A few actions may require a very quick response, particularly if you have some events where a rapid primary system re-pressurization occurs, operators have to try to deal with that rapid re-pressurization literally within one or two minutes. It requires very fast diagnostic and response time on the part of the operator. So you are certainly going to be concerned with modeling those kinds of events in the PTS work. I think that is all I will do here.

So out of Step 5, which is this knowledge-gathering process, basically again using Palisades as an example, what was concluded was that we wanted to explore as possible deviation scenarios, scenarios that might defeat or delay main feedwater runback or even cause a main feedwater ramp up because again this auto runback feature is slow and relatively ineffective compared with most other plants or explore scenarios and ways that they might evolve such that they delay the crew in getting through EOP 1.0 and therefore don't get to some of the other steps until five or ten minutes later than they normally would.

That means the cool down continues for ten more minutes than it normally would. And, therefore, we get closer and closer to a very severe PTS challenge.

Look at scenarios that would add to crew workload or go beyond expectations such as involving multiple function failures like a primary system LOCA and a secondary depressurization going on at the same time.

Key instrument unavailability failures, support system failures, what if instrument air is lost at the same time that this reactor trip has occurred that may slow down their ability to get through EOP 1.0, et cetera.

Look at rapid response events -- I showed an example of that already. Combinations of the above, et cetera. The knowledge gained in Step 5 gave us some clues as to what sort of deviation scenarios to look at.

So, in fact, we did that. And in Steps 6, 7, and 8, which I have rolled up here into one or two slides, basically what you are doing now is you are going through a process where you are taking what was those base case scenarios, steam line break, main feedwater isolates, they have to isolate auxiliary feedwater and begin to think about how else could that scenario evolve, how could it evolve differently such that it causes one or more of these situations to occur because then that would be potentially bad from an operator response perspective.

So we explored initiator and sequence progression deviations that would represent different plant conditions such as excessive main feedwater events to one steam generator or to both, whether the break was inside or outside, and so on. And, in fact, some of these we felt were important enough that as we showed you back a number of slides ago, we actually built those different deviation modeling structures into the PRA model itself.

We explored deviations that resulted in -- that looked at what about if support system faults are occurring simultaneously with the transient situation. We explored deviations and resulting plant conditions involving complexities and failures, different timings of events, et cetera.

Now during this process, one of the things that we are doing as we are searching for deviation scenarios, considering these additional complicating factors that could potentially cause a human performance to degrade, we also, at the same time as part of Step 8 in the ATHEANA process, we do think about but could the operator quickly learn that if they do, in fact let's say, make an inappropriate or -- excuse me, perform an unsafe act or do something that we would not want the operator to do.

Are the cues going to be such that it would be easily viewed by the operator that oh, I shouldn't have done that? And they can quickly recover, basically undo what they just did, and that is part of the overall context that we are considering when we think about these deviation scenarios. And if the recovery looks like it is very, very likely, then, in fact, we will probably that is a deviation scenario that isn't worth analyzing because even if they perform the unsafe act of interest, they would quickly recover from it the consequences of performing the initial error would be relatively benign. And, therefore, why bother developing this deviation scenario.

So in 6, 7, and 8, in those steps that is basically what we are doing here.

In the PTS work, we found that as a result, a lot of the postulated deviations are not worth pursuing. You find out that they are not worth modeling either because the context that you are developing is so unlikely that that kind of scenario would never be very risk significant even if the human failure event probability was one. The context is so unlikely that it just isn't worth pursuing that particular deviation so you may not model it.

Or the recovery potential was, in our judgement, very, very high and so why model a deviation scenario where the recovery on the part of the operator would be very high?

CHAIR APOSTOLAKIS: Did you also screen human failure events before you started all these steps?

MR. KOLACZKOWSKI: That actually was a process that involved -- Oconee was the first analysis we did. And you may or may not remember, the Oconee event tree, when we were done, had something like 100,000 sequences or something because we did no screening. We modeled pretty much --

CHAIR APOSTOLAKIS: One hundred thousand sequences after you guys expanded --

MR. KOLACZKOWSKI: After we expanded it yes and had different contexts.

CHAIR APOSTOLAKIS: How many did the PRA people have? Five.

MR. KOLACZKOWSKI: Well, maybe it wasn't that few but -- no, actually even in the `80s work, there were tens of thousands probably of sequences. But we developed that into hundreds of thousands of sequences.

Now we learned from the Oconee analysis and we learned from the Beaver Valley analysis and we did them in that order. And things that we could carry over into the next plant. We obviously -- if we found out that certain kinds of scenarios were just going to be unimportant after having looked at them at Oconee and said well, we can apply this also to Palisades. We didn't model those scenarios and maybe those human failure events on Palisades.

CHAIR APOSTOLAKIS: But is there -- I mean one of the values of this approach is you are going step by step in a very systematic way and so on. So do you have a systematic approach to screening, which would be important because all this work is not trivial, obviously. I mean you have to spend time and have to have the appropriate experts and so on, so are you screening so that you can select the few human failure events that might make a difference.

I mean you can be generous when you select. But I'm wondering whether you could -- Susan wants to say something.

DR. COOPER: I wasn't going to answer that question. I can let Alan answer that one. But my basic understanding of that is no, we don't have any formal guidance for screening.

But one thing I will say that with regard to the number of scenarios, especially with the Oconee analysis, in that particular study the HRA was actually -- that effort was really almost running ahead of the PRA and certainly ahead of the fracture mechanics and thermohydraulic analyses. So while we did -- the HRA team did more work than we might otherwise have done, the benefit that we provided was feedback then to the PRA and also the fracture mechanics and the thermohydraulics people that at least from the human perspective that these scenarios were not important. You didn't have to do analysis.

So while we didn't have savings in the Oconee analysis we were able to provide, you know, some feedback to some of the other parts of the project so far as, you know, their screening. And that was a unique characteristic really of all of the PTS analyses in that the HRA was either ahead or right with the PRA.

So we were examining a lot of the PRA questions at the same time as everybody else was. And so what we were doing may well have been more work for this time around than it would ordinarily have been, because we were asking some of the same questions that everyone else was asking at the same time in the overall team.

CHAIR APOSTOLAKIS: But in your user's guide, wouldn't you like to see something like that? I mean -- and how would one do that? I mean this is

-- I mean we screen everything else, right? We have a screening step in everything we do with the PRA itself obviously.

So I'm wondering whether there are any -- I mean you are the most experienced people who have developed and used this. What kind of guidance you can give perhaps? Is there such guidance?

DR. COOPER: I don't think we have any formal guidance at this point in time.

CHAIR APOSTOLAKIS: But you think you --

DR. COOPER: I don't know that we could have anything that would be formal and generic and very specific because each scenario, each issue, you know, whatever, each application will be a little bit difference.

I do think it is probably worth some thought, you know, I mean this is -- I mean I don't know that there is anything written down in the same sense for PRA. I mean this is sort of experience on the part of the analyst in a sense. So, you know, to what extent we can formalize that, I don't know.

MR. KOLACZKOWSKI: Yes, I was going to say --

CHAIR APOSTOLAKIS: You can have perfect guidance, nobody cares.

MR. KOLACZKOWSKI: No, no, no.

DR. COOPER: Well, yes, but the thing is that there isn't any -- I mean when I made the comparison to PRA, I made it intentionally. There are a lot of things that you do in PRA that you do based on experience. There isn't, you know, the PRA procedures guide or anything else doesn't explicitly take you through every step and give you guidance on every decision you make on modeling. You learn that through experience and through, you know, interactions with people who are more experienced than you.

And then you get a new problem and you have to address the question again or maybe in a different way. And reexamine, you know, your criteria that you used because maybe it doesn't work this time. So, you know, I think it is something that is worthwhile looking into but whether or not we can formalize it and still have it be generic, I don't know, you know, how far we can go because again, this is partly experience.

CHAIR APOSTOLAKIS: But, well, I mean yes, this today all you can say is it is worth looking into. I mean that is fine.

MEMBER KRESS: Excuse me. I'll let you have it next. I'm talking over here. In ordinary

PRAs, you could end up with thousands, hundreds of thousands of sequences and you truncate those. Now how do they go about doing that? They don't go ahead and quantify the sequence contribution yet do they?

CHAIR APOSTOLAKIS: Yes, they do. They have to cut the frequencies. The difference is that in the standard PRA, a lot of the stuff is computerized so they can put in the computer, you know, all sequences below ten to the minus nine frequency.

MEMBER KRESS: Oh, you truncate on the basis of initiating frequency?

CHAIR APOSTOLAKIS: Yes, everything.

MEMBER KRESS: Oh, the whole thing?

CHAIR APOSTOLAKIS: Yes.

MEMBER KRESS: Okay. Not just initiating.

CHAIR APOSTOLAKIS: The sequences, yes. The initiating events, I think, by regulations, if they have a frequency less than ten to the minus five, we don't look at them, right?

MEMBER KRESS: Yes.

CHAIR APOSTOLAKIS: There is a screening at that level, too.

MEMBER KRESS: Well, is there some way you can transfer for that process into this --

CHAIR APOSTOLAKIS: That's the problem.

MEMBER KRESS: -- because these are additional sequences.

CHAIR APOSTOLAKIS: These are very labor intensive. They have not computerized this. And they do not want to computerize it because it takes a lot of thinking. And that is why I think it is --

MEMBER KRESS: It is a different animal.

CHAIR APOSTOLAKIS: It is a different animal but look, at this point I don't have the answer.

Jeff, did you want to say something?

MEMBER KRESS: Yes, Jeff?

MR. JULIUS: Yes, this is Jeff Julius, science tech. But we just heard that there are three types of high-level guidance that you can put into the screening. And right now there really isn't any guidance put into the screening.

And one of them was the frequency of the context so you could compare that. That this scenario compares either to an initiating event frequency or some other. It is sufficiently low probability.

The second was the likelihood of recovery. And the third was consequences. I mean if this unsafe act leads to something that is inconsequential, you would screen it.

CHAIR APOSTOLAKIS: There is such a screening process somewhere from other methods?

MR. JULIUS: Yes, those three approaches are used in errors of commission that were done at Borislav, for example, but it was just brought out by the presentation here that we just heard.

George?

CHAIR APOSTOLAKIS: If I use the EPRI Calculator, I mean that is also a major effort to make the approach systematic. Is there a step there that tells me now you have to screen the human failure events or whatever terminology you use, so you don't analyze all of them?

MR. KOLACZKOWSKI: No, again, as Susan said, it is difficult to put that into perspective. There the screening or the differences comes from the ASME standard which says if something is a risk significant one then you do these certain things than if it is not risk significant.

CHAIR APOSTOLAKIS: Well, that is kind of --

MEMBER KRESS: After the fact.

MR. SAE: Nathan Sae, Office of Research. I think it is an excellent point to be thinking about screening. Obviously it is one of these things that you would like to have to make the tool more useful and widely applied.

I think one of the -- I won't call it an issue but the situation right now with ATHEANA, of course, is that it has been applied in a relatively small number of applications. So the knowledge base to build up these more generic rules of screening we just don't have.

I mean you might be able to say well, for PTS, you have learned a lot. Therefore, you know, for this situation, these are the screening rules that you would develop based on the judgment of the analyst team. Does that apply to a different situation? Don't know.

So I think you need to build up an experience base and maybe go through this pain to get the benefit from it and at some point in time be able to simplify it. And that is the same process you follow with lots of other engineering disciplines.

MR. KOLACZKOWSKI: But I do think you have a valid comment that we should look in the user's guide and try to highlight better. Even if the guidance has to be at a very high level or very general right now, where people can make use of screening processes, et cetera, because, in fact, that is what we think is appropriate to do. I think we should try to work at trying to get that built into the guide to whatever level we can.

CHAIR APOSTOLAKIS: Sure. Mario?

CHAIR BONACA: Oh, I simply had, you know, just a comment on these deviation scenarios. Clearly when I look at the, you know, at what you are looking at, inside containment, outside containment, one or two steam generators, these are really scenarios that are the questions you have to ask every time you are looking at a steam line break.

Often times they are not asked because in the traditional accident analysis, what you do is you looking at a bounding event. So you are taking the blow down, et cetera. But we have, for example, if you go to the LOCA, you know, depending on where the break is, the size of the break, the injection point, the ability of essentially bypassing the vessel, depending on where you put the water, when you put the water, so those scenarios are pretty well established by the traditional LOCA.

Therefore, it is easy to convey those kinds of analysis into the PRA. On the other hand, I mean it seems to me that these questions -- I mean you call them deviation scenarios. You can call them what you want but they are really part of the event itself. And, in fact, in the diagnostic of that, you have to ask how will the operator action in each one of those events be effected? Will he, for example, decide if he has a cool down because of a steam line break? All these particular deviation scenarios, that is a big question, okay? Is he going to distinguish that? How is he going to distinguish from a small break LOCA which has the same behavior and so on?

I guess the bottom line is that you got to have for an analysis of this size a very detailed evaluation of the system. You have to ask all these questions because operator action will be very much effected by the things that are happening there.

DR. COOPER: Yes, just to make a comment. I agree. There could be and there are PRAs that would have explicitly addressed some of the things that we would put in a deviation scenario. The point of this formalism that ATHEANA has added is to make sure that from the operator perspective that we examine these different plant conditions and make sure they are accounted for somewhere if they are important to operator response.

If it is already in the PRA model, they

have done some of the job for us. But if for some reason or other, the way the PRA has been modeled or the way the issue has been framed from the PRA side and they haven't explicitly modeled it, then the HRA needs to make sure that they pick up those distinctions if they matter to the operator response.

So here we have sort of another step forward. And the integration between HRA and PRA where HRA is trying to now pick up a little bit more of the PRA job if it matters from the operator perspective. So it's, you know, you are right.

This is part of the PRA but it is kind of a -- you know there can be differences between where, you know, the PRA and the HRA picks up. And then, you know, modeling differences depending on what the applications is, you know, analyst preference, or whatever.

The point is that we are now saying in HRA, the HRA analyst needs to make sure that these kinds of plant condition differences, if they have an impact on the operator response, make sure they are included somehow in the context of the scenario whether it be explicit in the PRA or somehow just fold it into the HRA analysis.

CHAIR APOSTOLAKIS: I think the last

bullet addresses that.

MEMBER KRESS: Well, I think, you know, if I were going to try to come up with some sort of screening methodology, I would treat the operator, the final human error action that you are focusing on like a success criteria. He either can do it or he can't. And, you know, it is the timing that matters.

So I think off line -- you wouldn't do this in the PRA but off line like you do success criteria for ECCS, for example, you may be able to go through real quickly and come up with times and say he can clearly do this operation in these times so let's eliminate those and just focus on the ones that get close.

CHAIR APOSTOLAKIS: That may be a major factor in the screening yes.

MEMBER KRESS: Yes, that would be the way I would start anyway. I wouldn't try and look at the endpoint.

CHAIR APOSTOLAKIS: You look at one scenario and you say the operators will have plenty of time for this.

MEMBER KRESS: Yes and just leave it at that.

CHAIR APOSTOLAKIS: You don't really have to worry too much about that.

MEMBER KRESS: Yes, we have some comment right here.

MR. FULD: My name is Bob Fuld and I work for Westinghouse from time to time. And I have a question that I think relates to this which is that the statement I hear somewhat in justification of ATHEANA is the need to address the human actions. And it is clear that those who develop this and would like to use it are interested in human actions as am I because I am a human factors guy.

But it seems like the formality of elaborating the models is kind of diametrically opposed, in a sense, to the desire to screen and be efficient. And there is an interest in more detail because the detail is interesting. But really -- and I would like to be corrected on this if I'm wrong -- it seems to me that the mandate for HRA in general is that it is a part of PRA.

And the point is to identify severe risks and the limiting risks and the things that might be interesting but nevertheless should be screened out because they don't have risks are really not relevant to the concerns of PRA.

And so it might be a cut-to-the-chase

question to ask whether when ATHEANA results are incorporated in a PRA whether on the balance, it generally makes the result more or less conservative. Because it would seem to me that the usual approach back when you showed the simple tree before you went down and elaborated it with deviation scenarios, that if you had made the radical failure assumption, I'll call it, that the human failed to isolate AFW with the simple tree, that that would have enveloped any possible result that you would have gotten with all the varied deviation scenarios and the, you know, hundred thousand additional sequences that you added.

And even though they may be very interesting and may provide a lot of useful feedback in other areas, it might be assumed up front that it wouldn't have the impact of raising risk generally.

So I was wondering how often does it raise risk? Or does it lower it?

CHAIR APOSTOLAKIS: What you are saying is another factor in the screening process would be the frequency of the sequence, assuming the operator failed. And if that frequency is very low, then there is no reason to do a more detailed analysis of the operation because putting the probability of one everywhere will lead to sequences that are unacceptable. So you have to go through this process.

MR. FULD: And that is generally what drives further elaboration is --

CHAIR APOSTOLAKIS: Yes, sure.

MR. FULD: -- when somebody comes back and says I can't live with the radical failure assumption for human performance. I need to understand it better. And at that time typically somebody would be called to say give me the more detailed analysis.

CHAIR APOSTOLAKIS: Well, you know, from this discussion what I get is that we have already identified two potential factors.

MR. KOLACZKOWSKI: I think it depends on the application though as well.

CHAIR APOSTOLAKIS: Of course it does.

MR. KOLACZKOWSKI: Okay. As long as that is understood. Again, if you take the concept that PRA is just trying to uncover, if you will, the high-level vulnerabilities, and certainly what is being said here is very appropriate, if you are now looking for small delta changes in core damage because you want to make a change to the plant, you want to compare it to Reg Guide 1174, et cetera, and so forth, and you are looking for some small changes now, we would argue that at least the potential is there that this kind of thing has to be done more to really uncover when, in fact, what you thought would be a small change could be a much more significant change if the context were a little different.

MR. SAE: Alan?

MR. KOLACZKOWSKI: Yes, Nathan?

MR. SAE: Also, if I may, the context for the PTS analysis, in particular, we were concerned that the previous analyses, and that is not just the PRA analysis, the whole analysis was too conservative. The whole idea was to question whether we had a basis for relaxing the rule. So the idea was to come up with a realistic estimate of risk and not a bounding estimate.

CHAIR APOSTOLAKIS: But still if a bounding analysis shows that the overall frequency of the sequence is very low --

MR. SAE: Absolutely.

DR. COOPER: If your desire is only to look for numbers, I mean if -- I mean again it depends on what your purpose of the analysis is.

CHAIR APOSTOLAKIS: The PRA value is dropped anyway.

MR. SAE: Well, the PRA, my understanding --

CHAIR APOSTOLAKIS: I mean without human events, when the frequency is below a certain threshold, they drop it. So you can do the same. And then if the frequency turns out to be not insignificant, then you say you go to the next step.

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: They will be required to do A, B, C. But the time is so long, available time, that it is really not worth it. So you can go step by step.

DR. COOPER: And, in fact, I mean --

CHAIR APOSTOLAKIS: We are not going to solve the problem today.

DR. COOPER: Yes, in our applications we do some of that screening. But we haven't formalized it --

CHAIR APOSTOLAKIS: Oh, okay.

DR. COOPER: -- again because there are different reasons why you might be doing the analysis. You may be interested in learning something. I mean there are other people besides, you know, the PRA group or someone else who has an interest in this. I mean we hear from the plant people, you know, the training department would like to have some feedback on, you know, what their operator vulnerabilities are.

I mean what do we need to fix or what do we need to worry about.

CHAIR APOSTOLAKIS: These thoughts can be in the screening step.

DR. COOPER: They can be put down.

CHAIR APOSTOLAKIS: I mean you don't just say do this.

DR. COOPER: They can't be prescriptive is what I am trying to say.

CHAIR APOSTOLAKIS: No, fine.

DR. COOPER: Because there are too many variations on what it -- but yes, they are certainly something that could be done. And I think it is a good point.

CHAIR APOSTOLAKIS: It is interesting, you know, with a five-minute discussion we came up with two ways already and there will be qualifiers. There is no question about it. But I think we should leave it at what you said. I mean it is worth thinking about.

MR. KOLACZKOWSKI: Yes.

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: Okay.

MR. KOLACZKOWSKI: Well, let me just end this slide by saying the point is we went through these Steps 6, 7, and 8. We decided what deviation scenarios we thought were worth explicitly modeling. And we made sure that those types of scenarios were either already in the model or, if necessary, add them to the model to account for these, if you will, deviations of how these scenarios could evolve that we thought would have some potential important impact on the human failure events in terms of what drives them and/or what the human error probabilities were.

Actually incorporating them into the model is addressed actually later on in Step 10 of the ATHEANA process where there is some guidance in the NUREG and in the user's guide about how to incorporate these things into the model.

I won't go into that in detail. I just want to point out that there is a step in the ATHEANA process that addresses this bit about incorporating these scenarios and these human failure events into the model and provide some examples on how to do that.

Okay, now the quantification when we want to actually estimate the human error probabilities. Again, depending on what level you have developed the model, whether you have actually developed these so-called deviation scenarios either in a formal way following the ATHEANA process or whether the analyst has done it using some other method but has thought about those, if, for instance, we come back to this simple base case scenario that I started off with, the steam line break, main feedwater isolates, and the operator fails to isolate auxiliary feedwater.

If you stay with that, using most HRA methods and for that matter, using ATHEANA, if this is your level of understanding of the scenario as is illustrated by the PRA model, the HRA analyst is going to fill in the context of what that scenario means. They are going to decide what the plant conditions are, what the cues are, when they occur in time, how redundant those cues are, et cetera, so that the timing of the scenario, the timing of the cues, how long does it take operators to get through steps of the procedures, et cetera, and so forth.

And they are going to fill in, if you will, their definition of what this scenario means in overall context terms or, if you will, in terms of plant conditions and the performance shaping factors that we are going to be worried about, that we say can have an effect on this human failure probability here.

And then we are going to estimate that HEP and with most methods -- well, actually with all methods, we are either going to use some sort of proscriptive rules that the method uses or some curves like the TRC curves or we are going to use tables or using ATHEANA as an example, we are going to use estimate judgment.

The point is some context is going to be developed that goes beyond what you see here in the simple event tree structure that basically sets a context for which the HEP is going to be applicable. And that is basically how we do HRA.

Now I've already illustrated that in the PTS work at some level we took those simple context and we developed them into, such as in this case, four different context. And we actually put this model structure into the PRA and now we have a somewhat better description of how to estimate this human failure probability for this event given that we are inside containment as far as a break and we are only effected one steam generator as opposed to two. Or we have a break outside containment and so on and so forth.

So we have sort of now defined the context in somewhat more detail. And the human failure events that we will analyze out here and the corresponding human error probabilities that we will come up with are these four situations will be potentially different depending on which context we are analyzing.

Now let me illustrate also that had we not done this, had we not put in this specific structure, and had we instead in the PRA model, stayed with this structure and just the one human failure event, if we stall want to account for these different inside/outside containment, or one or two steam generator combinations of conditions.

What you would do following the ATHEANA process is making use of the general equation in ATHEANA, you would take the probability of each error forcing context for the sequence of concern -- in this case we would take well what is the probability it is inside containment but it is effecting only one steam generator as opposed to a different probability for its inside containment but two steam generators and so on.

You would take the probability of those different contexts and for each one of those contexts, you would develop the -- this is representative, if you will, of the human error probability for failing to isolate the auxiliary feedwater given each one of those contexts --

CHAIR APOSTOLAKIS: But you said you wouldn't worry about the unsafe acts.

MR. KOLACZKOWSKI: Well, I know but the equation uses unsafe acts because it is meant to be general and it is at the unsafe act level. We would essentially reinterpret this as, if you will, HFE-1, or HFE-2, or HFE-3.

You would get the probability of that HFE for this context estimate by using ATHEANA and expert judgment process, which I will get into in a moment. So you get the probability of that human failure event given that context, multiply that times the probability of the context but then do that for each one of these four situations.

Each time you are putting in a different probability of a context and you have potentially a different probability of the HFE and you would sum over all of those four contexts in this case to now get an overall probability of the human failure event that you could plus into this simple model.

So that is a way that you would essentially account for the differing contexts leaving the PRA model it was originally structured in the most simple, but bass case, but that would be a way to account for that.

CHAIR APOSTOLAKIS: There is nothing that says that the original model has to stay the way it is.

MR. KOLACZKOWSKI: No, no.

CHAIR APOSTOLAKIS: I mean if you identify one of the subcontexts that is very important --

MR. KOLACZKOWSKI: You could do it. Exactly what we did was we actually changed and developed the model.

CHAIR APOSTOLAKIS: Sure.

MR. KOLACZKOWSKI: Okay? So then we are not actually making explicit use of the equation but essentially we are doing the same thing, okay?

DR. COOPER: There may be other cases where the context, you wouldn't want to put it into the PRA model. A very simple example would be, for example, an instrumentation failure. There isn't a place in the PRA model to put an instrumentation failure.

Maybe a sensor failure that fails an automatic actuation of the system. But if it is something that simply is generating cues or information for the operators, that is not going to be modeled explicitly in the PRA. There is just no place to put it.

CHAIR APOSTOLAKIS: Yes.

DR. COOPER: So there are types of things that you may not be able to explicitly put into the event tree structure.

CHAIR APOSTOLAKIS: Yes, but if one of these subsequences clearly stands out, it seems to me the basic PRA model should show it.

DR. COOPER: That is correct.

CHAIR APOSTOLAKIS: Yes.

DR. COOPER: And, in fact, that has already been part of the PRA/HRA practice when the HRA analysts can get their way. But say this is different enough that I really want a different tree. And I want to be able to model this as a separate human failure event in the model.

But this is just, again, making a little bit more explicit the handoff, if you will, between the HRA/PRA modeling. It is giving the HRA person a place to put, you know, to do their work if the PRA isn't, you know, cooperating with them for some reason or other. Or if there just isn't a way to address the particular conditions that they are interested in.

So you could argue that it is a bookkeeping formalism but it is an important one especially considering the fact that what we are providing the HRA analyst are tools to be able to find these conditions from the human perspective. But that isn't the job of the PRA analysts. They are looking from a different direction. They are looking from the system perspective. They are going to be constructing the event tree from, you know, according to success criteria for the different functions and the different systems that perform those functions.

We are coming from the other direction.

CHAIR APOSTOLAKIS: Yes, but I mean --

DR. COOPER: -- and somewhere in the middle we are going to meet. And the actual, you know, dividing live then between the HRA, you know, human failure event, and the PRA model may change, you know, depending on, you know, who is doing the modeling, the question of interest and so on and so forth.

CHAIR APOSTOLAKIS: Well, let's go back to the equation, Alan.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: You explained the terms there in terms of the sequence. But it seems to me that they are, of course, in context. There is much more into it than just the sequence.

MR. KOLACZKOWSKI: Well, yes. Because again the original sequence was this basically.

CHAIR APOSTOLAKIS: But even in your

sequences.

MR. KOLACZKOWSKI: Oh, yes, there are still more.

CHAIR APOSTOLAKIS: There is much more.

MR. KOLACZKOWSKI: There is still more.

CHAIR APOSTOLAKIS: So the big question then is how do you actually get those probabilities.

MR. KOLACZKOWSKI: How do you get what? I'm sorry.

CHAIR APOSTOLAKIS: The probabilities. I mean the easy part is the sequence. But then you added -- you know you have all things that you consider performance shaping factors. So is that where the expert judgment comes into the picture?

MR. KOLACZKOWSKI: Much more so because clearly I mean you can by virtue of pipe failure probabilities and knowing how much piping is inside containment and outside containment and so on and so forth, you can come up with estimates for what are the chances versus outside containment.

CHAIR APOSTOLAKIS: No, no. I understand that.

MR. KOLACZKOWSKI: Okay.

CHAIR APOSTOLAKIS: All I'm saying is you have a set of performance-shaping factors --

MR. KOLACZKOWSKI: Right, yes.

CHAIR APOSTOLAKIS: -- which are also either -- in fact, they define the context. So maybe another way of writing this equation is to say probability of scenario times the probability of the error force in context given the scenario -- or maybe that is what you mean there.

MR. KOLACZKOWSKI: Well, what we find --

CHAIR APOSTOLAKIS: So this is not then -- that is what you mean by slash S?

MR. KOLACZKOWSKI: No, no, that is given the sequence.

MEMBER KRESS: I think where you are looking at, George, would be the probability of the outside fact given the performance-shaping factors.

DR. COOPER: Yes, the error-forcing context --

CHAIR APOSTOLAKIS: Yes, but the error-forcing context contains the performance-shaping factors.

DR. COOPER: It does, yes, it does.

CHAIR APOSTOLAKIS: So you have to -- I mean given the scenario you say, so I don't have to worry -- I mean given that I have lost two steam generators, so now the question is what is the error-forcing context. And the error-forcing context will consist of all the things that you guys are talking about.

So the experts will come and give me both probabilities then. Both the probability of the error-forcing context and the unsafe act. Otherwise I can't get it from anywhere.

DR. COOPER: Well, it rather depends because let's say, for example, the error-forcing context involves certain condition that causes the operators to take proceduralized actions that are inappropriate. So in that particular case, your plant conditions have already set up the situation where the procedures are going to be used in a certain way that have an outcome.

So we don't necessarily have to quantify the probability that the procedures are in a certain way. It is just what it is, exactly.

Now there other situations where that might not be exactly the case. But the point is that most of the time, because of the way we set thing up, you might remember back in Alan's -- when he was talking about the result of Step 5, the potential vulnerabilities.

We are looking for certain ways in which the tools, if you will, that the operators have in their training, their experience, everything -- mismatched the scenario. And so we have more or less already made a one-to-one -- in many cases, not all cases -- one-to-one between the conditions and the probability of some sort of mismatch with say for procedures or their training.

So we don't usually have to make any kind of judgments about the performance shaping factors.

CHAIR APOSTOLAKIS: But okay, the question is --

DR. COOPER: They are triggers that are part of it.

CHAIR APOSTOLAKIS: Who gives you the first term in the summer. How do you get that?

MR. KOLACZKOWSKI: The PRA person likely because a lot of it is driven by system stuff for the most part, usually these error-forcing context are different, if you will, and plant conditions or different situations that set up plant conditions, you are going to be using a lot of that from data.

MR. KOLACZKOWSKI: What I want to -- I guess I want to come back to the point. This error-forcing context, while it implies PSAs by its nature -- I mean this context, inside containment, one steam generator implies something about are the procedures good for dealing with that situation? Have they been trained on that kind of a scenario before, et cetera, et cetera implies certain things about the context.

But the ultimate effect of those context is going to manifest itself in the probability of --

CHAIR APOSTOLAKIS: What you are saying is that the first term is just the frequency of the sequence?

MR. KOLACZKOWSKI: Yes. But it implies PSS, some which may be triggered with a 1.0 probability. The procedure does not match, clearly. The procedure would take the operator in the wrong direction. I mean that is clearly -- that might be an implication but it is ultimately only going to be manifested when the experts then, with that knowledge, say oh, well, in that case, then the human error probability is going to be really high.

The operator is going to have to figure this out because the procedure isn't going to give them any guidance.

CHAIR APOSTOLAKIS: So where you guys come in is only the second term?

MR. KOLACZKOWSKI: Yes, but we have to make the experts aware of what this context is and what it implies.

CHAIR APOSTOLAKIS: Oh, yes.

MR. PARRY: Mr. George?

CHAIR APOSTOLAKIS: Yes?

MR. PARRY: Can I make a comment? This is Gareth Parry from NRR. I think what the point you are getting to is how I would interpret this is that this equation is general at any level. So this equation is applicable also in the detailed event tree because as you point out, what you have got is a scenario that is defined in the very discritized way.

And that scenario can have a whole range of error-forcing contexts underlying it so that this equation should be used for any level of definition of the HFE. And I think that is the point you are getting to.

And some of the error-forcing context is driven by things like -- it is manifested in the performance-shaping factors. And I think Alan will be to some of that when he talks about things like the aleatory factors that effect the error-forcing context later.

CHAIR APOSTOLAKIS: But the clarification, though, she gave is very useful because we are back to equation. What you are saying is that the error-forcing -- the probability of the error-forcing context is, in fact, it is actually a frequency. The frequency of the scenario, which implies a certain context in terms of the PSFs. But this will be taken into account in the second term.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: What is the likelihood now though the operators will commit an unsafe act given these conditions.

MR. KOLACZKOWSKI: Well --

CHAIR APOSTOLAKIS: That is how Alan interpreted it.

MR. PARRY: Yes, but I think you will see later on when he talks about the quantification --

MR. KOLACZKOWSKI: Yes, there is more yet. There is more yet.

CHAIR APOSTOLAKIS: I know there is, yes.

MR. PARRY: But, in fact, he will still define --

MR. KOLACZKOWSKI: Some additional --

MR. PARRY: -- a set of Air Force in context which is not explicit in the definition of the scenario. But is implicit because of variabilities that underlie that thing.

MR. KOLACZKOWSKI: Yes, that is what he

said. That it is implied. A lot of this stuff is implied. Now given the time there --

MR. PARRY: But they still have to do this equation. I guess that is what he is trying to tell us.

CHAIR APOSTOLAKIS: The equation is fine. It's how you get the terms. Yes, John?

MR. FORESTER: You know I was just to add that it seemed like --

MR. KOLACZKOWSKI: Give your name, John.

MR. FORESTER: Oh, John Forester, Sandia Labs, excuse me.

As Susan noted, you know, part of the error-forcing context may be the procedures and the training. And those are sort of a given so you really don't have to estimate those.

And then the conditions, the PRA sequence, the probability of the various systems. But I think as Gareth is pointing out, we do get involved in estimating the probability of the error-forcing context if we have decided there are some aleatory factors, for instance like time of day or the aggressiveness of the crew or whatever we identify that might be important in sequence then that does have to be estimated as part of the error-forcing context.

CHAIR APOSTOLAKIS: Okay. But let me be more specific then. Let's say that by looking at the procedures, you find that there may be some misleading instructions. Now this is a perspective on all of this. So where is the probability that such instruction exists. It should really be in the first step.

MR. KOLACZKOWSKI: Yes. If you decide that some misleading or maybe a critical failed instrument would entirely change the likelihood of success on the operator's part.

The we would come back and put in not lonely. But we would have also put into this term and the probability that that key instrument happens to be failed, unavailable, they are in the middle of a work around or whatever at the time when this event occurs. This is true.

CHAIR APOSTOLAKIS: So then the experts will do that evaluation as well, right?

MR. KOLACZKOWSKI: Well, again, using the example I have, the probability that the instrument has failed is probably going to come more from system instrument unavailability information than it is from a psychologist for instance because we are talking about well, what is the chance the instrument happens to be unavailable at the time. You are going to talk to maintenance and operations crews and you are going to say something about, something to the effect do you do surveillance on this instrument? Is it unavailable when you do that? How often does that occur? Is that a monthly occurrence? Dah, dah, dah, dah. And you are going to get it from that.

CHAIR APOSTOLAKIS: But basically what you are saying is ATHEANA really does not get into this PEFCi.

MR. KOLACZKOWSKI: This term.

CHAIR APOSTOLAKIS: Yes.

MR. KOLACZKOWSKI: No, it may influence what should go in here but usually the kinds of things that go in here are more PRA related than they are HRA.

MEMBER SHACK: But it is ATHEANA that is asking the question.

MR. KOLACZKOWSKI: But ATHEANA is asking the question. ATHEANA is at least saying let's decide what this context is at some level that we think is important. And if we think that that instrument being failed is important, we tell the PRA person we need that probability that that instrument is unavailable because we need to be able to put that into this term.

DR. COOPER: Susan Cooper. I guess the thing is that going back to that search for potential vulnerabilities, it is in that step that we basically identify places where we can break down the human performance. And that is where we are identifying, you know, maybe places in the procedure or how the procedure is being implemented that could be problematic. Or training or experience.

And so we have identified those kinds of vulnerabilities, if you will, and then we find conditions that match up to those potential vulnerabilities. And that is what we have got. We have built into this error-forcing context.

So matched with that error-forcing context are these vulnerabilities that we have identified. It is just that we started looking for those vulnerabilities saying okay, we are going to find the condition under which those vulnerabilities are something we need to worry about.

So matched with those conditions are the vulnerabilities that we thought were important. And so that is the implied, if you will, performance-shaping factors. So they are underlying that.

Now there may be situations where, you

know, maybe it is not -- maybe there is a question as to whether or not, you know, there is going to be a mismatch problem. We haven't, you know, done enough applications where we really run into a situation where we have defined a context where it is questionable.

Most of the time we matched up this is a problem for this kind of condition. We know then that we have these kinds of issues that are related to what we traditionally call performance-shaping factors. Maybe it is something that comes in their training. Maybe it is something in procedures, whatever. But it is matched up directly with that context.

And it is because of that groundwork that we did earlier in the process. We have already made that link and so that is underlying or implicit in the context.

CHAIR APOSTOLAKIS: Okay, let's go on. I think I understand now.

MR. KOLACZKOWSKI: Okay, I know we are running out of time so I am going to -- I'm going to skip a number of slides that talk about just in general what goes on in the quantitative analysis but let me just say that the ATHEANA process basically uses an expert judgment process. It is based largely on the SSHAC report, NUREG/CR-6372 in terms of the process. And it is done through an expert elicitation.

CHAIR APOSTOLAKIS: Shack is everywhere, including here.

MR. KOLACZKOWSKI: I'm going to skip these slides and I want to talk just a moment about this simplification thing only because you are going to hear about it in the next talk.

And it actually gets to some of the points that you are making, Dr. Apostolakis. And so I think this is probably worth spending a few minutes on.

Let's look at one of the Palisades PTS PRA model sequences. This is slide no. 22 in your package. A little bit different sequence than the one we have been referring to in the earlier slides.

Some initiators happen. An atmospheric dump valve has been demanded. It has failed to re-close. So we are now depressurizing the secondary side. We are causing a cool down on the primary side. And the operator is supposed to close the atmospheric dump valve isolation valve. And by the way, this is an exit control room kind of action at Palisades. It's not just a switch that you can just turn in the control room.

Now what we did, particularly in the Palisades work, is that we would take the context that is implied by this scenario and we would look at yet additional aleatory influences that could effect the failure probability of, in this case, the operator failing to close the ADV isolation valve.

And, for instance, we thought about things like what if there are other or not nuisance alarms going on. Little minor failures that might have occurred during this scenario which happen in many plant trips. A lot of times they will have a slight feedwater control problem. It didn't quite trip out like it was supposed to. Or the diesel was supposed to start but it didn't.

And, you know, it may not be really critical to the sequence but it takes time for the operator to sort out what is happening, what isn't. What is important, what's not. What do I have to deal with, et cetera.

So we said what if there were or not nuisance alarms? What if there was an aggressive crew versus a very methodical crew when this particular event occurred? Because we saw that there were some differences in the way some of the Palisades crews might approach this event.

What if a key instrument, in this particular case the position instruments for the ADVs, what if those were unavailable because of a work around, maintenance, and so on? And these are aleatory influences from the perspective of the sequence.

CHAIR APOSTOLAKIS: And this is really what I think the Halden experiments are exploring.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: They showed us the results from four crews. And in response to an event, three of them responded correctly within -- in six minutes within a minute. But the fourth crew took 11-plus minutes.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: And you may make a case that this is the aleatory variability that may be due to some of these factors because it was exactly the same thing. And they were all Scandinavian, by the way, so we don't have --

MR. KOLACZKOWSKI: You will notice that one of the things we look at is these crew characteristics and whether or not -- how homogeneous are the crews?

MEMBER KRESS: Is it the worst crew

response or do you add them up some way and --

CHAIR APOSTOLAKIS: Well, that is for this afternoon's discussion.

MEMBER KRESS: Okay.

CHAIR APOSTOLAKIS: What do you do with that?

MEMBER KRESS: Okay.

MR. KOLACZKOWSKI: Now what I have not shown --

CHAIR APOSTOLAKIS: Now it is just experts.

MEMBER KRESS: Okay.

MR. KOLACZKOWSKI: -- what we could have done is we could have taken these other considerations and we could have built models like this.

CHAIR APOSTOLAKIS: I was a bit surprised to see the tables to tell you the truth.

MR. KOLACZKOWSKI: Okay.

CHAIR APOSTOLAKIS: I thought you were trying to get away from being prescriptive. And then you throw in a table where it says likelihood -- unlikely means this, very unlikely means that.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: Is it to train the known HRA people?

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: Can you find a better way of doing it? Because, you know, I understand this is a problem because you want to have a team as you have in one of your slides that --

MR. KOLACZKOWSKI: Operators, trainers, et cetera, that aren't using --

CHAIR APOSTOLAKIS: A combination of disciplines.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: I don't know. Myself --

MR. KOLACZKOWSKI: You have to train them a little bit in some sort of probability scaling.

CHAIR APOSTOLAKIS: Well, yes, in expert opinion elicitation, usually there is a training session.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: And you try to use uncertain events with which the subject is familiar. And then you say well this now has the probability of such and such rather than defining them. Defining them doesn't mean anything to people. I mean you take, you know, the probability of such and such event that you are familiar with is point one. Then that starts helping them.

MR. KOLACZKOWSKI: For the Palisades analysis, what we actually did was we went back to the plant and spent three days quantifying what looked like were going to be the more important human failure events in our models. And it was actually -- and the experts that we pulled together was a combination of NRC contractors and plant staff, trainers, et cetera, and so forth.

And the first half day or three-quarters of a day all we did was train on ATHEANA. We didn't bother trying to do human failure events. We had to get them to understand what a deviation scenario is, what context means, et cetera, et cetera. And we did -- in fact both things that you are talking about.

We talked about events that they had seen in simulator before to get them to understand that some events that might at first appear to be very unlikely that the operator would do anything wrong, well they were even recalling and saying well, yes, remember in this simulator event, Joe did this or Joe did that or whatever. So see, it is not as unlikely as you really think. And those kinds of things. We had those kinds of discussions.

CHAIR APOSTOLAKIS: I would really

encourage you to try to put a few examples like that or maybe from general knowledge instead of just putting the table. The table may or may not survive but it seems to me giving some of these examples -- so maybe you can talk to people who have done this before in NUREG-1150 or whatever. You guys at Sandia must have access to these people although they were contractors actually.

But -- and then another important thing that they did in those formal expert opinion elicitation exercises is they gave some questions to the experts to convince them that for certain events for which their first reaction is I can't give you this probability is they actually thought about it.

And the evidence that they already have in their minds, they could come up with something very reasonable. Now you don't want to turn this into an expert opinion exercise but maybe you can go back to the SSHAC report or other reports and see how they did it and the training and so on.

I think one of the questions that they were asking in the training sessions of NUREG-1150 was give us your estimate of the frequency of suicides of middle-aged women in Japan.

(Laughter.)

CHAIR APOSTOLAKIS: Something for which you say I have no idea, right? But then if you think about it --

MR. KOLACZKOWSKI: You break it down and you start thinking about things --

CHAIR APOSTOLAKIS: You break it down, you know, what do I know about these women --

MR. KOLACZKOWSKI: -- you can maybe come up with something.

CHAIR APOSTOLAKIS: -- the error-forced context, right? I think that would go a long way towards helping.

MR. KOLACZKOWSKI: A valid point.

CHAIR APOSTOLAKIS: Yes.

MR. KOLACZKOWSKI: A valid point.

CHAIR APOSTOLAKIS: Okay. So that's what you do.

MR. KOLACZKOWSKI: Okay. What I want to indicate here is that we did not take these other aleatory influences and develop this tree structure more because that would have just developed a tree --

CHAIR APOSTOLAKIS: But how do you take them into account though, Alan? How do you --

MR. KOLACZKOWSKI: Okay, and what we did do is we did what we are calling a variation of the approach or a simplified approach or whatever. And what we did do was we had the experts take the situation and develop basically an HEP probability distribution rather than a single number.

And we said we are going to consider that the 99th percentile of this HEP distribution we are going to develop is representative of the human error probability when the worst coincident but not too unlikely set of negative influences happens to occur at the same time. And represents a very strong EFC.

CHAIR APOSTOLAKIS: What do you mean by not too unlikely?

MR. KOLACZKOWSKI: Well, meaning that you'd have to understand that by this point, we are actually coming up with a number. We have already talked about the different context, what is going to drive the human error probability and so on and so forth.

And now we are saying well what is the chance that we have the instruments unavailable and it is the methodical crew and, and, and. And then they say, well then the human error probability would be yes, close to one. But if that context is so unlikely to occur, that is the coincident situation of the methodical crew, the instrument being unavailable, nuisance alarms being present at the same time, and whatever else might be is so unlikely it is coming back to your frequency argument, that is just too unlikely. We are not going to develop the HEP for that.

CHAIR APOSTOLAKIS: But another thing you are doing with this process though, I think you are blending together now both of the aleatory and the systemic.

MR. KOLACZKOWSKI: Yes. Yes.

CHAIR APOSTOLAKIS: So the distribution that you get --

MR. KOLACZKOWSKI: Well, and in fact though, it is focusing more on the aleatory.

CHAIR APOSTOLAKIS: Really?

MR. KOLACZKOWSKI: Even more so.

CHAIR APOSTOLAKIS: I thought it was more of the systemic.

MR. KOLACZKOWSKI: Well, no. I think it is focusing more on the aleatory because basically what you are saying is give me an HEP value based on the fact that these three or four aleatory influences happen to occur at the same time.

CHAIR APOSTOLAKIS: Oh, that's a very -- that is the second thing I am learning today.

MR. KOLACZKOWSKI: Okay.

CHAIR APOSTOLAKIS: Very good.

MR. KOLACZKOWSKI: Rather than coming up with the probability of the nuisance alarm and the probability of the instrument being unavailable, et cetera, the experts judged that that coincident situation was not too unlikely and it could, in fact, occur at some reasonable expected level of occurrence and yet would drive the HEP to some, in this case, relatively high value.

Then they would estimate that HEP for that context and that would be representative of the 99th percentile on this distribution that they were going to develop.

DR. COOPER: But, if I could just interject -- this is Susan Cooper -- just to remind you what Alan is describing is an approximate approach to the quantification that was used for the Palisades PTS analysis only. Okay?

And the reason why he is introducing it is because we did have some comments from the peer reviewers that we will be discussed in the next presentation about this approximate approach.

MR. KOLACZKOWSKI: Yes. Okay.

MEMBER KRESS: I presume that you are

implicitly assuming a normal distribution for this?

MR. KOLACZKOWSKI: No.

MEMBER KRESS: You are not?

MR. KOLACZKOWSKI: No, we're not. In fact that is explained by the next two bullets. The first percentile is -- having the experts imagine all the best -- the coincident set of best possible influences could occur. And if they thought that that is also not extremely unlikely, that yes, all the best things could coincidentally occur and the human error probability might be therefore very low, we said well let's have that represent the first percentile on this distribution that you are developing.

Now comes the harder part. We want to fill in the rest. I mean we only have two points. We want to fill in the rest of the distribution. Do you think it is normal? Do you think it is loginal? Or what shape do you think it is?

And basically without getting into a lot of detail -- and I'm really running out of time here -- but what we tried to do is have the operators think about the context in between.

CHAIR APOSTOLAKIS: The operators or the team?

MR. KOLACZKOWSKI: The experts.

CHAIR APOSTOLAKIS: The team?

MR. KOLACZKOWSKI: The team experts think about the different combinations of context in between, think about how likely those different combination of contexts are, develop the human error probability, if you will, for those contexts, and shape the distribution primarily based on the likelihood of those intervening contexts.

So in a sense --

MEMBER KRESS: I'll bet it comes out almost normal.

MR. KOLACZKOWSKI: Well, yes. It probably did as it does tend to --

MEMBER KRESS: What part of it was logged normal?

MR. KOLACZKOWSKI: It depends. If you think that most contexts are always going to be close to ideal, in other words not much else is going to fail, there isn't a chance that the instrument is going to be unavailable, et cetera, et cetera, then your distribution is going to be shaped where the HEP is going to be peaked more at the lower values.

CHAIR APOSTOLAKIS: Yes.

MR. KOLACZKOWSKI: If you think more of the -- I'll call them severe error-forcing contexts are, in fact, the more likely contexts, then your HEP distribution is going to be shaped more at the upper end.

Now obviously the difficulty with this, and by not explicitly modeling the different contexts and actually calculating their probabilities is that the poor experts, we were asking them to consider at the same time the relativeness of the contexts in order to shake this HEP distribution curve and come up with the HEPs at the same time. So a lot was being done at one time. It is all folded and mushed together. And obviously that is difficult.

CHAIR APOSTOLAKIS: Could you go to -- I'm sorry.

MEMBER KRESS: The question I have now is what do you do with this distribution?

MR. KOLACZKOWSKI: Okay --

CHAIR APOSTOLAKIS: Go to 26 and that's it.

MR. KOLACZKOWSKI: What we ended up doing -- and I'll just go to 26 and 27 -- what we did in following the process was we talked about the context of this situation, failure to isolate, stuck open ADV, et cetera, and so forth, what might be the driving factors, what might cause operators to be -- the human error probability to be high or low, what kind of contexts were they, how likely might they be, et cetera and so forth.

And ultimately we came down to in this particular case we came down to a consensus opinion and let me point to the very last bullet given the nature of the time we have here.

CHAIR APOSTOLAKIS: Very interesting.

MR. KOLACZKOWSKI: That the decision on the part of the experts for this particular event was that if we had bad weather -- because you have to go up on the roof to be able to get to the isolation valve, et cetera -- and they said well, this is Palisades. We are up in Michigan. There could be snow and sleet and rain and ice up there and whatever.

And they said -- and oh, that is some fraction of the year that you can calculate and it is not that small a fraction of the year. So anyways if you have bad weather or other problems that we talked about in terms of executing the action, along with the methodical crew happens to be the crew on shift, and there does happen to be problems with ADV status indication, which they decided was not all of that unlikely, and if you had this coincident set of occurrences at the time of this event, that then your human error probability would be something like .5 or .9 that they would fail to isolate using this isolation valve in the 30 minutes or 15 minutes or whatever the time was.

So they end up with -- we end up with a distribution that is trying to reflect these are the very severe error-forcing contexts. That is context that drive the human error probability to fairly high numbers. Maybe the expected, if you will, with very little else going wrong in terms of this scenario. It might be more in this nature here. And this might be more representative of when everything is just super ideal.

CHAIR APOSTOLAKIS: Okay. A simple question. Do these numbers -- having them the fraction of the year the way you have severe weather?

MR. KOLACZKOWSKI: In this particular case, in the -- the experts are trying to do that by determining how much -- how fast or how slow these high failure probabilities are going to drop off.

CHAIR APOSTOLAKIS: Assuming that the weather is bad though.

MR. KOLACZKOWSKI: Well, this one here for instance, this number right here, the .9 is based on the assumption -- is saying that we do have bad weather. We have a methodical crew. And we have a problem with the ADV status.

CHAIR APOSTOLAKIS: So what is not there is the probability of actually having those.

MR. KOLACZKOWSKI: That's right. It is not explicitly there.

CHAIR APOSTOLAKIS: Okay, okay. So this is -- I mean a thing that is still developing?

MR. KOLACZKOWSKI: No, no. The ATHEANA process would actually develop the contexts, would come up with the probabilities of the contexts, and then would estimate --

CHAIR APOSTOLAKIS: Somebody has to do this.

MR. KOLACZKOWSKI: -- would estimate the human error probabilities for each of those, okay?

CHAIR APOSTOLAKIS: Right, okay, okay.

MR. KOLACZKOWSKI: We applied a simplified approach to that when we did the Palisades --

CHAIR APOSTOLAKIS: Okay, now how did you get the consensus? By having the experts talk about it and agreeing?

MR. KOLACZKOWSKI: Yes,

CHAIR APOSTOLAKIS: Okay, good. That is a good way of doing it.

MR. KOLACZKOWSKI: Yes. And that was my last slide. Some of this will be more meaningful even or you will see the relevance --

CHAIR APOSTOLAKIS: This was already very meaningful.

MR. KOLACZKOWSKI: -- with the next talk.

CHAIR APOSTOLAKIS: Because when you read the report, you don't, you know, catch everything. And I think this was very, very informative. And I assume nobody has any comments?

(Laughter.)

CHAIR APOSTOLAKIS: So we will be back at quarter of.

MR. KOLACZKOWSKI: Thank you.

CHAIR APOSTOLAKIS: Thank you very much, Alan.

(Whereupon, the foregoing matter went off the record at 10:31 a.m. and went back on the record at 10:56 a.m.)

CHAIR APOSTOLAKIS: ATHEANA User's Guide, Dr. Cooper will take the lead.

DR. COOPER: Thank you, Dr. Apostolakis. I see we are a little behind schedule but we had some good discussions in the last presentation. We may be able to short circuit some of what we are talking about in this presentation which is the overview of the ATHEANA User's Guide and in parens, for prospective analysis or predictive analysis in support of PRA. And also to write an overview of the recommended revisions from peer review of the current version of the user's guide.

I want to recognize the project manager for this work, Erasmia Lois, and the authors, John Forester and Alan Kolaczkowski, as well.

Oops, what did I do? I went to the end.

MEMBER KRESS: That was a quick talk.

DR. COOPER: That was quick, okay.

What I will be talking about first of all is the purpose of the user's guide, overview, basic content description of what is in the current version of the user's guide. Just to remind you again from the last presentation, the formulation of the quantification approach for ATHEANA.

And then give some thought about highlights from the peer reviewers, their suggested revisions, and also from the senior NRC staff. And note at this point in time that we are also interested in getting the feedback and suggestions from the ACRS as well. And then just briefly what we see as the next steps.

The purpose of the user's guide is basically technology transfer. We have already published, as Alan mentioned, in May of 2000 the NUREG-1624 Revision 1 on ATHEANA. The purpose of the user's guide is to provide a better understanding of ATHEANA, what the process is for applying it, how and when to apply it, its strengths and limitations.

We want to update the guidance that was given n the NUREG in light of applications that we performed. We would also like to separate out some of the different aspects of ATHEANA that were discussed in the NUREG. In particular, we divided out the guidance on retrospective analysis. That is not in the scope of the user's guide.

I would also say that we don't include the background, the behavioral sciences background that is in the NUREG. That is not in the user's guide. However because as Alan mentioned, the previous presentation, the quantification approach was not complete at the time when NUREG-1624 was published so the user's guide does provide a complete description of the quantification approach.

But in some ways, we want to try to simplify the guidance, make it easier to understand

and use. But still we did not intend to make this a standalone document. We still wanted to rely or do rely on NUREG-1624 as a source of information. As I indicated, there is no description about the technical basis for the method in the user's guide.

Specific objectives for the user's guide include providing better guidance on treating the nominal or base case scenario. Alan's discussion in the previous presentation discussed this some.

And we wanted to try to include a better description as to what a base case scenario is and how -- a little bit more about the search for error-forcing contexts and the deviations from a nominal case. That was an emphasis in the NUREG and we wanted to also then bring in that ATHEANA can address the nominal and base case scenarios also if there were some more nominal cases that you wanted to quantify as well.

We wanted to provide a little more guidance on performance-shaping factor and their role, illustrate the use of the quantification formulation, again also looking at the base case deviation influence and other aleatory factors.

Now what is in the user's guide, there is an introduction that again discusses the purpose of

ATHEANA, tries to illustrate how it is different than other HRA approaches while at the same time trying to note some important similarities. It tries to address when it would be useful to use ATHEANA or even necessary.

There are illustrative examples to try to highlight some of these differences with other HRA approaches. The discussion of the ATHEANA process, we have tried to streamline that discussion to make it a little more understandable and at the same time factor in or combine in some lessons learned, in particular from the PTS evaluations.

But it still includes a step-by-step guidance for how you go from, you know, identifying or deciding the issue to be addressed and the scope through the quantification of human failure events and accounting for error-forcing context.

I don't know that we need to spend too much time on this equation. We talked about it quite a bit in the last presentation. You know human failure events are the things that are modeled in the PRA.

CHAIR APOSTOLAKIS: We did this.

DR. COOPER: So we will go on. I think we can skip this also.

Let's just go to the peer review comments and highlight them. First of all, I want to say --

CHAIR APOSTOLAKIS: Can you tell us who the peers were?

DR. COOPER: I don't have a complete list here.

CHAIR APOSTOLAKIS: Well, what you remember.

DR. COOPER: But I can give you some examples. We had some people, international HRA experts such as Oliver Strater and Vahn Dang. We had some other folks from -- some folks from industry here in the U.S. such as Jeff Julius here, Ken Kiper from the Seabrook plant. We had some folks from academia, if you will, Ali Mosleh. As an example, we had folks from other labs. I guess Harold Blackman specifically from INL was included.

Within the NRC, we had Gareth Parry and actually myself. I was kind of a dual role peer reviewer and old author. I'm trying to think who else.

CHAIR APOSTOLAKIS: How can that be so? That's a little bit too much.

DR. COOPER: Well, I'm not one of the workers on this project. I'm just an interested party if you will. So I reviewed it also.

CHAIR APOSTOLAKIS: Hopefully you are not disinterested.

(Laughter.)

DR. COOPER: No, I'm not disinterested. Is there anyone else you would include, Erasmia?

DR. LOIS: Erasmia Lois, NRC. I would like to clarify that Ali Mosleh of the University of Maryland volunteered his services and participated in one of the meetings. He was not a paid --

CHAIR APOSTOLAKIS: Oh, the others were paid?

DR. LOIS: Yes, yes. Everybody else was paid to provide the user's guide. Jeff was paid and Oliver Strater and everybody else except Ali.

CHAIR APOSTOLAKIS: Well, he drives a big car doesn't he?

DR. COOPER: So in the next couple of slides I want to just summarize or highlight some of the comments --

CHAIR APOSTOLAKIS: Yes.

DR. COOPER: -- that we received from the peer reviewers. One of the things that came out, which I guess you could say was a little bit of a surprise to those of us who had been involved in

ATHEANA for some time, is that the reviewers felt that the explicit identification and addressing of the range of error-forcing contexts was viewed as a strength of ATHEANA. And that we needed to make sure that we didn't deviate from keeping that as a focus of ATHEANA. And this is, in a sense, getting back to Alan's presentation and the use of the approximate approach to quantification.

So they felt very strongly that we should focus on the use of the equation where we quantify explicitly the probability of each error-forcing context element and then the probability of the unsafe action for each of those error-forcing contexts. So we should keep those separate. That was one of the --

CHAIR APOSTOLAKIS: I thought you were keeping them separate.

DR. COOPER: Well, as Alan discussed in the previous presentation, the approach for the Palisades PTS specifically and only used an approximate approach where in the quantification process, they ask the experts to try to consider at the same time both some of the very extreme contextual elements and then the associated probability of the --

CHAIR APOSTOLAKIS: So this is more the mixing of aleatory and the systemic?

DR. COOPER: Yes, in a sense, yes.

CHAIR APOSTOLAKIS: But I thought you were addressing the first bullet. Did I miss that?

DR. COOPER: I am.

CHAIR APOSTOLAKIS: Because the first bullet you are separating the two from the equation that Alan showed us.

MEMBER SHACK: But when he did the Palisades thing, he combined them.

DR. COOPER: Yes, the Palisades approximate approach --

CHAIR APOSTOLAKIS: I thought you were showing us.

DR. COOPER: -- did not --

CHAIR APOSTOLAKIS: Anyway, okay, you are doing it.

DR. COOPER: Well, I guess the point is that the peer reviewers made this comment. And, you know, we are considering the comments right now.

Go ahead, Erasmia.

DR. LOIS: Because -- Erasmia Lois again -- because the user's guide, the quantification process described in the user's guide is the approximated process, the simplified. That's what we had included in the user's guide because we believed that one of the ATHEANA criticisms was there is too much, et cetera. So we believed that we can roll it up and do the approximation.

And the reviewers told us no. You should go back to your original.

CHAIR APOSTOLAKIS: Is the document we have the updated document? It includes a response to these?

DR. COOPER: No.

DR. LOIS: The document you have describes the approximation.

CHAIR APOSTOLAKIS: Okay.

DR. LOIS: The simplified process.

DR. COOPER: The document you have is the one that the reviewers reviewed -- the peer reviewers reviewed. So we have not made any updates. We have their comments -- I think all of them at this point in time. And we are in the process of reviewing and evaluating them at this point in time and at the same time would like the ACRS comments as well.

Another one of the --

MEMBER SHACK: Clarification?

DR. COOPER: Yes?

MEMBER SHACK: You say only Palisades. But I mean as I read the Oconee document, you did the same thing in Oconee.

DR. COOPER: No, we did not. No, in that particular case, the error-forcing context was considered separately. However, I mean it was separated out.

I guess one of the -- and we sort of got into this discussion a little bit this morning -- one of the issues that comes out is that what the error-forcing context, it can be expressed or represented explicitly in the PRA model, leaving less for the analysts to assess, you know, in the expert elicitation for the unsafe action. And so I think there were fewer things considered in the Oconee analysis.

It was as detailed an analysis in the sense that we did not consider all of the factors that were considered in the Palisades approach. However, I was not involved in the Palisades. I was involved in the Beaver Valley and the Oconee analysis. So if either John or Alan want to jump in here, I'd welcome them to do so.

But that is my understanding. The Oconee and the Beaver Valley analysis did follow the equation as was presented this morning. But the Palisades analysis approximated that equation.

Another peer review comment that we received was asking us to provide more formal guidance on how we selected error-forcing contexts to be included and how to limit the number of error-forcing contexts.

MEMBER KRESS: That's sort of like our screening thing.

DR. COOPER: This is our screening question that we had this morning.

CHAIR APOSTOLAKIS: By the way, regarding screening, in a different context, I believe it was a report from Brookhaven. They use importance measures to identify important humans that deserve further analysis. And that could be the basis for another factor in the screening process.

You go to the PRA, you find your role or your fussel/vessily. Usually it is risk achievement work. And I don't remember the number.

Do you remember the number? NUREG what?

DR. LOIS: We have been involved in that NUREG as well.

CHAIR APOSTOLAKIS: Well, you guys supported it.

DR. LOIS: Susan supported that.

DR. COOPER: Yes.

DR. LOIS: That is to help NRR people to decide whether or not they build human factors review.

CHAIR APOSTOLAKIS: Yes, so that screening that is done there is perfectly legitimate.

DR. COOPER: Yes, I guess the thing is is that -- well, there are a number of different places within the ATHEANA process or any HRA process in which you could do screening. I think in this particular case where we are talking about selecting error-forcing contexts, in a sense we are also talking about modeling human failure events. So this is, in a sense, identification of human failure events to put in the PRA.

So it is actually sort of an additional thing that we wouldn't -- it is already sort of a step that has been passed over in that particular sense. You've already got a PRA. You go ahead and exercise your PRA. You calculate importance measures. And you decide which -- in this particular case, we are saying well, you are doing a PRA. You are trying to decide what things to model into the PRA. And so there is a different level of judgment -- a different judgment that the user uses.

CHAIR APOSTOLAKIS: Yes but the reason why I mentioned this, before I forget, that it is relevant to this screening process we were talking about earlier. I mean it is not necessarily this comment.

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: There is already a report that deals with the issue of importance of human errors. And you should capitalize on it.

DR. COOPER: We could do something like that.

CHAIR APOSTOLAKIS: It is really the bounding approach that was discussed this morning because importance measure takes zero and one and tells you how important it is. So that would certainly be one of the inputs.

So where are we now? Are you planning to revise this document in response to the comments you get?

DR. LOIS: So we just received these comments. We are thinking of how we are going to -- which -- how many and how we are going to revise.

CHAIR APOSTOLAKIS: But you will revise it?

DR. LOIS: We will revise it.

CHAIR APOSTOLAKIS: So you may have an opportunity to include the comments you are getting today?

DR. COOPER: Yes.

DR. LOIS: Yes, as a matter of fact, in terms of a schedule, the original plan was to have a final version next February. We do not believe that we can achieve that just because of the bulk of the comments we received. And absolutely your input is going to be taken into consideration.

CHAIR APOSTOLAKIS: And how does this work now? Are we going to review this before you issue it? Or this is the last time we see it?

DR. LOIS: It depends on you.

CHAIR APOSTOLAKIS: Do we usually comment on NUREGs?

MEMBER KRESS: We have.

MEMBER SHACK: We have. I mean we certainly don't comment on every NUREG but, you know, this is a NUREG of some impact presumably.

CHAIR APOSTOLAKIS: Yes, I would like to see it again before you decide to go out. I mean unless the members disagree.

DR. LOIS: The recommendation is to also go to pilot the user's guide before we finalize it.

CHAIR APOSTOLAKIS: Yes. I was reading -- we're destroying you presentation here but I was reading the EPRI comments that were sent to me separately and there were a lot of complaints about the time reliability curves. That you guys put them down every chance you get.

DR. COOPER: But is in the next presentation on the methods evaluation.

DR. LOIS: This is the user's guide, ATHEANA User's Guide.

CHAIR APOSTOLAKIS: I thought it was -- oh, yes, you are right. Oh yes, that is a different one.

DR. COOPER: That is coming up after lunch.

DR. LOIS: Okay.

CHAIR APOSTOLAKIS: Okay.

DR. COOPER: Another of the peer reviewer comments was suggesting that we focus on developing point estimates.

CHAIR APOSTOLAKIS: That is a very good comment to ignore.

MEMBER KRESS: Yes, that one surprises me.

CHAIR APOSTOLAKIS: Absolutely.

MEMBER KRESS: Yes.

CHAIR APOSTOLAKIS: Okay? We thought about it and we decided that it is nonsense.

DR. COOPER: Thank you.

MEMBER KRESS: I second that comment.

CHAIR APOSTOLAKIS: Thank you very much.

DR. COOPER: Continuing with the suggested comments, they also suggested was to provide some structure and formalism on the quantification process, I think especially with respect to the expert elicitation process, to support repeatability.

Another suggestion was to provide support on the effective use of the information obtained through the qualitative analysis.

CHAIR APOSTOLAKIS: Let's go back to the repeatability.

DR. COOPER: Okay.

CHAIR APOSTOLAKIS: You guys are probably tired of hearing me say that but, you know, this infamous benchmark exercise from ISPRA, are we ever going to put it to rest? I mean are we ever going to have an exercise of similar scope because, you know, it is there. I mean we cannot ignore it just because it has been 20 years.

MEMBER KRESS: It's like a wart, right?

CHAIR APOSTOLAKIS: Yes, exactly. We have to do something about it.

DR. LOIS: So actually in our plan for next year. And the intent is to have a collaboration with domestic and international entities interested. We had a meeting pre-Sum 8 meeting which was observed observed by many --

CHAIR APOSTOLAKIS: Down in New Orleans?

DR. LOIS: Yes, where, you know, Switzerland and Germany --

CHAIR APOSTOLAKIS: I wasn't invited to it.

DR. LOIS: -- you were not invited?

CHAIR BONACA: That's a message.

CHAIR APOSTOLAKIS: Right there, it is a message.

DR. LOIS: It's a good point but we had it before where on Friday, Saturday, Sunday before the meeting. And it was organized by Halden. So the idea is to use the Halden facilities to address some of these issues. But we believe that it should be addressed through other avenues as well.

And the ISPRA study was discussed extensively.

CHAIR APOSTOLAKIS: Good.

DR. LOIS: Pekka Pyy was there who is learning the international activities on human reliability.

CHAIR APOSTOLAKIS: There is one more

thing though that may be relevant here. It is outside the comments. As I was reading the EPRI comments, it seems to me that this -- another possibility might be to have a joint project with EPRI, not necessarily addressing the benchmark but, you know, we are just finishing this major project from prior modeling where apparently it is -- evidently it is working very well, and, you know, the industry, through EPRI and the NRC staff joined forces and they came up with, you know, the state of the art and this and that.

We have other examples from the past like the common cause failure, a project that also worked out very will. And there may be others that I don't remember now. Maybe this is a prime area to do something like that as well so we don't have the industry saying we are using the EPRI Calculator that has four models and all that. And people are getting very used to it, of course.

And then on the other side, we have the NRC. Maybe we have reached the point o we will reach it very soon where having such a joint effort in view of the benchmark exercise or before the benchmark exercise.

DR. LOIS: So if you want to --

CHAIR APOSTOLAKIS: That might be a good

idea.

MR. JULIUS: Yes, Jeff Julius representing EPRI. Yes, that -- we have discussed that when we went over the ATHEANA User's Guide comments at the meeting in May and that's -- we are talking about -- and proposed a joint collaborative effort.

CHAIR APOSTOLAKIS: Okay. I think that would be a great idea actually.

DR. LOIS: In fact we have a draft MOU with RES and EPRI.

CHAIR APOSTOLAKIS: So you are going to do it?

DR. LOIS: -- to start working on human reliability. And specifically if that goes, our calendar will start out with five events.

CHAIR APOSTOLAKIS: And to see how the best aspects of ATHEANA and with Calculator can be put together.

CHAIR APOSTOLAKIS: And you have a model already from the fire thing, you know, because you have to take care of some administration things. But there is a model there.

DR. LOIS: Yes, as a matter of fact, it would be an extension of the existing MOU for --

CHAIR APOSTOLAKIS: Okay. Boy, this is

great. This is great.

DR. COOPER: Continuing with the peer review comments and also I guess echoing now from the previous presentation another reviewer comment was to provide a more proscriptive connection between plant conditions and HEPs.

This is basically the idea of sort of calibration, I guess, if you will, although I guess your comment earlier, George, was that you were not necessarily in favor of the four values that we provided that would help sort of base the experts.

CHAIR APOSTOLAKIS: Abilities you mean?

DR. COOPER: Right. So this is suggesting actually toward the other direction, providing a little bit -- even more up front or proscriptive or, you know, I guess aids to the experts on how to develop their HEPs.

MEMBER SHACK: The choice is more repeatability.

CHAIR APOSTOLAKIS: Oh, sure. I mean, you know, if you have tables then everybody will come up with the same numbers. But the question is, you know, I think you are on the right track using the SSHAC approach. Now the question is, you know, can you really bring to the table what is needed to do a good job because SSHAC was a big job. I mean there were joint -- speaking of joint efforts, I mean everybody was involved: DOE, EPRI, NRC, you know, and then the Academy reviewed it. So it was a major thing.

But in terms of training the experts, it seems to me you can have a short essay, a couple of pages, explaining the meaning of certain events, you know. One of my favorites is that the age of the Earth's crust is three times ten to the ninth years. That gives you a bound, right?

(Laughter.)

CHAIR APOSTOLAKIS: If you say the probability of something is ten to the minus eight or nine, you are saying we built it at the time and nothing happened since then, you know. But then another favorite reputation is by Emile Borel, one of the great mathematicians of the 19th, 20th century.

He said once, I don't know why because he is dead, I can't ask him, he said once if you witness the occurrence of an event whose probably is less than one in ten, you have witnessed a miracle. There you are.

MEMBER SHACK: I'd like to know the context for that one.

CHAIR APOSTOLAKIS: Well, it is free of

context. But I think some planing would be useful.

MR. PARRY: George, can I -- this is Gareth Parry, NRR. Can I make a comment on this in the context of at least what I remember of the peer review meeting?

I think the problem here is the problem of repeatability. And not just that another set of analysts would do it on that day. But I think you have got to recognize, too, that these PRAs are going to be used as living PRAs. They are going to be updated.

You can't have a process where -- that you have to try and reconstitute the same group of experts all the time when you update the PRAs. So you have got to have the process such that it guides the analysts to coming up with at least a number that is compatible with what was developed.

CHAIR APOSTOLAKIS: Distribution?

MR. PARRY: Yes, well, I mean, you have to I think --

CHAIR APOSTOLAKIS: Easier to do a distribution.

MR. PARRY: Yes, well, no. Distribution, whatever, but it has to be a repeatable process so that the PRA can be updated on a continuous basis.

CHAIR APOSTOLAKIS: Well --

MR. PARRY: And that is really the context in which this was taken.

CHAIR APOSTOLAKIS: I don't know, Gareth. I mean if the answer to that is to have tables, that's probably not such a good idea.

MR. PARRY: No, it's not. But they are not absolute tables. They are tables in relation to -- I think they were more meant to be more like conditional probabilities given certain types of conditions. It's not a table like you would find in THERP, for example. It's a little more -- I think it has a little more --

CHAIR APOSTOLAKIS: Okay, then we will have to look into it. You know I appreciate the conflicting objectives here you know. But maybe you can give a range of possible values given certain conditions or something, yes. That probably makes sense.

DR. COOPER: Another suggestion was to provide more than one way to quantify.

CHAIR APOSTOLAKIS: I don't understand that comment. How can it be?

DR. COOPER: Well, this may again be in context of the approximate --

CHAIR APOSTOLAKIS: Provide more than one model you mean?

DR. COOPER: -- the approximate approach versus the strict following of the equation. It is just another suggestion. Another one is to provide some reference cases to support quantification. This is again --

CHAIR APOSTOLAKIS: Now reference cases, they mean what you showed us on PTS? Is that the reference case?

DR. COOPER: I don't think here so much examples as Gareth was suggesting maybe some examples of contexts and then associated ranges --

CHAIR APOSTOLAKIS: Oh, yes. It's a good idea.

DR. COOPER: -- of possible -- this is something that some other people are pursuing internationally also. And we floated this idea some time ago called GCAPS --

CHAIR APOSTOLAKIS: Okay.

DR. COOPER: -- Generalized Contexts -- whatever. It is something that we could pursue.

Another one is to provide some more definitions for each performance-shaping factor in order to minimize overlap of performance-shaping factors. That was another suggestion.

CHAIR APOSTOLAKIS: But the performance-shaping factors are taken into account in the minds of the experts.

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: So even if there is some overlap, it's okay.

DR. COOPER: I would agree.

CHAIR APOSTOLAKIS: Yes.

DR. LOIS: I just want to clarify we would possibly provide more than one way to quantify. And people were recommending you could use SLIM or you can use any existing method.

CHAIR APOSTOLAKIS: More than one model, yes.

DR. LOIS: Yes, an existing model. I guess that was kind of a --

DR. COOPER: Yes. I mean we could get into the next steps here. And I don't think we maybe want to do that right now.

CHAIR APOSTOLAKIS: Not right now.

DR. COOPER: Let's get your feedback. It seems to me that at least for this particular product that if they want us to focus on the equation, a strict following of the equation, that probably is what to put in this particular product.

CHAIR APOSTOLAKIS: Yes, yes. I mean if you start working with EPRI, there is a benchmark exercise later. After those things, you may want to do this but not in the user's guide I don't think.

DR. COOPER: Okay. Thank you.

More suggestions, this one was to make the user's guide a standalone document as opposed to making it an addition to the addendum. In other words, provide more of the information that was in the NUREG in the user's guide. And then also then to include the retrospective analysis.

CHAIR APOSTOLAKIS: Why are people so interested in retrospective analysis? Who would gain by that?

DR. COOPER: Well, one of the reviewers who suggested this from time to time is here is Gareth. And he can provide his comment on that. I know that from my perspective in working with the Office of Nuclear Material Safety and Safeguards that, you know, there is just basically a benefit to analyzing events using the ATHEANA perspective.

And as a matter of fact, kind of a lot of that kind of analysis went on when we were developing ATHEANA. And I think if you read the NUREG, it suggests that part of sort of the training of the users of ATHEANA would be to either review ATHEANA retrospective analyses or to perform your own to try to help you, you know, understand that perspective and sort of have that in your mind as you are doing that analysis.

So -- I mean I can see the benefit to that, the uses, but whether it is, in this particular product, is, you know, a question that we have to evaluate in reviewing the comments.

MEMBER KRESS: Would you use LERs for that? Or what?

CHAIR APOSTOLAKIS: More than that.

DR. COOPER: Probably something a little bit more detailed resource than that.

CHAIR APOSTOLAKIS: The AIT reports, they are much more detailed.

DR. COOPER: Gareth, do you want to comment?

MR. PARRY: I think we are thinking of things like the accident sequence precursor program and AIT reports and things like that where I think if you are really trying to dig deep into what really caused the events, then you are going to -- you could do research and find out, right.

Well, it is actually to help you analyze those events. Also in terms of analyzing those events, you could then take the information back to feed it forward. But I think it is really more for the analysis of events that we were thinking of.

MR. FULD: I had wondered if there had been any validation done on this method to assess the accuracy of its best estimate results. And the question of retrospective analysis, I guess might afford a possibility to do such a assessment.

CHAIR APOSTOLAKIS: Please state your name.

MR. FULD: I'm Bob Fuld.

DR. COOPER: You know the term validation is a difficult one to -- because I don't know that there are any methods that have been validated in that sense.

But I will say that the development of ATHEANA started with and continued throughout using the basis of analyzed retrospective events. The idea being that we wanted to make this method more realistic, more in line with what had actually happened, while at the same time using the understanding of more recent developments in cognitive and behavioral science. Marrying those two things, what we learned from psychology and also then what has actually happened in real events.

MR. FULD: Okay. So there has been no attempt to validate the probabilities that result?

DR. COOPER: I mean -- no -- and I don't know how you would do that to be real honest.

MR. FULD: Well, no, I mean there has been some attempt to compare reality with analytic results. And I think the Operator ORE studies attempted that with a simulator, which I believe is the method --

DR. COOPER: But that's not a real event.

MR. FULD: -- I think that is the method that got bad-mouthed in the later discussion. But they did try to validate.

MR. PARRY: No, I don't think that is really true. It doesn't validate the probabilities that you derive. I mean the ORE experiments were basically measures of successful operator times. To generate probabilities of failure, you have to assume some extrapolation and take that out to some time limit.

You can't validate those numbers. We didn't -- in those experiments, there were no failures.

MR. FULD: Well, without overstepping my

bounds and without trying to justify their validation exercise, I would simply ask whether there was any attempt to validate any of these results compared to reality. And if events do occur, I mean that would be the sort of empirical data you might compare the frequencies produced by --

DR. COOPER: No formal validation exercise but I mean certainly, you know, part of this work has been, as I said and I'll say it again, was based on reviews of retrospective analysis.

And as a matter of fact, a lot of the focus on errors of commission and addressing errors of commission was based on new reviews of events that involved errors of commission. And what kinds of events those were. And in also trying to address the kinds of conditions under which errors of commissions have occurred.

MR. SAE: This is Nathan Sae. And that being said, of course the whole discussion of benchmark studies gets to that point. Maybe not rigorous formal validation from some standards but some test of reasonableness.

CHAIR APOSTOLAKIS: At least, you know, if the leading analysts and practitioners around the world agree on certain things -- this issue has come back -- has come up in several instances with this Committee especially since the Committee has hardcore engineers as members. How do you validate these?

I mean these are not engineering studies. You know you are not relying on natural laws here. So the concept of validation is very different. And, in fact, I'm not even sure that you can use those words validation.

So, you know, people do the best they can. But you can't really validate it the way that you could validate a new model to do some thermohydraulic analysis for example where you can set up an experiment and naturally measure things. It is a very different beast here.

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: Basically what you are trying -- Bruno deFinetti and his book has a long discussion about these things you know. And his argument is that as long as your assessments are coherent, you are objective. You don't need to do anything else.

But we do want to get into that slide 11 maybe.

DR. COOPER: I just wanted to make -- ask that -- because you were making some head shakes. We would be interested in your comments or response on the idea of making this a standalone document because that has significant impact on how -- what effort we have left.

CHAIR APOSTOLAKIS: I would say to the extent possible. In fact, I've had this problem the last six, eight months with writing two papers that were relying heavily on the previous paper. And the question is now should the new paper stand alone? And what does that mean? I mean if you have to write ten pages describing what was in the other paper, then the reviewers revolt and they say well shorten it. It is too long.

If you put a short description, then they say well gee, you are asking me now to go and find the other paper so --

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: -- I think, you know, make it a standalone to the extent possible. And then use your judgment about what that means. That is my view.

DR. COOPER: Okay.

CHAIR APOSTOLAKIS: I don't know what else to say about it.

MEMBER SHACK: Well, I mean stand alone

could get in the way of a user's guide. I mean a user's guide is sort of meant to get somebody down to the chase rather than a technical justification.

CHAIR APOSTOLAKIS: Right.

DR. COOPER: Okay. Thank you.

CHAIR APOSTOLAKIS: At the same time, of course, you don't want the user every time he or she reads a line to have to go back to the original NUREG to understand what that means, right? So it is a balance.

DR. COOPER: Okay.

MEMBER SHACK: Can we go back to the last bullet on, you know, again the question is when do you do an ATHEANA analysis? Most of the PRAs will certainly not have ATHEANA analysis.

DR. COOPER: Yes. And that, as you picked out here, that is one of the comments from the peer reviewers that we try to provide some additional discussion on when it would be a good time to use ATHEANA.

And these are, you know, some of the examples. And for the most part, these are examples of new applications for HRA or PRA or, you know, going sort of groundbreaking things, things that haven't been done before.

MEMBER SHACK: Well I mean what I would like to know, for example, is can I do my 5069 analysis without this. I mean that is a practical question to me, you know. Am I going to have to go through a justification of my 5069 PRA which will not have ATHEANA?

DR. COOPER: I guess some of this is going to be addressed in the next presentation which is methods evaluation. And then also then this is getting into NRR decisions as opposed to Research's recommendations.

CHAIR APOSTOLAKIS: Most importantly, can I do my significance determination process with other methods? Or do I have to use ATHEANA?

DR. COOPER: At this point in time, this document only addresses HRN-supported PRA.

CHAIR APOSTOLAKIS: Yes.

MEMBER SHACK: That was part of, I assume, Gareth's retrospective analysis. STP would be a natural place to really worry about what your real risk was. I mean sometimes in PRA we are not asking what the real risk is. But it seems to me in the significant determination process, we are asking what the real risk was.

MR. PARRY: Was or could be if uncorrected

I think is the way the STP works. I think it generalizes the conditions.

It is a little different from the accident sequence precursor analysis which is really to see what the risk really was.

MEMBER SHACK: You don't think STP is?

MR. PARRY: No, it's not. It doesn't take all the as-found conditions and it generalizes to try to say what is the impact of the performance deficiency in a more general sense.

CHAIR APOSTOLAKIS: No but it is much more real though because the Agency's actions depend on the result of the STP, right? I mean that is pretty serious.

MR. PARRY: Yes, I think where we end up in difficulties in STP space is where the result of the risk analysis is very much a function of a particular human action, like a recovery action or something like that. We often get into arguments about well, in this case, the operators were able to recover this so we are okay. But really you have to think about well, were they just lucky in that case that they happened to have the right person at the right place?

CHAIR APOSTOLAKIS: Yes, but we have SPARH which means that we do need human error probabilities in some evaluations.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: The question is after this is issued are we going to continue SPARH or are we going to use this in some instances and what are these instances?

MR. PARRY: I can't tell you that but I was trying to --

CHAIR APOSTOLAKIS: Who is going to?

DR. COOPER: I guess one -- and this is getting to next steps and actually I would say it is more than just next steps for the user's guide. I mean I think it is evident to the authors of ATHEANA that ATHEANA is much bigger than just an HRA method to support PRA for specific analyses. It is also the retrospective analysis approach. And then there could be other applications or uses of it.

But I think my opinion is that that is beyond this particular product and there is going to be other developments.

MEMBER SHACK: Just to go beyond this product --

DR. COOPER: Yes.

MEMBER SHACK: -- I mean it seems to me as

Nathan pointed out, you need more of a knowledge base before you can really do a whole lot here. And are there plans to somehow expand that knowledge base by looking at more applications and more examples?

DR. COOPER: Well, I think that is going to be picked up, in part, as we do some of those applications. There has been discussion about the fire work that we are going to be doing.

From my personal perspective, I'm using ATHEANA for a spent fuel handling project for NMSS. Also using the basic principles in the medical area also in NMSS. This is getting more towards retrospective and just kind of the knowledge base but kind of a different knowledge base but still using the same perspective on why errors occur.

So I mean it is -- I think it will be taken into other arenas. But how that -- it is a problem that that knowledge base needs to be developed. But any application in a different area would have to develop that knowledge base as well.

It just so happens that it would end up -- so we'll go on.

CHAIR APOSTOLAKIS: Yes. We really have to stop at quarter of.

DR. COOPER: Right.

CHAIR APOSTOLAKIS: There is an absolute bound which is the show for Adani's celebration.

DR. COOPER: Some of these, I think, are perhaps redundant. Clarify when a full-blown analysis needs to be performed --

CHAIR APOSTOLAKIS: Yes, that's good.

DR. COOPER: -- versus other options. Again, you know, when you can apply only parts of the process and add value. Some of that we tried to illustrate through the PTS example but you know some of it, I think we are recognizing that probably we need to expand our use of examples and then document.

CHAIR APOSTOLAKIS: Wait.

DR. COOPER: Yes?

CHAIR APOSTOLAKIS: Who put that word resilient there?

DR. COOPER: John, is that you?

MR. FORESTER: Actually that came from Harold Blackman.

CHAIR APOSTOLAKIS: This is the new thing, right? Resilient engineering?

DR. COOPER: Yes.

CHAIR APOSTOLAKIS: For the life of me, I would have to call Dan Book. I couldn't understand what they were saying. Alan, do you understand it?

MR. KOLACZKOWSKI: What? The terminology resilient engineered system?

CHAIR APOSTOLAKIS: Oh, yes.

DR. COOPER: I think that goes a little bit beyond just HRA in support of PRA. At least from my understanding.

Suggestions that we just basically clarify and provide more detail on a variety of aspects of how to do things. Add a reasonableness check of HEPs. That is actually part of the good practices. And I think it was more or less an oversight that it was not put in this document.

Clarify terminology, do an actual test of the process. I mean I think the authors would argue that we have done that with the PTS analyses.

Bottom line, our view is that the peer review comments were, in general, positive about the advantages of ATHEANA but they provided a substantial number of suggestions for improving the user's guide in making it more user friendly.

They continue to be positive about the qualitative insights that you can gain with ATHEANA but they want to see more examples. They have a variety of suggestions for improvements, especially with respect to the quantification process. We have already discussed some of those especially with respect to more strictly following the equation and providing more formality and proscriptive guidance.

The comments have suggested that ATHEANA could be a more regularly used tool but we need to provide some more arguments and illustrations as to what its benefits are. And how we can use or how you would use portions of the process as opposed to exercising every single step.

CHAIR APOSTOLAKIS: Well, see when I mentioned something like last time we met, you were opposed to it. So is it possible to do something else first and then for selective -- you said no, you have to use ATHEANA from the beginning. Is that something you are yielding on now? You are more conciliatory?

MEMBER KRESS: More resilient?

CHAIR APOSTOLAKIS: More resilient?

DR. COOPER: Maybe I misunderstood your statement. I think that even in the PTS analyses we did not exercise every step of the process to the degree that it is described in, for example, the NUREG.

You know as Alan described in the example, we did use, you know, borrow from the old work in the 1980s. We did not, you know, go through to the nth degree the identification process for human failure events. We did borrow from some place else. And we didn't go to the level of unsafe actions because it wasn't necessary.

And, you know, also we didn't do very much development of deviation scenarios for the PTS scenarios because they, in themselves, were really deviation scenarios. We didn't have to look far to find challenging context for the operators for PTS.

You know a different kind of scenario, a different kind of application might have been a different story. So we have already had some experience in when you can, if you will, shortcut or, you know, it's just not necessary to use all of the tools that ATHEANA provides. They are there for you to use if you need them if you want to use them.

So, you know, the suggestion is that we provide a little more discussion on how and when you do that in a general sense.

CHAIR APOSTOLAKIS: I don't know if we will decide though that the parenthesis there is true.

DR. COOPER: I'm sorry?

CHAIR APOSTOLAKIS: Why is the prevailing climate that the other HRM methods are sufficient for today's uses. I mean I don't recall any document that said that because just de facto that people didn't want to bother.

DR. COOPER: I guess I'm going to have to defer to someone else. I don't where that --

CHAIR APOSTOLAKIS: Well, I know what it means so let's go on.

DR. COOPER: Well, you know, I don't know whose comment it was. Okay, you want to go on? That's fine with me.

Okay, next steps. We are planning to revise the user's guide on the basis of the peer review comments and your feedback. We will create a revised version. At least at this point in time, our plan is that we will provide a revised version that still focuses on the prospective analysis process. In other words, HRA to support PRA. Provide a revised NUREG next summer.

Because of the interest in the retrospective analysis, it is our thinking that we should provide -- develop a separate user's guide to address that, that being a separate product from, you know, this user's guide that is for HRA in support of PRA.

CHAIR APOSTOLAKIS: Good.

DR. COOPER: And that is as far as our

thinking has gone at this point in time in absence of your comments.

CHAIR APOSTOLAKIS: Done?

DR. COOPER: Thank you.

CHAIR APOSTOLAKIS: Thank you.

DR. COOPER: You are welcome.

CHAIR APOSTOLAKIS: At least one minute early because you didn't have a lot to say.

We will recess until 12:15.

(Whereupon, the foregoing matter went off the record at 11:47 a.m. and went back on the record at 12:21 p.m.)

CHAIR APOSTOLAKIS: The next presentation on the public comments on NUREG-1842. Dr. Lois?

DR. LOIS: Thank you very much. And again thanks for giving us the opportunity to. Very few we just received the public comments and the date was the 16th but people are still sending us.

The intent of the briefing today is to let you know what comments we received and we appreciate your feedback as to how we would address the comments.

I note that I have an inserted page, page 7, because the original printout was not very good.

For the sake of time, the ACRS has seen

this before. The only thing that I would like to say is that we hope that we will have a final version of NUREG-1842 by September.

Again, a reminder, these are the methods we reviewed. These are the methods that are commonly used for regulatory purposes. And, of course, there are domestic methods and our review at this time did not include any of the non-domestic methods that are not used frequently in regulatory space.

Where we received the comments from, we had a public meeting on May. The bulk of the comments came from the EPRI HRA users group. It is a big group that represents 30 organizations composed by utilities, owners groups, contractors, et cetera.

Progress Energy sent also individually some individuals for NRC staff, et cetera. And I'd like to note here that overall the comments we received are very good. And by addressing these comments we'll improve the quality of the NUREG.

Now I note that the objective of 1842, the NUREG, is to evaluate methods and therefore a lot of the good things about HRA were not kind of highlighted. So I think there is a concern that the NUREG creates a negative impression about HRA. And recommendations that the NUREG should be revised to provide a more balanced message.

Highlight that the current tools and methods are sufficient and robust for many regulatory applications and therefore are used successfully in risk-informed decisions.

Now in some cases where we had some strong statements about not being appropriate or not being used on some methods in the future, although there is a split here, some reviewers agreed that this is a good point. We should do that.

Again, a concern that the document implies that the HEPs overall as a group are inaccurate. And, therefore, we should acknowledge that these are models and therefore approximations with uncertainties. And that's not a characteristic for human reliability models only. That is how it goes for hardware failures or all sorts of models.

As a --

MEMBER SHACK: Maybe they are not good approximations.

DR. LOIS: What?

MEMBER SHACK: Maybe they are not good approximations.

DR. LOIS: Well, that's the point. But we can speak to how good an approximation could be. It may be that it is a good approximation.

CHAIR APOSTOLAKIS: Well, that implies that any model would be acceptable. That's a different view of approximation and that is not quite true.

DR. LOIS: Again, I think these comments come from the fact that the NUREG is focusing on the weaknesses of the HRA and it is not out to promote HRA as a tool. And, you know, when you evaluate, you focus on the weaknesses. And I think we should think we can balance out our view by identifying some of these issues.

MR. KOLACZKOWSKI: This is Alan Kolaczkowski. I also -- just to make comment on this one -- I think part of this comment stems from the fact that as I recall, the document probably does talk a little bit about this problem of validating human error probabilities. And so if you take that statement to its fullest, you could begin to make the argument we don't know if these HEPs are accurate or not.

And I think that is being -- at least that is the implied concern that well maybe they are inaccurate because we can't validate them. And so there have been comments made with regards to addressing this thing. It's maybe we shouldn't be saying these things are inaccurate. That we just don't know.

But on the other hand, we believe they are reasonable. They are being used. There is some sense behind the models, et cetera. And we ought to at least acknowledge that in the document. I think that is the point trying to be made.

DR. LOIS: Also, it was pointed out, EPRI pointed out that we used the word method broadly. Some of the methods reviewed are guidance documents on how to do human reliability and there are some methods like ATHEANA, et cetera, that include both how to do an HRA and also how to quantify but comparing across the board all methods against the good practices, it is a little bit misleading. And they do recommend to do a comparison among the quantification tools versus alone both the HRA guidance methods and quantification tools like --

CHAIR APOSTOLAKIS: Maybe you can make a distinction between frameworks and methods.

DR. LOIS: Yes, that is the recommendation.

Many comments we received had to do with not giving full credit to the many capabilities of the

Calculator. And it is pointed out that the Calculator provides a step-by-step walk through on how to do an analysis, about ability to document every step of the process, ability to create repeatable results, and also a big emphasis of the EPRI efforts to provide training to the Calculator users so that the HRAs have been by appropriate expertise.

CHAIR APOSTOLAKIS: But this is kind of a strange situation here. Is there another area in the Agency where the industry is using methodology to do something that the NRC has not reviewed? Would we ever accept that? Why are we accepting it with a Calculator?

As far as I know, the NRC staff has not reviewed, has not issued an SER on the Calculator and the models that are in it. And yet we have applications where the licensee says we did this, we did that. And somebody in NRR passes judgment that this is reasonable and that is it.

I don't know of any other situation where this Agency would accept this.

MEMBER SHACK: MAP calculations are done now for all the PRAs.

CHAIR APOSTOLAKIS: MAP has not been reviewed by the NRC?

MEMBER KRESS: No, it's a major tool for all the PRAs in severe accident analysis.

CHAIR APOSTOLAKIS: What is the rationale behind this?

MEMBER KRESS: It is too hard. I mean it would be a big job to review it I think. And besides that, the current version is an EPRI proprietary version. But we have recommended that it be reviewed by NRC and pass judgment on it, you know, is it acceptable or not?

CHAIR APOSTOLAKIS: Well, anyway, reviewing the Calculator is not such a big job as reviewing MAP. But maybe part of the complaint is the reason why the staff did not get full credit, maybe the staff is not very familiar with the method because they never had to --

DR. LOIS: Well, actually here the recommendation is to provide input as to how the Calculator has been used. And I don't know, we haven't thought how we could address that.

But this is how the practice is, how, you know, the fact that it is training there, how do you make sure that every person in the industry has been trained adequately to be an HRA expert. I don't know how we can pass judgment on something like that.

CHAIR APOSTOLAKIS: In that case, if you plan to work with industry jointly in the future, then that will go away because there will be some consensus as to what are the advantages or disadvantages of doing this and that? And maybe fighting.

MR. JULIUS: Your comments are valid about the tool. I think that this bullet really goes more to the full credit to the capabilities and benefits of the user's group

And the comment there was that the qualification, you needed to be an HRA expert in order to do a human reliability analysis of an HEP versus the, you know, and in their analogy there isn't another area of PRA where we require people to have qualifications in systems training to do fault trees or qualification of quantification so they don't inappropriately truncate. But we are, you know, providing training on HRA. So this is -- it is kind of -- it doesn't fit with the rest of the elements of PRA.

DR. LOIS: Shall I go on?

CHAIR APOSTOLAKIS: Yes.

DR. LOIS: Okay. Another comment again on the Calculator is that it has been revised, Version 3, and the recommendation to include -- revise and review to include the capabilities that have built now. And I guess, for example, an example was given here that Calculator adds guidance on how to perform screening of human actions addressing dependence, et cetera. So these are some improvements that ought to be included.

The report is too strong on the time reliability correlations without providing useful alternatives. I guess last time we were here we all agreed that EOCs are not good and we should say so. When we said so, a lot of people did not like it or did not agree with it. EPRI provides many comments on HCR/ORE and states many of the strengths. It was developed for the implementation phase of the actions proposed to including diagnostic and implementation and were derived from empirical which is something no other method has done with.

And also there is the next phase of the EPRI HRA guidance is going to include guidance on how the HCRs should be issued to be used.

CHAIR APOSTOLAKIS: Well, this is not an issue that puzzles me. But there is some conference in New Orleans. We asked point blank one of the original developers I believe it was, should ACR be used and he said no. I asked another practitioner from a utility and he said no because the curves that we have do not include the data we receive from the operator reliability exercises that were on the high side.

So here we have now people who ought to know telling me don't use the HCR. And yet it is one of the models there. And, in fact, it was the only model that has time in it. And I suspect, for example, when it comes to power uprates, this is the modern thing to use because I can go and find, you know, that for this time, this is the probability. And other times, this is the other probability. No other model has that, okay? And they all come from the licensees and yet two of these people who ought to know say no.

And then I've heard over the years, you know, that common wisdom was that the experiments did not confirm the original assumptions of the HCR. So what do we do with that?

MR. PARRY: George, can I make a point of clarification here? This is Gareth Parry from NRR.

I think what the experiment showed was that the original form of the HCR as proposed back in 1983 was not supported by the experiments. But the ORE program did suggest ultimate time reliability curves.

And I think the person that you talked to who said that you shouldn't use the HCR was probably associated with the original HCR, not necessarily the ORE.

CHAIR APOSTOLAKIS: Well, again, and we don't review this, I mean have you heard anybody saying MAP, a version of MAP is no good? Another version is good? And I don't think so. I mean somehow we have to pass judgement on this as an Agency. What is acceptable? What is on solid ground? And what isn't?

MR. PARRY: Yes but I think you also have to look at it in the context of what decision you are making.

CHAIR APOSTOLAKIS: When you do that, then you will do that.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: But you have to start by saying this year we are going to review this. And then you look at the context or whatever. But you can't just have these rumors flying around. Do it, don't do it, it's the earlier version, the later version. And then just accept the numbers. It doesn't make sense to me.

Jeff, you want to say something?

MR. JULIUS: This is Jeff Julius. Yes, I want to back up what Garret said. I mean actually the first slide of the presentation makes the point that the original HCR was, you know, there are methods that evolve and change. And then first one didn't prove out. And it should be stricken and it should be widely know that that should not be used.

And then later on, the HCR/ORE was validated or not validated but it was backed up with data from simulator experiments and that is the one we recommend you use and we provide guidance on when it should be used.

MR. PARRY: And also, it does have its own limitations but as long as they are recognized when using it to make decisions, I think it is okay to use it.

MR. JULIUS: And I thought the purpose of 1842 is to do the review, correct? That is to review the different methods. The purpose of this document, the 1842, is to --

CHAIR APOSTOLAKIS: Oh, it was based on, as far as I understand, you know what was publicly available. It was not a serious review.

DR. LOIS: This is an evaluation with respect to good practices but not a review of the model.

CHAIR APOSTOLAKIS: Yes, it was not a review of the model. I mean they looked at papers and maybe talked to some people and, you know, this and that.

MR. JULIUS: Well, they were provided with proprietary data from EPRI. EPRI tr'd 100 259 report and any report that they asked for was provided.

CHAIR APOSTOLAKIS: But it was not a review of this particular model. I mean maybe you did and I have no doubt 00

DR. LOIS: But it was not the scope of this evaluation to actually review any of the models in depth. And one of the things that 1842 states is that TRCs in general should not be used. And now the last bullet is I probably will change it to use it with caution.

But I think there are a couple of things. TRCs in EPRI in the THERP method are used for their diagnostic worth while the HCR/ORE has been promoted to be used as part of the implementation phase of the action. Is that a correct statement? No?

MR. FORESTER: No. This is John Forester, Sandia Labs. It focuses on probability of non-response. But included in that is a soon-to-be some sort of diagnosis phase. You know it does address all the way from diagnosis to implementations.

DR. LOIS: But if I understand well the EPRI comments is that the argument is made that HCR/ORE has been developed for the implementation phase of the action. Is that correct, Jeff?

MR. JULIUS: No. It is the probability of non-response. I have a slide that shows a graphical depiction. It is really saying that if you take the cognitive in execution, that there is actually a piece that could be attributed to either this probability of non-response and it's not being able to provide a response in the time that is available.

And again, given that you have correctly diagnosed a situation, you just don't accomplish it in time. And that is similar to the way the SPAR handles it. Where SPAR has in the cognitive modeling, there is a time piece that says that you failed the cognitive because of timing consideration.

DR. LOIS: But you are stating here its failure mode of failing to complete the action of the time available given diagnosis success. That is what you are stating in your comments. So therefore you imply that HCR/ORE should be used given that it has been -- need for the action has been diagnosed.

MR. PARRY: Then that comment is incorrect. And I think you need to check it. Because that is not the intent of the original ORE curve.

DR. LOIS: That's why I put this here because that is what has been stated.

MR. JULIUS: I really meant that it had its feet between both. I mean it was given successful diagnosis that you don't respond so either to complete the diagnosis or to implement the execution.

MR. PARRY: To begin the implementation.

MR. JULIUS: To begin the implementation.

CHAIR APOSTOLAKIS: Does the latest version accommodate those outliers so to speak from the ORE? There were some long times that the original assumption of the log normal could not accommodate. Does it?

MR. PARRY: I don't remember any of those times. I don't remember seeing any of those, George. And I was really involved with our project. I don't remember seeing them so I don't know where that comment came from.

CHAIR APOSTOLAKIS: But why do we have to speculate like this? And why don't we have a serious review of this? I mean what is it that is stopping us? I mean I can't imagine. I mean I have to start writing other comments every time we receive a request for power uprate.

This is, you know, I mean I don't doubt what Jeff is saying but this is not the way to do business. I mean we have done it. You didn't read it very well. Would it take more than six months to do it? I don't think so.

And look at the actual data, convince ourselves that the data are relevant from the simulators, look at the model, the curves that they could use, and pass judgment. And if there are limitations or if it is applicable to certain decisions, that's fine. If it is not, let's find out.

MR. KOLACZKOWSKI: Also, let me -- this is Alan Kolaczkowski -- just to put this in the proper context, I do want to indicate that the current document and the one that was reviewed actually was pretty positive about the HCR/ORE in that it said look, it is empirically based and if you can actually do simulations and get information from such simulations to better estimate the failure probability, we are all for it.

The concern that is expressed in this document and the point of contention that there is is that probably in practice, most utilities cannot expend the resources to do that. And so they end up taking a curve that was created in who knows what context and just say oh, it generically applies to me without testing whether that curve really applies to them or not.

And that is where I think the point of contention begins. It is the same thing with the TRCs. TRCs per se I don't think the authors of this document are necessarily against TRCs. The question is but do you just go to THERP and just use the generic curve and say it applies to me or do you use it in a sense of but I know there are other things that will effect this that I need to account for. And I don't just blindly use the curve and look at it oh, in ten minutes it tells me the failure probability of diagnosis .01 and you just use it.

So I think there is also a miscommunication between what the document was intending to say and, therefore, what the comments came back. And we are going to try to clarify that.

But I want to make the point clear here at this meeting that the document is positive about these in some respects. But the problem is -- what we see is the practical use of them because everybody takes the shortcut. Oh, I'll just use the curve. And they don't even ask themselves necessarily does the curve apply to my plant? To my crews? To my scenario? They don't ask those questions. They just use it. That is our concern.

CHAIR APOSTOLAKIS: Then maybe you could make it clear that you are not --

MR. KOLACZKOWSKI: That's what we plan to do.

CHAIR APOSTOLAKIS: -- against the concept but maybe the specific -- I mean what Alan just said. But I'm still bothered by this. I mean we have this model. The industry is using it. And we have to talk in a meeting like this to each other and why don't we have this document that says here is the HCR/ORE. Here is what it is good for. Here is why you have to be careful. And don't do it. And use something else.

MR. KOLACZKOWSKI: George, I think that's an NRC perception of how important it is. Setting aside resources, et cetera.

CHAIR APOSTOLAKIS: But, you know, our job on this Committee is to raise technical issues.

MR. KOLACZKOWSKI: I understand.

CHAIR APOSTOLAKIS: And I think this is a technical issue. You may very well come back and say everything is fine.

DR. LOIS: Also some people felt that it would be good -- I think that was one of the good feedback we got in the public meeting --

CHAIR APOSTOLAKIS: Excuse me, you mentioned earlier though there is a memorandum of understanding now. Would it be all right to work from human --

DR. LOIS: It is in the works. We tried to establish one. It is a draft.

CHAIR APOSTOLAKIS: Would this be one of the first things you are going to do then if this goes through?

DR. LOIS: It focuses on fire re-quantification to extend that -- it would be an extension of the MOU with EPRI for fire research.

CHAIR APOSTOLAKIS: But that is the administrative part. In terms of the work that will be done, it is fire related? Only fire?

DR. LOIS: Right now, HRA collaboration with EPRI --

CHAIR APOSTOLAKIS: But in your fire context, you still have to worry about time, response, and so on. So I can see you getting together with EPRI and looking at the HRC and ATHEANA and all that and see how we can put these things together.

The context is fire but you still have to look at the model. Nothing stops you from looking at the model.

DR. LOIS: The only concern here is that a fire -- the actions are outside the control room. HCR/ORE, the knowledge base is control room actions. It's not a response time given that the operators have indications, dah, dah, dah, and they don't have to go outside. And they are going to work from procedures, et cetera.

So the underlying technical knowledge is very different than what we may need to have. But I think everything --

CHAIR APOSTOLAKIS: So it is still up in the air?

DR. LOIS: -- everything can be, you know --

CHAIR APOSTOLAKIS: Can you amend it to allow you to do this? I mean when you think about it, this is really a problem issue.

DR. LOIS: We could potentially work a different MOU or use that and extend it or whatever.

Again, some people would like to include in the NUREG an example of applications and say show us how you would do one HRA and what it would take.

This is the resource issue from perspective users of NUREG-1842.

It is noted that the NUREG has bias towards the ATHEANA features, especially the executive summary. A concern that the document implies the need to redo HRA for this application and possibly use new or different methods.

CHAIR APOSTOLAKIS: Excuse me. I thought ATHEANA was reviewed by Jeff. There is some bias.

DR. LOIS: The executive summary was --

(Laughter.)

DR. LOIS: I'm pretty sure Jeff and EPRI provided comments on ATHEANA to the extent, you know, to what extent we have correctly portrayed reviews because the final version was -- we did not give to the extended reviewers the document to be re-reviewed to when we published it for public comment.

Some people challenged us what do we mean by HRA expert. Just to go ahead and define it and recognize the limited resources available for performing comment reliability. I'd like to make a note here. It seems that people are so concerned about human reliability when it comes to resources and I don't know if that is typically done for any other of the engineering approaches or applications.

It seems that it is a little bit biased. Why spend money for human reliability versus thermohydraulic analysis.

CHAIR APOSTOLAKIS: Well, I'll tell you why.

(Laughter.)

CHAIR APOSTOLAKIS: If you can get favorable decisions from the NRC by your reporting a few numbers, why should you go through this? The probability doesn't change much. The reviewer says I agree. Well, that's great.

Would you spend resources on it? No. They are not in the business of advancing the state of the art anyway. They are in the business of running a plant. And of course you should also do it within the ASME Regulatory Guide 14200 and so on. But the question is is that sufficient.

DR. LOIS: Well, this comment here is that -- a recommendation instead of going and doing the evaluation against the good practices, do it against the ASME standard in Reg Guide 1200 because good practices go beyond the ASME standard. For example, talking about EOCs, et cetera.

CHAIR APOSTOLAKIS: Well, the ASME standard doesn't really tell you how to do it. It just says you should do it, correct? So it is not unusual. I mean in other areas we do the same thing.

MR. JULIUS: This is Jeff Julius. But it is unusual because the ASME standard, there is not requirement to look at errors of commission. And the good practices says that it is a good practice to consider human errors of commission. So there are significant differences between the two.

CHAIR APOSTOLAKIS: Does it say you should limit yourself to errors of omission? Does it say that? It says human error as I remember it. But if it is not specifically excluded, and the staff thinks it is important, then it should be considered.

I mean the standard is, you know, kind of an unusual standard. It is pretty high level. The only place where I think it becomes more specific is when it comes to common cause failures because of the existence of this joint project. Where it says specifically, you know, here is a NUREG where you can go and find information.

MR. KOLACZKOWSKI: George, let me try to give an example of the point you are trying to make, too, I think is that the ASME standard, as I -- this is almost verbatim, I think one of the first steps, and it just says you shall use a systematic process for identifying human failure events. Now it doesn't say what that process should be or what the technique should be. But you have to have a systematic process.

Now the good practices tries to offer some things about what a good practice might look like. And then we take the methods and compare it against that. So I mean if we were to take the methods and just compare them to that particular ASME standard requirement, we would say yes, they all have systematic methods or some -- excluding just the quantification only, yes, there are methods out there for identifying.

They are systematic. Yes, they all meet the requirement. We thought that wasn't enough because you try to now evaluate well how good of a job does it do, et cetera, et cetera, you got to get into more details than just is the method systematic or not.

So I'm just indicating that, you know, we are going to do what we can about this particular comment. But to compare them to just the ASME standard in some respects is probably not enough.

CHAIR APOSTOLAKIS: Maybe the message there or the comment is similar to Gareth's comment. Don't forget what decisions you are going to make.

That's really -- that would make much more sense to me.

That all these models should be evaluated within a decision-making context. And because ASME was developed to help risk-informed decision-making, maybe that is what they meant.

MR. KOLACZKOWSKI: Yes.

CHAIR APOSTOLAKIS: Not literally go to the ASME standards unless specifically excluded. Then I think the staff has the right to say we think this is important.

MR. PARRY: I think, too, that you've got to remember that the methods that we are talking about here, like HCR, is only applicable to high-level requirement G in the human reliability, which is just the quantification. And that there are a lot of other requirements that have to be met beforehand which means that you have constructed the model appropriately, you have identified the right HFEs, you defined them appropriately.

And given that, if what the quantification method does is to provide a ranking of those HFEs within a certain acceptable scale, then if you look at an application like 5069, for example, which requires that -- it is the categorization of the components which requires that you do sensitivity studies on the HEPs and take the most conservative of those categorizations, then maybe the details of the quantification method are not all that important as long as you have done the calculation.

And it is in that context, I think, that we have to look at these methods to see whether they are applicable or not.

CHAIR APOSTOLAKIS: I think yes, it should be decision driven because ultimately that is what you want to do, make decisions.

MR. PARRY: Right. And I would argue probably that any decision that was based on an actual number for an HEP is probably going to meet by any of these methods because none of them is validated in that sense.

CHAIR APOSTOLAKIS: The least we can do though is try to understand how the number was produced. And if it is, again, it is a change from 32 minutes to 29, I have no problem. If you go down to less than 10 minutes, though, I do.

Now you are running over.

DR. LOIS: Okay. I think I am done. I note here that we received a comment that we should acknowledge that there is activity out there to build

HRA on simulation using simulation modeling.

CHAIR APOSTOLAKIS: That is a perennial problem. I mean you do learn a lot but the question is how much credit can you give to simulation.

DR. LOIS: Well, the person that recommended this is very enthusiastic about this prospect. And also a comment which was kind of a really -- it was surprising to us -- came from a utility that said why don't you now try to get away from ASEP and THERP and recommend to use actual plant experience for pre-initiator event analysis.

And he is noting that the industry now has been collecting pre-initiator type of data through so many programs which are improving the programs targeting to reduce the human error. In actuality, they are collecting both failures and causes of failures. And also demands. So that was a --

CHAIR APOSTOLAKIS: Are you guys dealing with pre-initiator events?

DR. LOIS: What do you mean dealing with?

CHAIR APOSTOLAKIS: Maintenance errors. You are not. ATHEANA is not doing that. You have an initiating event and then you look at what --

DR. LOIS: But the PRA does.

CHAIR APOSTOLAKIS: But your report here

did not deal with that.

DR. COOPER: Yes, it does.

CHAIR APOSTOLAKIS: It does?

DR. COOPER: I mean to the extent that good practices addresses pre-initiator events as well as post. So I mean it is addressing pre-initiators.

MR. KOLACZKOWSKI: George, remember this is a good practices document. Don't confuse it with ATHEANA. This is Alan Kolaczkowski. Yes, this addresses both pre -- to what extent methods treat pre-initiators, how good a job they do, and to what extent methods treat post-initiating events and how good a job they do.

DR. LOIS: So we are going to publish the submittal publication by September, plan to incorporate the points made. We are not quite sure how yet but we are going to provide clarifications, correct specific inaccuracies, and acknowledge successful use of methods, et cetera.

CHAIR APOSTOLAKIS: You have to define what a successful use is. I mean otherwise you are doing a disservice to the community. Just because somebody -- I mean this was a perennial problem with the retrospective analysis. Mr. Joe Smith came down from the mountain. He said I helped developed this model. I went back and applied to these events and my application was very successful. In other words, it was good, good. Now I did it myself, too, and I was successful.

What is success? What does it mean you are successful? I mean that is the key. Just because they use it doesn't make it successful.

MEMBER SHACK: It was accepted by the NRC.

CHAIR APOSTOLAKIS: It was accepted by the NRC, then it is successful we must admit.

CHAIR APOSTOLAKIS: Okay great.

DR. LOIS: So -- and, of course, we are not --

CHAIR APOSTOLAKIS: So what are you going to say about the HRC? Do you know enough to say anything meaningful that maybe will satisfy the other side? I mean especially if you want to meet the September `06 schedule.

DR. LOIS: I believe the -- I think we have differentiated between HRC and HRC/ORE. And probably we will remain with the comments we have right now for HCR/ORE. The reason is that we have made statements that to the extent to which utilities are willing to run simulator experiments enough to comfort themselves that these curves represent their particular performance for that particular context, that may be, by itself, a very useful exercise. And, you know, as might any other HRE method. Probably we should be acceptable. But we haven't figured it out yet. We have to talk. And, of course, we are --

CHAIR APOSTOLAKIS: Do you have the reports from EPRI on the ORE and all that?

MR. JULIUS: They have at least one.

CHAIR APOSTOLAKIS: I mean the curves themselves. Do you have the report that establishes the curves?

DR. LOIS: The underlying data for them?

MR. KOLACZKOWSKI: This is Alan Kolaczkowski. If you mean do we have the underlying proprietary data, that answer to that is no.

CHAIR APOSTOLAKIS: What do you have?

MR. KOLACZKOWSKI: We have the published report on the HCR/ORE method and how to implement it.

CHAIR APOSTOLAKIS: Well, that gives you a --

MR. KOLACZKOWSKI: But it has the curves in them. It has the curves.

CHAIR APOSTOLAKIS: But you don't know what the basis of the curves is.

MR. KOLACZKOWSKI: That is correct.

CHAIR APOSTOLAKIS: So this criticism that the outliers have not been included we cannot pass judgment about.

MR. KOLACZKOWSKI: To my knowledge, I think that is a true statement.

MR. FORESTER: Yes, John Forester, Sandia Labs. There is volume three, I think, of the results of the experiments that we are doing.

MR. PARRY: Volume two. It is volume two.

MR. FORESTER: No, there is volume -- I'm pretty sure there is a volume three.

MR. PARRY: Oh, I'm sorry. You are right, yes. You are right.

MR. FORESTER: The first two volumes, the second volume does provide some discussion of the basis for the curves. But the data is not there.

MR. PARRY: Right.

CHAIR APOSTOLAKIS: Is it one curve? A family of curves?

MR. PARRY: Family with different --

MR. FORESTER: But see the issue there of the data is that everybody has pretty much agreed that the generic curves that were obtained from ORE probably shouldn't be generalized to all plants. What plants should do is run their own simulator exercises for a range of scenarios, a range of variations of particular scenarios so that they have enough data that they are confident that they have represented that range, they have ran it through enough crews.

And if they do all that for all the scenarios then that is a very useful exercise to do. But again, as we pointed out, that is a very difficult and requires a lot of resources. And plants are probably not intending to do that.

So they may use the generic data. And I think everyone is in agreement that that is not a good idea.

CHAIR APOSTOLAKIS: Well, you have -- there are three volumes and you have two of them.

MR. FORESTER: Yes.

CHAIR APOSTOLAKIS: And we can get those, too?

MR. FORESTER: Yes.

DR. LOIS: Probably we should -- yes, I think we can forward it to --

CHAIR APOSTOLAKIS: I don't know how it works but I mean if you have given them to the staff, probably we can get them, too.

MR. PARRY: The first two volumes I think were not proprietary. But the third volume was. But the first two were not.

CHAIR APOSTOLAKIS: The staff can get proprietary information, too.

MR. PARRY: Right. But, George, you might also ask about the data that underlies the third because I don't know if anybody has ever reviewed that either. Certainly not in the last 25 years.

CHAIR APOSTOLAKIS: I think it was from the NRC wasn't it?

MR. PARRY: No. I don't think so. Yes, that was done for -- yes, they developed third. But the data tables in there and the basis of them, I think that is lost in time.

CHAIR APOSTOLAKIS: But don't they say up front in the introduction that this is really based on our overall experience? They never claimed that they relied on data.

MR. FULD: Well, they claim they rely on data to some extent.

CHAIR APOSTOLAKIS: To some extent, yes.

MR. FULD: This is Bob Fuld. But the THERP -- the 1278 I believe is the number is well caveated with the limitations in data sources.

CHAIR APOSTOLAKIS: In fact, I admire that because they wrote it when it was not fashionable to do that.

MR. FULD: Right.

CHAIR APOSTOLAKIS: They said, you know, we have experience with all sorts of industries but when it comes down to it, it is our job.

MR. PARRY: So you would accept that for THERP but not for HCR/ORE?

DR. COOPER: Susan Cooper, Research. This methods evaluation has not -- and it wasn't in the scope of it to examine the technical basis for any of these methods. Only to examine how the methods match up to good practices and in some case, you know, if there are limitations in the way the methods are supposed to be applied based on their technical basis, you know I think that the intent was to address that also.

But there was -- it was never within the scope of this effort to examine the technical basis of any of the methods.

CHAIR APOSTOLAKIS: Okay. I guess we are done. So we are going to see the revised report at some point?

DR. LOIS: Our objective is to submit it to publication by September. We can certainly, as soon as we have the final version, forward it to you.

And typically we give NRR the opportunity and we will give the opportunity to comment before we publish it.

But we do not plan to come back and brief you again on how we would address those. So if you have specific recommendations on how we should address, those comments we would welcome them.

CHAIR APOSTOLAKIS: Well, you know, coming back to the THERP issue, I think the answer to that is the Agency decided to spend a hell of a lot of money on developing ATHEANA.

So that tells you something about how it was accepted. Maybe nobody came out like I just did and said, you know, this is not good. We haven't seen the basis. But the actions of the Agency do demonstrate that there was unhappiness with that.

And then the industry, at the same time, did the same thing. So, you know, they didn't come out and say well gee, you know what is this. But by their actions, they demonstrated that they were unhappy with the basis.

And for the time being, it was okay. You know they did the best they could. In fact they pioneered the whole thing.

So, you know, there are many ways you can look at this. And the second argument is about precedent. We should not repeat it again.

Now we will go -- we don't need a transcript any more. Thank you very much. It is over, this discussion is over.

(Whereupon, the above-entitled meeting was concluded at 1:07 p.m.)