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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

COMBINED THERMAL-HYDRAULIC PHENOMENA/

FUTURE PLANT DESIGN: SUBCOMMITTEE MEETING

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ROCKVILLE, MARYLAND

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THURSDAY,

FEBRUARY 14, 2002

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, T2B3, 11545 Rockville Pike, Rockville, at 8:30 a.m., Graham B. Wallis, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

GRAHAM B. WALLIS, Co-Chairman

THOMAS S. KRESS, Co-Chairman

DANA A. POWERS, Member

VIRGIL SCHROCK, Consultant

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

STAFF PRESENT:

PAUL A. BOEHNERT
MAGGALEAN W. WESTON
MEDHAT EL-ZEFTAWY

ALSO PRESENT:

JOE WILLIAMS
DALE SPENCER
BOB KERESTES
HAROLD CROCKET
FRAN BOLGER
TIM BYAM
LARRY WESTBROOK
JASON POST
KENT SCOTT
ISRAEL NIR
BILL BURCHILL
KEITH JURY
TAD MARSH
JON HOPKINS
GEORGE THOMAS
TONY ULSYS
RICHARD LOBEL
DAN PAPPONE
ED THROM
ZEENA ABDULLAHI

ALSO PRESENT (Continued):

JARED WERMIEL
MOHAMMAD SCHUABI
DAVID SHUM
ANDRZEJ DROZD
JIM LYON
LARRY BURKHART
JERRY WILSON
GOUTAM BAGCHI
DAVID TERAO
RICHARD ORE
MIKE CORLETTI
STEVE BAJOREK
MARINO DI MARZO
WILLIAM BROWN
KATSU OHKAWA

C-O-N-T-E-N-T-S

C-O-N-T-E-N-T-S

P-R-O-C-E-E-D-I-N-G-S

(8:33 a.m.)

CO-CHAIRMAN WALLIS: The meeting will please come to order.

This is the second day of the meeting of the ACRS combined Subcommittee on Thermal-Hydraulic Phenomena and Future Plant Designs.

We will continue to hear from the AmerGen Company about the application for extended power to operate at the Clinton Power Station, Unit 1. And then we'll take a break at about ten o'clock, and then we'll hear from staff.

MR. BYAM: Good morning. I'm Tim Byam with AmerGen, and we're prepared at this point to answer the one question we took away with us yesterday.

I'd like to turn it over to Joe Williams.

MR. WILLIAMS: Thank you.

Joe Williams, Exelon Nuclear.

Yesterday during the flow accelerated corrosion presentation we stated that the highest wear rate location predicted for the power upright flow accelerated corrosion calculations was 70 mLs per year versus a 38 mLs per year predicted for pre-EPU conditions.

The question was asked what the actual measured wear rate has been at that location. Bob Kerestes of AmerGen will provide a response.

MR. KERESTES: Good morning. My name is Bob Kerestes, and we did some checking and the actual wear rate is 20 mLs per year. We have looked at this area three times in the past. So we have a good baseline from which to start.

MEMBER POWERS: Does that imply that the post EPU corrosion rate will be 52 mLs per year?

MR. KERESTES: I don't think you can necessarily say that it's going to, you know, double or be uniform, and that's why we have an erosion/corrosion, flow accelerator corrosion program that we look at, and we will continue to monitor this area.

MEMBER POWERS: Could it be 88 mLs per year?

MR. KERESTES: Again, you know, we will continue to monitor this and look at it, and it's going to change, and we need to look at it closely.

MR. WILLIAMS: We believe the calculation, the prediction is conservative. We can provide additional information from our flow accelerator corrosion specialist.

MEMBER POWERS: Well, I mean, it looks like it's 100 percent at certain -- when the air range is equal to the major value.

MR. WILLIAMS: Harold?

MR. CROCKET: Harold Crocket.

In addition to what Bob just said, we do have inspections ongoing. This particular line has replacements scheduled for refueling outage ten, which will be two cycles from now. So we do have scheduled replacements, and as he stated, it is in our program, as are the other lines in the steam cycle.

MEMBER SHACK: What kind of a line is it?

MR. CROCKET: It's scavaging steam goes from the moisture separator reheater to the heaters.

CO-CHAIRMAN WALLIS: It's just pure steam going through there?

MR. CROCKET: The quality of the steam is a mix. I don't remember the exact numbers.

CO-CHAIRMAN WALLIS: So they are all droplets in there. So this is probably why the wear is so high.

MR. CROCKET: Yes, sir. And these lines throughout the industry are noted for being fairly high wear.

MR. BOEHNERT: You're indicating that I

guess eventually these lines are going to be -- all of them are going to be changed out

MR. CROCKET: Normally we would upgrade this type of line to a chromolly or stainless, usually chromolly. But we don't automatically upgrade unless we see a significant amount of wear either in a sister train or that type of thing. Normally we would inspect first.

MR. BOEHNERT: Sure.

CO-CHAIRMAN WALLIS: Anymore questions about this issue?

MEMBER POWERS: Well, I guess the next question, I mean, what you're concerned about is some sort of a surrey event where we get surprised and suddenly we fry workers and things like that. With this kind of uncertainty in the calculation, of course, the next thing you ask is: are there areas where CHECKWORKS predicts there's no problem and, in fact, there is a problem?

CO-CHAIRMAN WALLIS: Well, is CHECKWORKS always conservative?

MEMBER POWERS: Yeah, I mean, that's what you're asking.

CO-CHAIRMAN WALLIS: What kind of uncertainty are we talking about?

MR. CROCKET: CHECKWORKS, part of the planned operation of the code is that you do ultrasonic inspections to refine the analysis, and you input your actual measured wear form your UT exams back into the program, and it has what's called a line correction factor that refines those predicted wear rates.

So, yes, they acknowledge that the code is just a tool.

MEMBER POWERS: Well, I mean, the challenge you face is that where you do those UT inspections is where the code tells you you ought to do the UT inspections; is that correct?

MR. CROCKET: The code is one tool that we use. The industry interaction has been really excellent in the realm of fact, and EPRI sponsors meetings twice a year. We talk about where everybody is working and what's the right solution, either material upgrade or changes to the piping system itself, if you need a larger diameter line to cut back the velocity or whatever, whatever is appropriate for the specific location.

CO-CHAIRMAN WALLIS: With this particular line now, you've changed the steam conditions. You've got more pressure drop from the boiler to the turbine, a different kind of wetness, different pots in the cycle. It might well be the steam scavaging line would see significant change in dryness fraction. So it's not clear that it's all that predictable what's going to happen.

MR. BOEHNERT: Dana, I don't --

CO-CHAIRMAN WALLIS: Is that a true statement I've made or do you take issue with that?

MR. WILLIAMS: We believe it is predictable by the CHECKWORKS methodology, correct?

MR. CROCKET: The code has largely proven very reliable, and there have been few occasions that they have upgraded the analysis, but they always are looking at refinements and periodically have new releases of the code to acknowledge certain things either in chemistry or different -- where the industry is learning about.

MEMBER POWERS: CHECKWORKS seems to get used broadly within the United States. I notice the Taiwanese developing alternatives to CHECKWORKS. Has anybody looked at those to see if they're more useful, less useful?

MR. CROCKET: There is one site in the domestic utilities that does not use CHECKWORKS, and that site uses three analysis. So it's proven very reliable, and there are other foreign utilities that also use CHECKWORKS, and we have not seen a reason to switch over from an industry perspective.

CO-CHAIRMAN WALLIS: Does CHECKWORKS put in something about the flow regime when you have droplets in the steam?

MR. CROCKET: It recognizes steam quality.

CO-CHAIRMAN WALLIS: It does? It has some way of handling that?

MR. CROCKET: Yes, sir.

MEMBER SIEBER: That's provided you know what it is.

CO-CHAIRMAN WALLIS: Mostly you know where the drops are. When you have a bend --

MEMBER SIEBER: That's right.

CO-CHAIRMAN WALLIS: -- you get subterfuge and they come off --

MEMBER SIEBER: Yeah, it heats up the end of the bend.

MR. BOEHNERT: Several years ago, well, I guess it was four or five years ago, Fort Calhoun blew out a pipe, and they were using CHECKWORKS. In fact, we had Mr. Checks in here to talk about it.

MEMBER SIEBER: Yes, yes.

MR. BOEHNERT: And his allegation was or

he said if you use the code properly, it works right. And as I recall, Fort Calhoun, I don't believe they were using the code, what they should have done because they went back and looked at the code again, and the code, indeed, predicted that area that blew out was a problem, and they had missed it the way they were applying the code.

So the code has been shown to be quite reliable when it's properly used.

MEMBER SIEBER: Yeah, there's another way that you can get into trouble, which is usually you don't analyze the whole plant. You, you know, start with the very large pipes and go down to some level. Unfortunately, erosion/corrosion will eat away any pipe, and a lot of the smaller lines are just as susceptible as the large ones, which leads to the question of how far down in pipe size do you go to do analysis for Clinton.

MR. CROCKET: We do all susceptible piping that's in our program, and if the information is not there for the analysis, we do inspections that are commensurate with that.

But there is no size restriction that we don't go beyond. We have one inch, two inch, socket weld fittings that we do exams on and replacements, and it's all in the program if it's in the steam cycle.

MEMBER SIEBER: Okay. Thank you.

CO-CHAIRMAN WALLIS: Are we finished with this issue now?

Return to the original plan?

MR. WILLIAMS: Yes, sir, and thank you, Dr. Wallis.

I would like to introduce Larry Westbrook.

MR. WESTBROOK: Good morning. My name is Larry Westbrook of AmerGen. I am the Clinton Power Station senior reactor operator, leading the EPU power ascension testing team.

I will be discussing large transient testing.

First, allow me to provide some background related to large transient testing. ELTR1 specifies that large transient tests be performed. One specified test is closure of all main steam isolation valves at 110 percent of original licensed thermal power.

The second specified test is a generator load rejection at 115 percent original licensed thermal power. AmerGen has taken exception to these tests as an unnecessary challenge to the plant.

General Electric has concluded that large transient tests are no longer necessary when reactor steam dome pressure is unchanged. Supporting this conclusion are the following.

Clinton Power Station reactor steam dome pressure remains the same following power up-rate. Large transient tests will provide no significant ne information, and existing modeling code adequately predicts plant response.

Next, I would like to present AmerGen's methodology for exempting large transient testing. First, we have reviewed industry power up-rate experience and determined that similar plants have demonstrated acceptable performance following large transients. kkL performed planned transient testing at up-rated conditions with acceptable results.

Also, an unplanned generator load rejection at Hatch at up-rated power levels showed that the plant responded as expected.

Second, performance of plant structures, systems and components, at Clinton Power Station has been evaluated at EPU conditions and determined to be acceptable.

Also, surveillance testing will confirm that plant structures, systems, components maintain their required performance capability.

In conclusion, large transient testing will provide no new significant information. This is supported by the following.

Plant response to large transients at extended power up-rate conditions will not change significantly as demonstrated by acceptable transient modeling code results and operating experience at similar up-rated plants.

Based on evaluation and existing surveillance testing, Clinton Power Station structure, systems, and components will perform as designed. Therefore, large transient testing is not required at Clinton Power Station.

MEMBER POWERS: Can you show us an example of the plant response to transients before and after the upgrade?

MR. WILLIAMS: I think your question is getting at the details of the transient.

MEMBER POWERS: You can just point to it in the documentation if it's in there.

MR. WILLIAMS: I believe it is. G.

MR. WESTBROOK: Could you repeat the question, please?

MEMBER POWERS: A key element in this

conclusion slide is the plant response to these transients as a result of EPU not changed significantly based on modeling, and I was just asking is there some demonstration of that equivalency of response.

CO-CHAIRMAN WALLIS: That's about the only conclusion that can be tested. Statements such as plant components will perform as designed is a statement of faith. What you really mean is that you think there's a high probability that they will perform as designed.

And the same thing about tests will not provide new significant information. You've got a couple of tests already. One more, that's not a very big base of tests. So, again, these are probablistic statements. You think it's not going to provide new information.

It will provide new information. You just don't think the information is going to be very useful.

MR. WESTBROOK: That's correct. I don't think that the information that would be provided will be significant or --

CO-CHAIRMAN WALLIS: But if it were to result in a failure or something, that would be extraordinarily useful information.

MEMBER POWERS: Without a doubt.

CO-CHAIRMAN WALLIS: So something is happening here about assessment of the likelihood that the plant will perform as designed.

MR. WILLIAMS: G.E.?

MR. NIR: Israel Nir, G.E.

What I would like to add is that typically the actual events at the plant will turn out to be very benign, and we have discussed this with you in other occasions. There are control systems in place and protection systems that actuate specifically to address this large transient, and the end result is that typically we see a very small increase in neutron flux, you know, a pretty minor change in peak pressure.

And that has been demonstrated analytically, and that is what is expected from an actual event.

Now, to actually test the type of things, I think, that you may have in mind, you really need to impose some restrictions or come up with a sequence that may represent some risk to the plant, and it is just not advisable, such as, for example, have the bypass, turbine bypass inactivated.

So this type of sequences will not occur during the actual plant events, and they will result in a very benign event.

MEMBER SHACK: The prediction is made that you've done these calculations and comparisons for kkH and kkL. I mean, all you have to do is essentially show the comparison presumably.

MR. NIR: Right, and we have -- in other occasions we have shown this Committee -- excuse me -- last year we have shown you some comparisons for kkL. kkL happened to be a plant that has 100 percent bypass capability, and again, the comparisons are good, and they effects are very benign.

MEMBER SCHROCK: I guess I continue to be puzzled by what prompted G.E. to require the testing in the ELTR originally. What has changed that changed the G.E. position?

MR. NIR: I would say two elements. One, it was a new program. It was, you know, a major step forward. We had to consider the entire licensing process, and that at the time appeared to be the right thing to do.

The other thing is that we included in the ALTR allowance for increasing dome pressure of up to 75 psi. That is not the case here. There's no increase in pressure.

Based on our experience, and now that we have performed analysis for a large number of EPUs and actually implemented a few, our position is that if the dome pressure is not increasing, we don't see the value for these large transients. Our judgment is that, again, there is no significant information that can be extracted from them.

MEMBER POWERS: I guess I'm still struggling to understand the basis of the second point here. I mean, the statement is made that we've modeled before and after and it looks the same. Does it? I mean, can you show me that this is the case?

MR. NIR: Yeah. That's, again -- I believe that we already shared some f this information with the committee, but we can -- we can definitely review it with you and show you some comparisons.

CO-CHAIRMAN WALLIS: Can you find it this morning?

MR. NIR: This morning? Yes.

MR. POST: This is Jason Post.

For example, I have an ATWS comparison. It's not exactly what we're after, but I mean, I have that that we could show them if that's --

MEMBER POWERS: I mean, you looked at

something in order to write the sentence down on the viewgraph. If that is an adequate demonstration of the truth of the second point, then let's see it.

MR. BOLGER: This Fran Bolger from G.E.

When we presented a few weeks ago, I presented for a AAOO licensing evaluation a low rejection type transient before and after EPU. Would you like to see that comparison?

MEMBER POWERS: Well, is it done for the Clinton plant?

MR. BOLGER: No, it's not.

MEMBER POWERS: Well, then it's not very useful, is it, to support this statement?

MR. BOLGER: The plants have shown a very small change of their flux response to a low rejection type event. All the plants that we've analyzed have shown a similar type, very small change.

Yesterday when we presented the results of the transient analysis, the decrease in the calculated operating limit was presented to you. If that were looked at in more detail, it would show that there's a reduction in the integral flux peak before and after power up-rate, and as was stated yesterday, that was primarily due to change in the fuel characteristic and not due to the power up-rate.

CO-CHAIRMAN WALLIS: I think we have seen these figures before, but I'm trying to just get a picture in my mind. I think a blue and a red curve or something with these.

MEMBER POWERS: I simply don't recall any pictures for Clinton

CO-CHAIRMAN WALLIS: Oh, I don't know for Clinton.

MEMBER POWERS: Well, I mean, we're talking about Clinton here.

CO-CHAIRMAN WALLIS: He's saying Clinton is very close to the other plants.

MEMBER POWERS: I mean the other ones we were talking about, BWR-3, I think.

CO-CHAIRMAN WALLIS: That may well be true. That may well be true.

Perhaps you could dig something out to give us before the --

MEMBER POWERS: There must be something that existed in order to write the second bullet down.

CO-CHAIRMAN WALLIS: Yes, that's right. That's the only one which can really be tested by evidence, isn't it, without doing the test?

MR. WILLIAMS: Yes, we will.

CO-CHAIRMAN WALLIS: Okay. Thank you.

MR. BOLGER: Let me clarify the request. Would you like to see the Leibestodt comparison?

CO-CHAIRMAN WALLIS: Like to see a Clinton comparison that supports conclusion two or something from a plant which you can show is very, very close to Clinton for some reason.

MEMBER POWERS: The technical basis by which conclusion number two was reached.

CO-CHAIRMAN WALLIS: And if you have a code prediction for the same event, that would also help to reinforce some of these statements. The existing modeling code adequately predicts plant response, but there you'd have to go to something like Leibestodt. We've seen that before.

MEMBER POWERS: That's the first question.

CO-CHAIRMAN WALLIS: But if you happen to have it, it might be useful to remind us of it.

With that request for information, are there any other points that the Subcommittee wants to raise?

(No response.)

CO-CHAIRMAN WALLIS: All right. So let's move on then. We'll return to this question later.

MEMBER POWERS: We might share with everyone that part of our challenge that we face here is that we have a member not present in the Subcommittee meeting that disagrees with this conclusion that transient testing is not correct, and we were unable to persuade him of the wisdom of not testing based on hand waving arguments.

So more hand waving arguments presumable are not going -- we're not going to wear him down.

CO-CHAIRMAN WALLIS: Maybe he'll persuade us this time.

MEMBER POWERS: And he might well persuade us this time.

CO-CHAIRMAN WALLIS: Okay.

MR. WESTBROOK: The next topic I would like to discuss is ATWS event response.

The Clinton Power Station extended power up rate ATWS event response operator actions are unchanged from pre-EPU conditions. For example, reactor power and flow response to reactor recirculation pump trip during an ATWS remains unchanged from pre-EPU conditions. This is a result of no change in the flow control line.

The symptomatic conditions for ATWS, greater than five percent APRM power following a scram initiation and shutdown criteria not met remain unchanged for EPU conditions.

The mitigating operator actions remain unchanged for controlling reactor power, water level and pressure. These mitigating operator actions include standby liquid control initiation, lower reactor water level, and alternate control rod insertion.

CO-CHAIRMAN WALLIS: The first statement there, I'm trying to figure out what you're saying. The reactor power and flow is unchanged from what it was pre-EPU. Is that what that says? You have the same power before and after EPU?

MR. WESTBROOK: That's correct.

CO-CHAIRMAN WALLIS: That's a bit strange if you've got a power up rate.

MR. WESTBROOK: That is following the reactor resert. (phonetic) pump trip.

CO-CHAIRMAN WALLIS: Once you trip the pump, the reactor power becomes the same as it was pre-EPU?

MR. WESTBROOK: That's correct.

As a result of a plant specific analysis, the minimum allowable standby liquid control boron concentration was raised to insure that the rate of negative reactivity addition during an ATWS remains acceptable.

The table compares analytical results for EPU ATWS versus original license thermal power ATWS and design limits. This shows the small changes in ATWS related peak parameters will occur due to EPU conditions, and that the peak parameters will remain within design limits.

The small magnitude of these parameter changes and the fact that they remain below limits supports the adequacy of existing operator actions to mitigate an EPU ATWS event.

MR. BOEHNERT: How much did you have to raise the concentration of boron?

MR. WESTBROOK: Actually we're not changing the concentration that we maintain, but we had a very low minimum level. It was 10.3 percent, and we essentially made the minimum allowable 10.8 percent.

CO-CHAIRMAN WALLIS: Are these numbers dependent on proper operator actions?

MR. WESTBROOK: Yes.

CO-CHAIRMAN WALLIS: And they have less time with the power up rate than they had before?

MR. WESTBROOK: No, that's not correct. They have the same time.

CO-CHAIRMAN WALLIS: The same time?

MR. WESTBROOK: That's correct.

CO-CHAIRMAN WALLIS: So the operator actions are all the same as before?

MR. WESTBROOK: That's correct.

CO-CHAIRMAN WALLIS: Do they have to take action to avoid an instability region or something like that?

MR. WESTBROOK: During an ATWS, they will always observe for instabilities and take the actions as directed by the EOPs.

CO-CHAIRMAN WALLIS: So they could get into an unstability region during an ATWS event.

MR. WESTBROOK: That's correct. However, the EOPs are designed to compensate and to mitigate those oscillations.

In conclusion, Clinton Power Station has implemented an ATWS mitigation strategy consistent with the BWR owners group emergency procedure guidelines. Therefore, EOP operator actions remain unchanged for EPU conditions.

MEMBER SHACK: Now, is it my memory that's faulty that in the previous up rates we did see a change in the operator response time for the ATWS so that Clinton is different in that respect?

MR. SCOTT: This is Kent Scott from

AmerGen, senior reactor operator.

I believe in the next presentation that Bill Burchill gives us on probablistic risk assessment, we'll see that the allowable times for operator actions are somewhat reduced, but also the key is that the magnitude of that reduction in time has no impact on the actions that we take.

So we're taking the same actions. We're doing them the same way, but as opposed to having 31 minutes to automatically depressurize the unit, now we've got 28 minutes to do it. They're of a magnitude where it's easy to do those actions. We can get those done in that same period of time.

MEMBER SHACK: But when these calculations are done, they're done assuming the operator does something at a certain time, and that time is the same for before and after the EPU.

MR. POST: This is Jason Post of G.E.

That's correct. The example operator action time are injection of boron and initiating the RHR suppression pool cooling, and we use exactly the same operator response time in both cases.

MEMBER SHACK: What is that response time that was used in the calculation?

MR. POST: For RHR, I believe it's 11

minutes after the beginning of the event, and for boron injection it's about two minutes after the beginning of the event, and we use the same in both pre-EPU and the EPU.

CO-CHAIRMAN WALLIS: So you expect the action at 11 minutes, but the time available is 28 or 31, whichever?

MR. POST: The time available in the PRA analysis --

CO-CHAIRMAN WALLIS: In order to success, to be on the right path of succeed.

MR. POST: Right.

CO-CHAIRMAN WALLIS: So if the operator waits for 35 minutes, then it might be off on some other path.

MR. WESTBROOK: Next I would like to introduce Mr. Bill Burchill, Exelon Nuclear.

CO-CHAIRMAN WALLIS: This is where we need our PRA expert, keeping a reserve.

MEMBER POWERS: We have on the committee the classic problem. We have not one PRA expert, but two or three, and as in all things of this nature, they simply disagree.

CO-CHAIRMAN WALLIS: Well, Bill is going to explain it so that even we can understand it.

MR. BURCHILL: Thank you, Dr. Wallis.

Good morning. My name is Bill Burchill. I'm the Director of Risk Management for Exelon. Good morning, and happy Valentine's Day. I hope you've all bought your flowers. Your wives will be happy if you've done that. Just a little reminder.

I'm here to present the results of the evaluation of risk impact of the EPU on the Clinton Power Station. This, as you know, is not a risk informed submittal, but according to the ELTR-1, risk evaluation will be done, and as you may also know, an ELTR-2, a generic evaluation was performed.

That generic evaluation was for a smaller power up rate than is being proposed here for Clinton, and we have, therefore, done a plant specific evaluation.

The presentation that I'll go through this morning is very similar to one that we discussed a couple of months ago for Dresden and Quad Cities, but I'll point out that the Clinton Power Station experienced much less impact in the risk area than did Dresden and Quad. The numbers there were small numbers. Here are even smaller. So we'll discuss that.

The purpose of the evaluation is to use

generally accepted risk metrics, core damage frequency, and large early release frequency to measure the risk impact of the changes being proposed for the plant.

We've done quantitative evaluations using the full power internal events, PRA model, and we've done quantitative evaluations of individual effects where we had other quantifying tools. Where we did not, we did qualitative evaluations, particularly in the area of external events and shutdown operation.

We've identified revisions to the PRA that would be made to represent the plant following the EPU. These revisions were represented in sensitivity studies. During our risk evaluation, they will be folded into the PRA at its next scheduled update.

The subjects that I'll cover age essentially the same as I discussed with you a few months ago, the quantitative, the qualitative, and then a summary of the risk impact.

The methods that we used were to identify the plant configuration changes due to the EPU. This involved examining all of the hardware changes, procedures changes, operating condition changes, and set point changes.

The principal change, of course, here is the power level. As a number of speakers before have noted, there is really very little change to this plan in terms of actual hardware and operation other than the power level. Most of those changes are out in the balance of plant or in the switchyard.

The primary components' pumping equipment and so forth that we have available for mitigating core damage essentially are remaining unchanged in the EPU state. So there's no change to RCH RHR high pressure core spray, low pressure core spray, ECCS. NPH limits remain the same, and the service water remains the same.

The only change that I'm actually aware of is that there is a change out of impellers in the TBBCW, but that has very little impact, and no impact at all on dependencies.

We used the most recently updated PRA model. As the staff noted in their SER, the Clinton PRA has had a lot of attention over the years since its initial development in the IPE days. They seem to update more frequently than most that I'm familiar with, and the most recent was in December of 2000.

I will point out that that update was motivated by the fact that we were about to submit a license amendment request to extend the emergency diesel generator allowed outage time, and that has, in fact, been approved by the staff.

When I first encountered this PRA, it was about the time that we merged our companies, and I wasn't particularly satisfied with what I found. So we made a number of improvements to that PRA in order to support that EDG AOT LAR.

CO-CHAIRMAN KRESS: Has your PRA been through the industry peer review?

MR. BURCHILL: Yes. In fact, the industry peer review was in August of 2000, and in fact, that was just before our merger. I had a member of my staff on that peer review team, and so that was my first real detailed look at the PRA.

And the peer review results were what really drove our changing the PRA in late 2000 in order to support that earlier LAR.

We've also examined all of the elements of the comments made by the peer review team, and we've tabulated those for staff review relative to the EPU. It turns out particularly with the changes that we made for the EDG AOT extension there were no remaining significant elements for this particular application.

As you know, in a PRA we use realistic models. We've talked just a moment ago about operator response times. I'll come back to that, but we use realistic limits on thermal hydraulics, and we credit all available systems, and likewise we compare to realistic success criteria and limits.

MEMBER POWERS: When you think in terms or realistic models, what do you do with the frequency of a pipe break brought on with flow assisted corrosion?

MR. BURCHILL: Well, the frequency of pipe breaks is represented by industry data of an empirical nature. We do not do explicit analytical modeling of fact in a predictive way. We look at industry experience in like situations, and then we use that in an actuarial fashion in order to predict those passive component failures.

MEMBER POWERS: I guess what I'm asking here is we're coming along. We're making a change to this plan. One of the pieces of information coming to us is that we have predictions that some piping systems are more susceptible to corrosion and a more rapid rate.

One would presume then that the probabilities that the pipe would rupture unexpectedly must go up. I can't imagine it doesn't.

MR. BURCHILL: Theoretically, yes.

MEMBER POWERS: I guess what I'm asking

is: how is that piece of information reflected in the PRA analysis for the Clinton plant?

MR. BURCHILL: There is no change in those rupture frequencies within the PRA model to reflect what you're saying for two reasons.

On is that, again, the PRA model is looking at a time average, you know, annual average, and it's not a point prediction. So what we're looking at is what's the overall impact for the remaining operating life of the plant.

The second is that the FAC program, I think, as we've mentioned earlier, does monitor these pipes and well before they would be expected to rupture with any probability of significance they would be repaired or replaced.

So that's taken into account, you know, industry-wide in the database that we use for the actuarial data on pipe rupture frequency.

So the simple answer is there's no change made, but I think there's a good rationale for not making that change.

The other comment I'd make is the areas we're talking about, extraction, steam lines, and so forth, you know, really have very little impact. You're down the dependency chain in terms of systems that would respond to a potential core damage event. You're down the dependency chain about three levels.

So I don't think you' ever actually find a place to insert that information in the PRA.

MEMBER POWERS: I guess I will concede to you that I have a poor example here, but --

MR. BURCHILL: Well, we'll work with it.

MEMBER POWERS: -- I'm going to pursue that poor example because I don't believe your answer, and that is that if I have a line that is corroding more quickly, unless I have a monitoring program that is accelerated parallel to that more quickly eroding thing, even if I look at an annual average, I must have a higher rupture frequency with that loss.

MR. BURCHILL: At the instant you're talking about, yes, you would.

MEMBER POWERS: And your annual average, I must have a higher value.

MR. BURCHILL: We could debate that. I agree that it will be higher until that line is replaced. Once the line is replaced, the rupture frequency, I think you'll agree, goes significantly down.

MEMBER POWERS: If I replace the line in July, from January to December, that average I must have a high rupture frequency.

MR. BURCHILL: Well, it will certainly have a higher rupture frequency from January to July. From July to December if we've replaced it with pipe that's not susceptible, I would think the rupture frequency would go down.

So I don't know whether the net would be plus or minus.

MEMBER POWERS: Okay. Suppose I replace it in November?

MR. BURCHILL: I think we're in agreement.

MEMBER POWERS: There must be something in the PRA to reflect this additional information. You're telling me there's nothing. What I come down to is this. I mean, what I think I'm seeing in all of these PRA analyses is that we change nothing, and we find that the CDF doesn't change. This is not a remarkable finding to me.

MR. BURCHILL: Hopefully I'll persuade you otherwise through showing you the things that we actually did change.

I think the more substantive part of the answer is the question of what the impact would be of this line rupture in terms of actually interrupting any of our --

MEMBER POWERS: I really am using NMA as an example. I'll agree we're working --

MR. BURCHILL: We're down here.

MEMBER POWERS: -- in subsidiary systems that actually I'm surprised your answer was we don't even model that at PRA, but I'm using it as an example because clearly other things. It must be that probably if you are rupturing, the core shroud must go higher. It must be higher.

Do you reflect that in the RPA? I think you don't.

MR. BURCHILL: Well, actually, as you're well aware, we've had a recent occasion to experience some jet pumping failures in another area, and we did, in fact, explicitly represent that in the PRA and do a fairly detailed analysis of its impact.

In this particular case, the impact could be put in the PRA. It's certainly true that we do not explicitly represent these lines. It would come in through the initiating event frequency, you know, on the secondary side, you know, loss of feedwater or something of that nature that would be created by a rupture of an extraction steam line.

MEMBER POWERS: Yes.

MR. BURCHILL: Shall I proceed, sir?

CO-CHAIRMAN WALLIS: Please do.

MR. BURCHILL: We did compare the results of our analysis with the guidelines provided by RegGuide 1.174. As you know, this RegGuide is for permanent plant changes, for evaluating risk informed submittals, but it is a generally accepted guideline against which to benchmark results. So we did use that.

The next slide shows how we went about the review a little bit more detailed. We evaluated each of the individual PRA technical elements. These, of course, are the same elements that are evaluated by a PRA certification team.

We didn't find any change in the initiating event frequencies. There was nothing that was indicated in the power up rate because of the lack of major equipment changes that would create a change in initiative events, and likewise the same is true for the success criteria.

The main place where there were changes were in the operator response times, and I will show you the examples of the more significant impacts in that area, but, again, even these changes were small compared to the required coping time for the operators.

MEMBER SHACK: Of course, a lot of those elements were where you've got your two grades in your PRA peer review.

MR. BURCHILL: Well, that's a good point, and I'm happy you could bring that observation up. I mentioned my pleasure with this PRA when I first encountered it.

The grades on this PRA were somewhat lower than the ones that I discussed with you before on the Dresden and Quad situations, but they were a mix of twos and threes, actually a slight majority of threes, and some of the areas that they pointed out that they were uncomfortable with were the ones that we attended to in late 2000 prior to making that EDG AOT submittal.

So I'm keenly aware of what you're talking about in that PRA. I don't think that those detract, and, again, we gave the staff a detailed tabulation on this, from this particular application, but, you know, I can go into whatever detail you like on that.

We also did quite a number of MAP runs to support this evaluation. The MAP code, as you know, is a best estimate code for severe accident, thermal hydraulics and, in fact, releases. The reason that we did that is that this is a fairly substantial change in the thermal power of the core, and therefore, the decay heat level is higher post trip and the heat up and the boil down rates are considerably higher.

So we did a number of MAP runs in order to support this evaluation.

CO-CHAIRMAN WALLIS: This is for the containment, the MAP runs?

MR. BURCHILL: They are -- the MAP goes from the core all the way out.

CO-CHAIRMAN WALLIS: It is in the core, too?

MR. BURCHILL: Yes.

The next slide shows the evaluation of effects in the operating conditions, and the following slide will talk about systems. I'll preface this by saying we found no new accident types in the evaluation. We didn't find any significant changes to accident scenarios, going back to the previous discussions on operator response. We found no new operator responses required, nor were the sequencing of operator responses changed.

The only thing we did find in that area was that there is a higher demand on the time of operator actions in certain situations.

We found no change in system dependencies.

In other words, the front line systems are supported by the same support systems and essentially the plant is wired and hooked up the same way that it was before.

And the risk evaluation revealed no vulnerabilities produced by the EU.

The principal effect in the operating area is the increased heat loads, the reduced time to boiling in both the core and the suppression pool, and of course, at least theoretically reduce the time to core damage.

This produces a reduced time for equipment response and operator actions, and in each case where those operator actions were shortened and were felt to be of significance, we evaluated explicitly the analytical impact of that on the core damage frequency.

The Atlas does produce increased power levels and peak pressure. In this particular case, I think the committee asked me this question a few months ago on the other plants. ATWS only contributes about four percent of the total core damage on this plant. So it's a significantly smaller fraction than we talked about before, and therefore, changes in this area would likewise have a small impact.

The biggest difference between this and a previous discussion is that although the feedwater flow is increased, there's no change in the normally operating number of feedwater pumps or condensate booster pumps. So we still have the same two turbine driven feedwater pumps and three condensate pumps and condensate booster pumps that are in the pre-EPU condition.

MEMBER POWERS: And these pumps are working harder?

MR. BURCHILL: These pumps are -- certainly they're working harder because you've got more flow coming out of them, yeah.

MEMBER POWERS: And so does their failure probability go up?

MR. BURCHILL: The failure probability could go up, and the way we evaluated that, we did not do an explicit model of that, but we did a sensitivity study were we raised those failure probabilities by ten percent. Well, the initiating event frequencies associated with them.

MEMBER POWERS: So now the flow in is up by 20 percent. So you increased the failure probability by ten percent.

MR. BURCHILL: Of the initiating event,

right.

MEMBER POWERS: Right, and what was the rationale there?

MR. BURCHILL: yeah, the rationale was we used -- actually I think we did this more analytically than is justified -- but we used a bathtub type curve for the burn-in, and I think we increased the failure rate in the first year by 50 percent, and then the second year, I think it was 25, and then we tailed it down. And then the average came out to be the ten percent, yeah.

CO-CHAIRMAN KRESS: In your MAP analysis, do fission products enter in it any way other than decay heat level?

MR. BURCHILL: There's a source term represented, correct.

CO-CHAIRMAN KRESS: To determine its effect on containment?

MR. BURCHILL: Right, and so that was scaled up, but it was a simple scaling.

CO-CHAIRMAN KRESS: So it was just by the power ratio?

MR. BURCHILL: Right, correct.

CO-CHAIRMAN KRESS: And that adds a heat load to the containment.

MR. BURCHILL: Oh, absolutely.

CO-CHAIRMAN KRESS: And that's why.

MR. BURCHILL: Yeah, everything, you know, starting in the reactor assembly with the boil down rate of the coolant out to the wet well, out to the suppression pool, everything, you know, the boil down rates, you know, go down. The times set shortened.

CO-CHAIRMAN KRESS: What sort of fission product release model is in MAP? We've never reviewed that as a committee.

MR. BURCHILL: I'm not going to be able to answer that question. We can get back to you on that. I mean, I'm not a fission products person. So I don't know explicitly how to even answer what the model is.

The next slide addresses the question of system effects. As I mentioned, there were no changes in systemic PRA success criteria. Systemic criteria though is associated with the number of pumps, the number of buses, the number of instrument air systems, and so forth. All of those remain the same.

The one area that would be of interest here would be in the over pressure protection and the depressurization capability, but the number of safety valves and relief valves that were required in each of these cases, as has been previously discussed, remained unchanged in the EPU state. So that didn't change at all in the PRA model.

The changes that were made in the BOP and in the AC switchyard were not represented explicitly, but rather, again, were represented by sensitivity studies in which we raised the failure rates to represent a burn-in period of those new components.

The set point changes also produce a negligible impact, and we did evaluate those explicitly in the PRA model. Again, there were no changes to the equipment itself, but some changes to set points.

The next slide is really the heart of the changes that were made. There were 45 operator actions that were evaluated for impact. Twenty-eight of these were chosen because of their importance in the PRA, in other words, their importance with respect to contributing to core damage frequency, and 17 were chose because they were the operator actions that had to be taken in under a half an hour. So we judged those to be time critical and evaluated them explicitly.

The remaining operator actions that were not evaluated, if you sum up all of their contributions to core damage frequency, it was less than a half a percent. So we've captured 95 or 99.5 percent of the operator actions that contribute to core damage.

The first one which has been discussed at every one of these EPU, you know, applications, of course, is the failure to initiate ADS. That normally comes up fairly high on the list, and it requires a shortening of time from about -- and, again, remember this is realistic analysis now with best estimate parameters -- a shortening of time from about 32 minutes to 28 minutes.

So there is some change in the human error probability, and that does contribute to about a three percent increase in the core damage frequency, a fairly substantial increase in relative terms, but a very small increase, of course, in terms of the overall PRA result.

The next one is an interesting one. This is the failure to restart a feedwater pump following a failure to initially depressurize the reactor pressure vessel. This is what's called a dependent failure.

In the reference case in the submittal, we were assuming that the plant would implement an auto start on the motor driven auxiliary feed pump, and in fact, that meant that this situation, this contributor got better. So that the risk actually went down by about one and a half percent.

We did do a sensitivity study, however, in the submittal that showed what would be the effect if we did not implement the auto restart feature, and that gave the result that you see on the slide, which is a plus, about one and a half percent.

And it turns out that at this time, that auto restart feature is not being implemented at least initially. So the result that you'll be seeing here will look like a slightly different figure than you've read several times in the staff SER, and the reason is the swing in this contribution from this particular human error probability.

The next two have to do with the slick operation by the operator, injecting boron post ATWS. As you know, there's an early and late period for that. The early period in this plant's case is measured by the necessity to inject boron to avoid hot well depletion, hot well inventory depletion in the late period. If you miss that one, you're next trying to save the suppression pool, and so you want to inject in time to avoid loss of unacceptable inventory from the suppression pool.

In the analyses we do, we do a set of MAP runs, and we do these parmetrically so we can see what the impact is of various operator action times. This early time, which these next two actions deal with, decreased from in the case of a two pump injection, from 12 to nine minutes. In the case of one pump injection, the second one of these pair on the slide decreased from nine to six minutes.

So, again, we modeled the effective --

CO-CHAIRMAN WALLIS: Well, that's different from the 31 minutes we were told earlier.

MR. BURCHILL: Well, we're talking early injection here.

CO-CHAIRMAN WALLIS: That was for something else.

MR. BURCHILL: That's right, and this is just for early injection. The reason I bring this one up in detail is this is comparable to the two minutes you discussed earlier. Two minutes is a licensing number, but if you look realistically at what time is actually available to the operator, in the worst of cases only one pump operation, there's at least six minute available.

And depending upon, you know, the exact sequence of the event, it could be as much as nine minutes, and I'll let the operators speak to this question with respect to their response time if you wish, but clearly, you know, these are response times that are well reasonable.

MEMBER POWERS: I mean, what's intriguing to me in this area is you calculate some probability that the operator will do things in six minutes or nine minutes, depending on what he has, and those numbers, I hesitate to guess off the top of my head, but I suspect you calculate like ten to the minus third or something like that.

MR. BURCHILL: On that order.

MEMBER POWERS: And things like that.

And then we speak to the operators, and we haven't on this particular incident, but I'm just guessing that if I asked them, "How long does it take you to do this?" he says, "Well, about 30 seconds."

"What's the probability that you'll fail to do this?"

And he says, "Not a snowball's chance in hell that I'll forget to do this."

MR. BURCHILL: That would be pretty close.

MEMBER POWERS: "And I'm tested on this every two weeks, and it's beaten into my head. I dream about it at night and things like that. So there's just no chance."

And I come back and see, you know, you have this discrepancy, and we talk about realistic models in PRA, and how do we factor -- how would one go about trying to factor in what we learn from the operator testing and whatnot and what we calculate when we go through Swain or something like that?

MR. BURCHILL: Well, yeah. I'm not sure I understand the discrepancy you're describing because what the operator will tell you is that he's tested on this frequently in the simulator, and that he does it really fast.

And actually, these are sometimes measured time-wise, but the really important thing is that they're responding to symptoms, and the timing isn't really the deal. It's whether or not they respond to the symptoms adequately.

Now, the way that the PRA models is this is using human error probability models, that a big EPRI program you may recall about ten years ago or 15 did a lot of measurements in simulators and determined, you know, what was the error rate that was occurring with various types of actions, either cognitive or skill based, you know, type of actions.

And so the numbers I'm talking about are based on that, and I don't think there's a real big discrepancy. If I say that the error rate is on the order of ten to the minus three, I think that correlates pretty closely with the operator saying, you know, "No way will I miss this, you know." Because at some point he might miss it, and that's what that ten to the minus three number is meant to represent.

But I think that you --

MEMBER POWERS: I think what you're saying is that, in fact, everyone is pretty bad at guessing what a ten to the minus third probability is.

MR. BURCHILL: Oh, absolutely, absolutely.

MEMBER POWERS: One chance in 1,000 is just zero to most of us.

MR. BURCHILL: Guessing it, guessing it, right.

MEMBER POWERS: To most of us it's zero. I mean, there's just no chance this will ever happen.

MR. BURCHILL: I will say, I mean, and there are certainly practitioners in my peer group that would say this is all voodoo anyway, but the fact is that it's come a long way since Swain wrote his handbook, and there are some very sophisticated models today. I won't try to defend the absolute numbers, but I think the relative numbers, and the understanding of the cause and effect relationship between various performance shaping factors and their impact on the actual probabilities is pretty good. I mean, I think we have a reasonable handle on that.

MEMBER POWERS: Yeah. I mean, I think I agree with that. I also have to inject that I applaud your use of sensitivity analyses on those things where it's difficult to find data. We talked about that earlier yesterday.

MR. BURCHILL: Well, I wouldn't be able to defend it with you if I did, you know.

MEMBER POWERS: Well, but I mean, that's the appropriate thing to do. You've got to go find out is there an effect because all you're trying to do is see if there's a magnifier.

MR. BURCHILL: Right.

MEMBER POWERS: I mean if I change things by ten percent and the core damage frequency goes up by 85 percent, I get nervous about that.

MR. BURCHILL: Right, right.

MEMBER POWERS: And if it goes up by six percent, then I'm not so nervous about my number.

MR. BURCHILL: Right.

MEMBER POWERS: That's all.

CO-CHAIRMAN WALLIS: Okay. Should we leave this slide now?

MR. BURCHILL: We can leave this slide. Let's leave this slide.

MEMBER POWERS: Is it grating on your nerves?

CO-CHAIRMAN WALLIS: No, I think we've covered the important items on it.

MR. BURCHILL: Yes. The full power internal events model in this particular case does include explicit representation of internal flooding in both the base case and, as you would expect, in the EPU case. This is a very small contribution, on the order of five percent to the total core damage frequency.

We didn't find any new initiating events or increases in initiating event frequencies, and so we found that there really is a negligible effect of internal flooding on core damage.

The Level II is the actual containment response and release evaluation, Large in this case or LERF is used as the measure of merit here, and large is defined as a greater than ten percent release of the cesium and iodine inventory in the core, and early is defined as releases in under six hours.

The methodology used here was an explicit calculation as opposed to the simplified calculation I mentioned to you a couple of months ago. This has explicit PRA model with containment event trees.

We did do a binning of the end states for the core damage and then put those as the initiating event frequencies into the containment event trees to calculate the containment response.

There were very minor changes in the human error probabilities here, largely because we're talking very long times, you know, on the order of hours for response in this case, and these are mainly conditional probabilities for either repair or recovery, particularly for earlier actions that were not successful.

The next to the last bullet should say that the EPU has no impact on the containment event trees. I apologize. That was a carryover, the minor impact. There actually were no structural changes to the event trees here, and we found that the LERF is directly proportional, as you would expect, to the core damage frequency impact, which we'll show on the next slide.

This is a summary then of the numerical results from the full power internal events model evaluation. These are similar to results that have been reported in previous EPU risk studies. The pre-EPU PRA has about a 1.4 times ten to the minus five core damage frequency per year, and the LERF is about 1.4 E to the minus seven, two orders of magnitude lower, and the reason for that, of course, is that we're not using a simplified model. We are using an explicit model of containment response.

The EPU has a very small impact on both, about six percent. Again, I'll remind you that in the SER if you've been reading that, it reports a reference case of about three percent. The difference here is the swing on that auto start and the motor driven feed pump.

The absolute numbers are that the core damage frequency changed by nine E minus seven per year, and this puts it below the RegGuide 1.174 criterion of ten to the minus six for being classified as a very small risk impact.

Likewise the LERF was eight E minus nine per year, which is well below the RegGuide 1.174 criteria of ten to the minus seventh, to be classified as a very small risk impact.

The other important thing is the composition of initiating events contributing to core damage did not change. We did answer an RAI from the staff that displayed the explicit spectrum of the core damage due to individual initiating events, and there was only very slight change, some up, some down. But essentially the pie chart looked identical.

CO-CHAIRMAN WALLIS: Could you explain, Bill, on this SER, there's something about sensitivity number four and talking there about 23 percent increase in base CBF.

MR. BURCHILL: Sensitivity number four was the combination of sensitivities one through three, where we increased those initiating event frequencies by 20 percent, and we increased the operator error rates by 20 percent, which was a very high increase, and to be frank with you, I can't remember what the third one was.

But we combined all of them. In all total they gave a 23 percent impact, which I think, you know, referring back to Dr. Powers' remark, if this had been an 85 or 90 percent impact, we would have probably paid very close attention. At 23, percent giving the bounding nature of that sensitivity, it was felt not to be significant.

We did look at uncertainties. This is the following slide. We examined this through the traditional use of risk importance measures. We did do explicit sensitivity studies, the ones I just mentioned, and we did compare this PRA's results to those reported in NUREG 1150.

We didn't find any sources of uncertainty beyond those already identified by NUREG 1150, and if you took the NUREG 1150 outer bound on uncertainty, which is on the order of a factor of five or six overall, the results here would still be in the small risk range in the RegGuide 1.174 risk MAP as compared to the very small risk.

CO-CHAIRMAN KRESS: Excuse me. How did you examine uncertainties used in risk importance measures again?

MR. BURCHILL: In risk importance measures, what you do is you look at the change from the pre-EPU state to the post EPU state and see what --

CO-CHAIRMAN KRESS: Change in what is important?

MR. BURCHILL: Yes, what is important, right. And then you can look at whether or not if you find an important piece of equipment. Is there anything that's changed about the dependency structure of supporting that piece of equipment?

Basically you're looking at whether or not there's anything about the PRA in going from the pre-EPU state to the post EPU state that would actually change the impact on that importance for those pieces of equipment.

CO-CHAIRMAN KRESS: Yeah, I was having trouble relating that to uncertainty, but I can see it's a nice thing to have done.

MR. BURCHILL: Okay. The next three areas are in the qualitative evaluation area. We started, of course, with the IPEEE. It concluded that none of the external events had risk significance.

We explicitly evaluated the fire risk. We do have a fire PRA for this plant. It gives a base CDF for the plant of about 3.3 E minus six per year, which is about an order of magnitude lower than the internal events frequency.

We looked at the dominant scenarios. These are primarily loss of inventory control or loss of decay heat removal, and we found no change in the risk profile produced by the EPU; a minor impact on decay heat removal scenarios because of the human error probabilities, but again, most of these are out late in time.

We didn't find any new initiating events, nor any increases in fire ignition frequencies. So we judged that the EPU has a negligible impact.

In the seismic area, a point to make here is that the IPEEE is based on seismic margin analysis. That analysis did not reveal any outliers or vulnerabilities in this plant. We looked at the seismic margin report, found no reason to believe that the seismic qualifications of the SSCs would be changed, and as was previously discussed, there's really negligible impact to the increase in stored energy on blow-down loads so --

CO-CHAIRMAN WALLIS: Do you have an increase in power? We have presumably great occurrence in part of the electrical system. Is this, in fact, a fire initiation risk, circuit breakers and things?

MR. BURCHILL: The only place that I'm aware that that would be an issue, I think we're making changes to the equipment. These are mostly out in breakers in the switch yard, if I remember, and those were the ones that we covered with the sensitivity study.

Is that sufficient?

Okay. The EPU has the word "negligible" that's also appropriate here for the seismic risk. We could not find any impact here.

In the shutdown risk area, we do not have a shutdown PRA, but, again, we can evaluate what would be the impact by principally being guided by the operator actions required for the dominant sequences that contribute to risk in the shutdown states. The shorter times for boiling, the decrease in inventory, decrease in the inventory loss time does shorten the time for operator response, and it also, of course, delays the time when alternative decay heat removal systems, such as the spent fuel cooling system or the reactor water clean-up system could be used.

But the times that we're talking about are measured in hours or even days. So the impact here is essentially negligible, and is managed through the use of a configuration risk management program.

So, in summary, we did evaluate the impact using standard PRA methods, both quantitative and qualitative. The risk impact is a very small percent of the current plant risk, on the order of six percent.

That risk was compared for both CDF and LERF to the guidelines provided for a permanent plant change in RegGuide 1.174 and found to be in the very small risk region, and the risk impacts from external events and shutdown conditions were found through examination of the dominant sequences in judgment to be negligible.

Again, as I will say, as I said a couple of months ago, the staff review in this area was, in our opinion, quite thorough, especially that this is not a risk informed submittal. We had quite a lot of dialogue with the staff, although not quite as much as we did on the previous submittal, but they did ask, I think, quite relevant questions relative to our submittal.

So if there are no further questions, I will turn this back to Larry Westbrook, who will discuss the project implementation.

MR. WESTBROOK: Thank you, Bill.

Good morning, again. I am Larry Westbrook with AmerGen, and as Bill mentioned, I will be discussing the EPU project implementation regarding operator training and EPU testing.

EPU training consists of classroom presentations and simulator scenarios. Classroom material was presented in licensed operator requalification training covering the following topics:

Technical specifications and updated

safety analysis report changes;

Plant limits and operating conditions changes, such as core thermal power and generator limits;

Design changes associated with EPU;

The extended power up rate power to flow MAP operating procedure revisions;

And Exelon and industry power up rate experience.

Simulator training is being provided to operating crews --

CO-CHAIRMAN WALLIS: Could I ask you here now? Classroom training is presumably a two-way thing. I mean, you tell them things and they ask questions.

MR. WESTBROOK: Yes.

CO-CHAIRMAN WALLIS: Were there any particular questions they raised that you remember?

MR. WESTBROOK: I'm trying to think of particular questions. The questions generally that were asked --

CO-CHAIRMAN WALLIS: Did they have any particular concerns?

MR. SCOTT: Larry, if I could help you out here, again, I'm Kent Scott from AmerGen, senior reactor operator.

One of the concerns that I heard with the guys in training is focused around how we're going to operate the generator now. You know, we're going to be limited by the secondary balance of plant side. So there was a lot of concerns with respect to, okay, how do the limits on our generator change, explaining the increase in hydrogen pressure from 60 to 75 pounds. I think that was the most focus that I had saw, and I think that was supported a lot by showing the operators in the simulator the difference in response.

Here's the plant at a higher feed flow. Here's the plant at a higher steam flow. Here's a transient. It looks the same.

And they kind of took that away and focused in on, okay, what's going to be different. So the balance of plant inside the generator was the thing that I saw most from them.

MR. WESTBROOK: Okay. Simulator training is being provided to the operating crews covering the following: EPU full power conditions, and as Kent stated, that involved the generator limits and the plant response.

Normal operations scenarios, such as raising reactor power along constant rod line and dynamic scenarios that were selected to highlight both similarities and differences in plant response at EPU versus current power levels; these scenarios included a feedwater pump trip, a reactor recirculation pump trip, and ATWS.

Operator requalification training is being covered in two cycles of classroom and simulator training. The first cycle of training has been completed, and the second cycle is currently in progress.

CO-CHAIRMAN WALLIS: I would guess that there's no real significant change, and the way that they diagnose events is very much the same as before.

MR. WESTBROOK: That's correct.

CO-CHAIRMAN WALLIS: In terms of the same -- it's just slight qualitative differences in the response.

MR. WESTBROOK: That is correct. A slight difference in response. The way we operate the plant is essentially the same. If they're -- the most significant difference, if you will, is that to maximize Clinton's output will be BOP limited. They will be looking at and maximizing the output by focusing on the generator limits, and we won't be as bounded by our license power level because we'll have a margin to the license power level. Of course, we won't be monitoring that.

CO-CHAIRMAN WALLIS: It's like driving an automobile with a slightly different gear box or something. I mean, it's not as if many things have changed. It's just you're going to have a slightly different response.

MR. WESTBROOK: That's correct.

Also, just in time, simulator training specific to EPU testing will be conducted prior to power ascension.

CO-CHAIRMAN WALLIS: Just in time. The day before?

MR. WESTBROOK: The day before, a couple of days before so that this training, as I stated, is specific to the power ascension. It may be specific to certain testing done during the power ascension, and it may be specific to the crew that will be performing the testing.

MR. SCOTT: And again, this is Kent Scott from AmerGen.

That's a typical process that we do prior to any start-up, is we have the crew that's going to start up the reactor take them over there the day before.

MR. WESTBROOK: Next I would like to provide an overview of the start-up test program.

The start-up test program employs a careful and deliberate approach to upgrade power levels. The program has incorporated previous successful Exelon power up rate experience.

The La Salle EPU test director is the Clinton Power Station project manager. Also the Dresden Quad Cities test procedure developer is also developing the Clinton test procedure.

Beginning at 90 percent original licensed thermal power, steady state data collection and testing will be conducted. Once 100 percent original licensed thermal power is reached, reactor power will be raised in two percent increments along a constant rod line to maximum achievable power level.

Beginning at approximately 70 percent of original licensed thermal power dynamic testing will be conducted. These dynamic tests include pressure control system stability tests, feedwater level control system stability tests, and turbine valve surveillances.

This slide shows the testing to be performed at each power level.

In conclusion, the operator training to

prepare for EPU is extensive and utilizes both --

CO-CHAIRMAN WALLIS: I don't understand what you mean by testing of core performance, let's say. Are you just recording how it's performing? You're not performing any sort of transient tests.

MR. WESTBROOK: That's correct. Core performance is no transience test. It's monitoring with our 3D Monocore system that all of our thermal limits and our inspect and that we are operating on the power --

CO-CHAIRMAN WALLIS: This isn't so much testing. It's just monitoring that things are behaving as expected.

MR. WESTBROOK: Part of the testing is data collection and analysis and a static, and then some of the tests, such as pressure control system stability, feedwater level control system stability, those are the dynamic tests.

CO-CHAIRMAN WALLIS: Now, presumably you have guidelines here. I mean, you've got something like piping vibration data. These folks are recording piping vibration data. There must be some procedures written down about what they do if the vibration steps out of line beyond some magnitude or something. All of these must be things to look for --

MR. WESTBROOK: That's correct.

CO-CHAIRMAN WALLIS: -- or guidelines about what to do.

MR. WESTBROOK: The test procedures being developed by or from the General Electric task report which selected the tests that need to be performed --

CO-CHAIRMAN WALLIS: All of those checked things, you've got to check that the vibration has not increased beyond something.

MR. WESTBROOK: Right.

CO-CHAIRMAN WALLIS: And so on and so forth.

MR. WESTBROOK: This test has a Level 2 and a Level 1 criteria. Certainly exceeding the Level 2 criteria requires evaluation, and exceeding Level 1 criteria would certainly be more extensive actions required. Those criteria are being built into the test procedure.

MEMBER SIEBER: You've run these tests before. So you have a database --

MR. WESTBROOK: Yes.

MEMBER SIEBER: -- of what the vibration levels are. So you're really looking for deviations from that as you go beyond the old 100 percent power level; is that correct?

MR. WESTBROOK: These tests are similar to the original start-up tests.

MEMBER SIEBER: Right.

MR. WESTBROOK: As far as the criteria, we're taking what's established in the task report and insuring in the course that they are consistent with the original start-up test.

MEMBER SIEBER: Right.

MR. WESTBROOK: In conclusion, the operator training to prepare EPU is extensive and utilizes both classroom and simulator environments. The testing plan is incremental and comprehensive and is a careful and deliberate approach to up-rated power levels.

Therefore, project implementation will insure that EPU is implemented as designed and plant response is as expected.

CO-CHAIRMAN WALLIS: When you're doing this power up rating by two percent, do you have extra people in the control room?

MR. WESTBROOK: The actual people in the control room will be very minimal. Clinton Power Station's control room is physically very small. A lot of the data collection will be taken off the process computer and analyzed outside the control room.

CO-CHAIRMAN WALLIS: So there are other people who are engineers sitting somewhere else monitoring what's going on?

MR. WESTBROOK: That's correct.

MR. WILLIAMS: Are there any more questions for Larry?

(No response.)

MR. WILLIAMS: Thank you, Larry.

Prior to concluding, we are prepared to answer the follow-up questions on the large transient testing.

Tim.

MR. SPENCER: Good morning. Dale Spencer, Exelon Nuclear.

We would like to address the earlier question regarding analysis of the plant response to transience. We have provided the staff with the results of these analyses, but in response to today's question, we have a couple of things we pulled together.

A couple of points here. General Electric has asked that the session be closed. Again, this is some proprietary information.

The other thing, if you'd please excuse

us, we pulled it together at the last minute. We have to change computers and get a couple of flemsies up there so that we have the right information, but pardon us for just a minute.

And we would ask the Chairman that we treat this as a closed session also.

CO-CHAIRMAN WALLIS: Okay.

(Whereupon, from 9:57 a.m. to 10:05 a.m., the Subcommittee meeting was recessed for closed session.)

MR. BOEHNERT: Okay. Let's go back to open session.

CO-CHAIRMAN WALLIS: We're ready to conclude.

MR. SPENCER: Yes, Dale Spencer, Exelon Nuclear.

At this time I believe the ACRS had one pending question for Bill Burchill, and he's prepared.

MR. BURCHILL: This is Bill Burchill, Exelon.

I wanted to answer Dr. Kress' question about the radiological release model which is in the MAP program. I knew it would have some catchy name, and I couldn't remember what it was, but it's based on IDCOR data. It was actually a model developed by EPRI. It's called the IDCOR EPRI steam oxidation model, and it does detail a phenominological evaluation of both the release and then the various partitioning mechanisms as you go out from the fuel through the coolant, through the steel boundaries of, you know, the reactor assembly, and on out through the containment.

So it is a detailed model for radiological release. Does that answer your question?

Right. It's the old Cubachasie (phonetic) model, right.

MR. BOEHNERT: Dale, what version of MAP are you using now?

MR. BOLGER: This was all done with MAP 3B. We are now converting fleet-wide to MAP 4, which we'll have in place this year, but all of these results were on 3B, and in this area, there is some enhancements in MAP 4, but basically the fundamentals are the same.

MR. WILLIAMS: If there are no more questions, we would like to introduce Keith Jury to conclude.

MR. JURY: Thank you.

Good morning. My name is Keith Jury, and I'm the Director of Licensing for the Midwest Region.

We had to have one licensing guy to talk here. So I guess I'm the token.

Dr. Wallis and the other committee members, on behalf of Exelon and AmerGen, we'd like to thank you for the opportunity to come here and give this presentation. As always, we appreciate the insights that we get from you all individually and collectively.

It's clear at least to me that the team, including G.E. and Sargent Lundy have done a very thorough job on this project.

I would like t apologize for the fact that we weren't able to answer all of your questions immediately and had to huddle, but I think that given the fact that the team has taken not only the lessons learned from our fleet, but the industry as a whole and have incorporated into this project, that it speaks to the thoroughness of the effort.

I'd like to bring up the fact that, you know, I think as time has evolved here and as we've gone through these up rates, for this up rate, we use the most up to date and accepted analytical methods and believe that we've demonstrated that the up rate will have a minimal impact on the plant from not only the plant perspective, but the system integrity, and as Bill so eloquently pointed out, from a risk perspective as well.

As such, we've concluded that the up rate in the plant operation at the up rated conditions is acceptable and clearly safe at these conditions.

And with that, I'd like to thank you again for your time, and that completes our portion of the presentation.

Thank you.

CO-CHAIRMAN WALLIS: Well, thank you.

I believe we're ready to have a break, and so we will break, and we will come back here at 20 minutes past ten.

(Whereupon, the foregoing matter went off the record at 10:10 a.m. and went back on the record at 10:23 a.m.)

CO-CHAIRMAN WALLIS: We'll come back in session, and now we're going to hear from the NRC staff, and we're looking forward to that.

MR. MARSH: Yes, I have a few opening comments. Good morning, Mr. Chairman. This is Ted Marsh, and I'm still the Deputy Director of Licensing.

And in the interest --

MEMBER POWERS: We're working on that.

MR. MARSH: Yeah, I know you are. In what sense I don't know.

(Laughter.)

MEMBER POWERS: EDO, EDO.

MR. MARSH: EDO. Thank you, thank you. I appreciate that.

I did want to point out that the agenda has us talking a little bit this morning about our efforts to improve safety evaluation quality, and we did talk about that yesterday, and we also have the letter to you. So I'm not going to go through that anymore, unless you'd like.

Let me just begin by introducing Jon Hopkins, who is the project manager for Clinton, who will be going through the presentation format and introducing the speakers.

Jon.

MR. HOPKINS: Okay. Thank you.

As Ted said, I'm Jon Hopkins, NRC project manager for Clinton.

And next slide.

I'll start with an overview. Clinton's BWR-6 Mark 3, it's the first one to apply for extended power up rate. This will be a 20 percent power up rate. Even after the up rate, which will be to 3473 megawatts thermal, Grand Gulf will have greater power level and Perry will be slightly greater power level. It's a constant reactor dome operating pressure, and to achieve the 20 percent up rate, there are many balance of plant modifications that need to be done, and in large part because of that, this has two-part implementation.

The refueling outage that begins is it scheduled to start the end of March, early April with start-up in May, and they expect to achieve roughly seven percent when they start up this time.

They will also have roughly two-thirds G.E. 14 fuel when they start up this time, and then the next refueling outage is scheduled for early 2004, where they'll make the rest of the modifications and achieve the rest of the power.

This application mostly follows the licensing topical reports, the LTR-1 and 2. It was submitted in June of last year, and as I stated, the refueling outage starts the end of March, early April. So we'll be going to full committee in March, and we will be looking for a letter from the full committee.

There are some exceptions to ELTR-1, too. It states four of them. The first one is large transient testing. That exception is similar to Dresden and Quad Cities, and we found it acceptable for them not to do large transient testing.

The other three exceptions are in the reactor systems review area, and they'll be talked about by the next presenter.

Mainly I'll mention that the other three exceptions in the reactor system area dealing with stability, transience and ECCS performance. It's hard to discuss those without getting into proprietary information. Our presentation is, you know, scheduled for an open presentation and everything.

Questions, we may have to go into closed session based on --

CO-CHAIRMAN WALLIS: I think if things become proprietary, what you should do is stall them, and then at the end of the session we'll have discussion of the proprietary items if we need them.

MR. HOPKINS: Yes.

CO-CHAIRMAN WALLIS: Will that be okay?

MR. HOPKINS: Yes, I'm fine with that. I just wanted to mention it.

This is a non-risk informed submittal, but as you just had the presentation, there were substantial risk evaluations performed. I won't mention anything more about that.

Experience. This plant is owned by AmerGen now, which is 50 percent Exelon, and so they have plant up rate experience specifically with the Dresden-Quad extended power up rate.

The staff, of course, has that experience plus Duane Arnold and Hatch and Monticello in boilers.

CO-CHAIRMAN WALLIS: Has Dresden and Quad Cities actually implemented an up rate?

MR. HOPKINS: I know -- I'm sorry -- Dresden 2 has.

CO-CHAIRMAN WALLIS: Dresden 2 has

influence at the up rate.

MR. HOPKINS: Yes. To continue from our review to finalize my review of the application, we have one license condition at this time. It deals with the feedwater nozzle. That, again was discussed by the licensee yesterday.

They are doing additional analyses of the cumulative usage factor in there, and they have to submit them to the staff. We feel that this is not a significant item, that we can make it a license condition and resolve the issue easily during the next fueling cycle. We don't anticipate that this should stop them from starting up.

Also, one other item. The staff is going to perform or, in fact, is performing confirmatory containment analyses. We just received data from General Electric to allow us to go do that. The confirmatory analysis is similar to that performed at Duane Arnold, and I expect we'll have that done fairly soon.

MR. BOEHNERT: Who is doing that analysis, Jon.

MR. HOPKINS: Well, our plant systems branch.

MR. BOEHNERT: Oh, it's in house?

MR. HOPKINS: Yes.

MR. BOEHNERT: Okay.

MR. HOPKINS: We have no other items other than those two I mentioned, the license condition and the confirmatory analysis.

With that I'd like to introduce our first presenter, who is George Thomas, and he will discuss reactor systems review.

MR. THOMAS: Yeah, my name is George Thomas. I'm from the Reactor Systems Branch.

Our review scope, mostly in the standard review plan, Chapter 4, 5, 6. There is a small portion of nine, and most of 15. And our review is mostly about the fuel and the reactor systems, and we review high pressure core spray, low pressure core spray, RCA system, CID system, and the standby control system.

Also we review reactor ore pressure, transients, LOCA, dose, and stability. So this is our scope.

As Jon told, you know, basically for all the ELTR 492, for most of the EPU evaluation, but the tech. deviations under -- they're in the areas of transient analysis, LOCA analysis, and the stability analysis.

Typically they sum it (phonetic) during the obligation, equilibrium, quote, analysis for the transients and the LOCA, but this obligation, they already are very limited analysis for the transients, LOCA.

MR. NIR: This is G.E.? I think you're getting into proprietary information which has to do with scope, and I would like to strike this from the record if possible.

And, again, we can get into this discussion in the closed session if necessary.

MR. BOEHNERT: I know no way to strike the record.

CO-CHAIRMAN WALLIS: I don't understand what. He hasn't said anything yet which is proprietary, has he?

MR. NIR: It's G.E.'s position that he's discussing now some proprietary information, the basis for the analysis and the scope, which we consider proprietary.

MR. BOEHNERT: I'm sorry.

CO-CHAIRMAN WALLIS: Well, he hasn't really discussed anything yet, has he?

MR. BOEHNERT: Yeah, that's --

CO-CHAIRMAN WALLIS: Can we move on? Are

you clear on what he's objecting to?

MR. THOMAS: I'm not going into details. I'm only just telling, you know, they did only a very limited analysis. It was not done typically like before. That's all I'm telling, you know. I'm not telling the details now.

MR. BOEHNERT: Let me make a comment here for the record.

There's been some controversy over the scope of what is G.E. holding proprietary here, and we need to get this straightened out between the staff and ourselves because this is becoming a problem.

I don't want to say any more right now, but I think this has to be straightened out because it seems that it's become quite broad, and it's impacting how we're doing business here.

CO-CHAIRMAN WALLIS: The fact that there are exceptions for transient analysis, LOCA analysis, and stability analysis is actually in the SER, isn't it?

MR. THOMAS: Right, right.

CO-CHAIRMAN WALLIS: Which is a public document.

MR. THOMAS: IT is in the SER.

MR. HOPKINS: Excuse me. The SER is the

draft safety evaluation, which we have sent to the licensee for their comments on proprietary aspects. So, in fact, it is not a public document yet.

Now, I will state that this slide was developed, and we feel this slide is entirely nonproprietary.

MR. NIR: We agree.

MR. HOPKINS: So we feel that you can say that those exceptions -- that that's public.

MR. NIR: We agree.

CO-CHAIRMAN WALLIS: Okay.

MR. BOEHNERT: They agree. Okay. Then we don't have a problem.

MR. HOPKINS: So far, right.

CO-CHAIRMAN WALLIS: Well, you're going to be watched like a hawk by G.E. now. So --

(Laughter.)

MR. THOMAS: Okay. As part of our review, we went to D obviously some time in September of last year, and four of us went there for a week, and we reviewed their design record files and the past report and all of the recommendation.

The focus of our audit was all these deviations. So most of the time we sent there was on all these three deviations. So the first was about the transient analysis. With the summit (phonetic) of the EPU obligation, they only analyze only two transients. So when the (unintelligible) was done with the equilibrium core.

So all other transients will be analyzed as part of the reload analysis, and then --

MR. NIR: This is Israel Nir, G.E.

This is proprietary information.

CO-CHAIRMAN WALLIS: It sounds rather extraordinary that it's proprietary.

MR. NIR: Well, it is proprietary just to -- this has commercial implication just General Electric. The fact that we do or do not do certain analysis is based on significant experience, power operator experience, and this is information that is commercially sensitive, and we would like not to share it publicly, and we would like --

CO-CHAIRMAN WALLIS: How much of your presentation is going to run into this problem? Maybe we should just close the meeting and get on with it.

MR. NIR: We have no proprietary issues with the slides as they presented. We -- the words that are written here are not proprietary. We have an issue with some of the verbal information.

CO-CHAIRMAN WALLIS: So he has said

something which is slightly different from the slide, which is a problem?

MR. BOEHNERT: Jon, do you want to comment?

MR. HOPKINS: It might be easier if we close this session.

MR. BOEHNERT: Okay. That's fine. We can close the session. We'll close the session. We'll do that, but I want to put on the record that we're going to have to decide, you know, where to draw the line here because you guys in the end make the decision on what is proprietary. We just go along with it basically, but I can close the session on the proviso that if you later decide this is not proprietary, we'll release the information.

CO-CHAIRMAN WALLIS: Well, let's close the session and see if anybody leaves.

(Laughter.)

MR. BOEHNERT: So again, anyone who should not be here to hear G.E. proprietary information, please leave the room. We're going to close the session and go into closed session.

(Whereupon, from 10:37 a.m. until **, the Subcommittee meeting was recessed for closed session.)

MR. BOEHNERT: And if they jump up again, I guess we'll see what happens.

CO-CHAIRMAN WALLIS: Yes, if you jump up again, you'll have to have good reason to do so.

Please go ahead.

MR. LOBEL: Good morning. My name is Richard Lobel. I'm with the Plant Systems Branch in the NRR, and I'd like to talk about the balance of plant review that we did in containment.

This review of plant systems covers a broad area. The standard review plan, there are some sections in Chapter 3 that we look at having to do with high and medium energy line breaks. We look at Section 6.2 on containment and 6.5 on combustible gases, and a large part of the SRP Chapter 9 that deals with heating and ventilation systems, the spent fuel pool and other miscellaneous topics.

The next two slides are just some examples of some of the topics that a balance of plant reviewer would look at, or reviewers, and that were looked at for the Clinton power up rate. I won't go through reading them all.

The containment systems review followed the power up rate topical report. I listed the codes that were used by G.E. in the calculations for the containment, and they're standard G.E. codes that have been used on other containment calculations that are used frequently. M3CPT and Super Hex are used pretty much on every containment, G.E. containment calculation, and LAMB code was used for this review. It was also used for the Dresden-Quad Cities power up rate. The LAMB code provides the mass and energy into the containment. M3CPT is for the short-term response, and Super Hex calculates the long-term pressure and temperature in the containment.

CO-CHAIRMAN WALLIS: This is a more realistic flow-down compared with one which was less realistic?

MR. LOBEL: It's conservative. The calculations are conservative.

CO-CHAIRMAN WALLIS: Which ones, the ones which are less realistic? I'm not quite sure what you mean by a more realistic flow-down.

MR. LOBEL: Oh, more realistic.

CO-CHAIRMAN WALLIS: More realistic than what?

MR. LOBEL: Oh, oh, I'm sorry. LAMB is less conservative, more realistic than M3CPT.

MR. PAPPONE: This is Dan Pappone of General Electric.

The M3CPT break flow model that we're using is a simple hand calculation with critical flux, and then the LAMB code is actually a reactor model. So that's where we're getting more realistic break flow rates.

CO-CHAIRMAN WALLIS: It's a hand calculation because you're using somebody's simple method?

MR. PAPPONE: That's right. We're looking at pressure and enthalpy for the up stream source for the break, the break area and critical flow look up in a table.

CO-CHAIRMAN WALLIS: Whose model are you using?

MR. PAPPONE: That's in the M3CPT approach.

CO-CHAIRMAN WALLIS: Whose model is it?

MR. PAPPONE: It's G.E.'s. Oh, both of them were actually using the Moody-Slip.

CO-CHAIRMAN WALLIS: Using Moody.

MR. PAPPONE: Right.

CO-CHAIRMAN WALLIS: Which may give you a reasonable answer, but it's not realistic.

MR. PAPPONE: Right. It's on the conservative side and over predicts the break flow.

MR. LOBEL: I think the more realistic refers to the LAMB model.

MR. PAPPONE: That's right.

MR. LOBEL: Correct me if I'm wrong. Is a more detailed model of the vessel and the core.

MR. PAPPONE: That's right.

MR. LOBEL: Go on?

CO-CHAIRMAN WALLIS: Well, they're all approved codes. So --

MR. LOBEL: Well, they're approved up to a point that they're used all the time. We haven't written an SER on the LAMB code for containment use. It is an Appendix K code and has been approved by the staff for local calculations.

Super Hex hasn't been approved. There was a 1993 letter to G.E. that talks about the staff's intention with Super Hex, and what it says is that we don't intend to do a detailed review of Super Hex because it has the capability to vary the input, and we didn't see the worth of a detailed review of the code.

So what we ask is that a licensee that uses Super Hex compare a Super Hex calculation with an existing FSAR calculation just to verify that it can reproduce containment response that it's been previously approved.

And it also brings in the next bullet of the confirmatory analysis. One of the reasons for doing the confirmatory analysis is that these codes, in general, haven't been approved by the staff, and so that gives us -- that provides an impetus to us try to do an independent calculation with a staff code that we understand and compare it

CO-CHAIRMAN WALLIS: It says "is performed."

MR. LOBEL: Pardon?

CO-CHAIRMAN WALLIS: It says "is performed," and that means right now they're doing this?

MR. LOBEL: It's underway, yeah. We've just received, I understand, the last of the G.E. data. The calculation is being done in our branch, not by a contractor this time, and some preliminary work has already been done in setting up the model.

CO-CHAIRMAN WALLIS: hat happens when you get the results? Is that after you've issued the SER?

MR. LOBEL: It may be because we're looking at this as a confirmatory calculation.

CO-CHAIRMAN WALLIS: That's strange.

MR. LOBEL: Well --

CO-CHAIRMAN WALLIS: It's a kind of "new speak." I know. I understand, but it's very strange that you do the test.

What are you going to learn from it if you've already given out the SER?

MR. LOBEL: If we find a significant problem, we can always deal with that problem.

CO-CHAIRMAN WALLIS: It would be very good if you could do these things in a slightly more anticipatory mode.

MR. LOBEL: I agree.

CO-CHAIRMAN WALLIS: So that the results were available before you wrote an SER.

MR. BOEHNERT: So this is not an open issue, Rich?

MR. LOBEL: No, it's not considered an open issue.

MR. MARSH: Mr. Chairman, let me clarify. Rich, maybe you could help.

Do we anticipate having the results by the full committee meeting?

MR. LOBEL: We're going to try very hard to have the results by the full committee meeting, but since it's a calculation and we may need to go back to General Electric or the licensee for some more information, and we're not sure how it's going to turn out, I'd rather not make that promise, but --

CO-CHAIRMAN WALLIS: And also if you rush it --

MR. LOBEL: -- it should be done by then.

CO-CHAIRMAN WALLIS: -- the chance of making some error is increased.

MR. LOBEL: Right.

CO-CHAIRMAN WALLIS: Are you using your own codes or are you using the G.E. codes?

MR. LOBEL: We're using Contain 2R code.

CO-CHAIRMAN WALLIS: You're using a different code altogether.

MR. LOBEL: Yeah. We're using Contain 2, which is the latest version of the NRC code, and we're trying to follow the guidance that we've received from research from a previous user need.

We made a request to research to give us guidance on how to use the contain code, which is essentially trying to reproduce the physics that really occur, how to use that in a design basis analysis, and they've prepared reports for us for the different types of containments, and this is going to be the first time we've tried to use the Mark III guidance that they've given us.

We did follow the guidance we got from research for the Duane Arnold calculation, and we compared very well with the G.E. results.

CO-CHAIRMAN WALLIS: So this has been done before. They've run Contain for Duane Arnold? I forget now what happened.

MR. LOBEL: We had very good agreement. We were within a degree and less than a psi, if I remember right, with Duane Arnold.

CO-CHAIRMAN WALLIS: It was a different shaped containment.

MR. LOBEL: Right, and that's why we're repeating the process.

CO-CHAIRMAN WALLIS: Okay.

MR. LOBEL: And another reason this isn't an open issue is because we've asked questions about the containment response and why the results that G.E. got or the licensee got are what they are, and we think we understand what's going on.

So we're doing the calculation as a confirmatory, not as an open item.

CO-CHAIRMAN WALLIS: It's not an open item.

MR. LOBEL: No.

CO-CHAIRMAN WALLIS: I thought you had

said it was.

MR. MARSH: No, it's not.

MR. SCHUABI: Dr. Wallis, just to clarify, this is Mohammad Schuabi.

We have reviewed the licensee submittal in this area, and we find it acceptable. So we don't have a need for this confirmatory calculation, but we are doing it anyway. That's why it's being presented this way.

It's a little awkward. It's not the way we normally do --

CO-CHAIRMAN WALLIS: I would not encourage you to kill it just because you don't think you have a need. Please complete it.

MEMBER POWERS: When you do these calculations of the pressures and dry wells and wet wells and places like that, do you consider the dry well to wet well bypass?

MR. LOBEL: Ed, do you want to answer?

This is Ed Throm for the staff.

MR. THROM: My name is Ed Throm. I'm with the Plant Systems Branch. I'm kind of the resource that became available to Plant Systems to do this type of work. My background is more in the LOCA area, but I have experience running codes.

As Rich pointed out, we had researchers set up models for evaluating containment response, and we plan to use that. What we've basically done is looked at the Grand Gulf III model, and we are upgrade -- as a matter of fact, I've upgraded that model to Clinton, and at this point what I've done is benchmarked the current USAR calculation for the recirculation line break, and I missed it by a PSI and one degree.

So we have --

MEMBER POWERS: Boy, you must have been embarrassed, huh?

MR. THROM: Absolutely.

(Laughter.)

MR. THROM: And I'm trying to figure out what the problem is. So it builds up the confidence in the fact that the analysis techniques are comparing well, and this is why I think it's really confirmatory.

The other question, of course, is the long-term suppression pool, and that presents more of a challenge to do a calculation in a specific time frame. That's why we don't want to commit to having the complete set of confirmatory calculations done within a certain time frame.

Anyone who runs these codes knows that you run into unanticipated numerical problems somewhere along the line. You've got to find the inertia factor or what's potentially leading to the problem and resolve it.

But the intent is basically to use the modeling criteria that research established and develop guidelines for doing design basis calculations, and to basically mimic or reproduce the efforts that we've done on Duane Arnold for Clinton just to make sure that we're not missing anything in the Mark III performance.

MEMBER POWERS: My recollection on the Grand Gulf model is a substantial bypass flow from the dry well into containment. It does not go through the wet well.

MR. THROM: That's right.

MEMBER POWERS: And you take that into account in the calculation, or do you shut that down?

MR. THROM: It's in the model as it is right now, as I understand it.

MEMBER POWERS: Could you remind me of the magnitude or do you remember?

MR. THROM: Do you mean area-wise?

MEMBER POWERS: Maybe area.

MR. THROM: Well, I think the area is on the order of 40 -- in Clinton, I think it's about 42, 43 square feet.

MEMBER POWERS: For the bypass --

MR. THROM: I guess I'm --

MEMBER POWERS: As I recall, it was like 1,000 CFM bypass flow.

CO-CHAIRMAN WALLIS: Forty-two square feet.

MR. THROM: Well, I can't answer your question today. As I said, you know, we're using the models. I will look into that in terms of the way things are being considered, but as you pointed out, you know, as a resource, this work is just starting.

As I said, I've been able to benchmark against the USAR calculation for the recirc. line break. We did receive the hard part of the data from G.E. and the applicant on Monday, which is all of the mass and energies that are necessary to perform this calculation.

I think I have all the data I need, but there might be a couple of geometrical inputs, some flow areas that I might have to go back to the licensee to get. Sometimes what you think is in the USAR isn't quite there.

There's no challenging information that's needed.

MR. LOBEL: The bypass flow area, the K over squared A number that's in the tech. specs. is determined from small break calculations and not the large break because a smaller break turns out to be limiting for that because you get flow for a longer time.

We can get back to you on the question.

MEMBER POWERS: Yeah, because the reason I asked is because it's not clear what's conservative, to include it or not include it. I mean, if you were interested in special temperature, then you want to cut the bypass flow out. If you're interested in containment pressure, maybe you want to turn it on. I don't know.

MR. LOBEL: Well, that's another reason why we tried to do our own calculations, because we can run sensitivities on things like that, and that might be a good problem to run.

We did that. Yesterday I was talking about Arkansas. We did quite a bit of sensitivity calculations with the Arkansas, independent confirmatory calculations.

CO-CHAIRMAN WALLIS: As I remember the

table we saw from yesterday, these criteria are met pretty well, except the dry well temperature briefly being above 330. Is that the one?

MR. THROM: Yeah, that's correct.

MR. LOBEL: And that was just for a short time so that it really --

CO-CHAIRMAN WALLIS: Most of the other criteria seemed to be met by reasonable margin. Is that true?

MR. LOBEL: Yeah, yeah, and the changes actually weren't that great. I have a slide that talks -- in fact, it's the next slide or the slide after -- talks about the actual numbers.

Yeah, that's true. Where are we? Well, I think we've talked about that.

The next slide says what you just said.

CO-CHAIRMAN WALLIS: And you're not concerned about this brief temperature exceeding criteria?

MR. LOBEL: The SER says that -- we've looked at that, and that it's brief enough so that the temperature of the containment structure won't be changed, won't exceed its limit even though the atmosphere is slightly above the design temperature.

MEMBER POWERS: Is the concern over the

dry well temperature one of the structure or is it of the penetrations and the penetration seals?

MR. LOBEL: I believe the limit -- I don't know for sure. Maybe G.E. can answer that or licensee.

MR. PAPPONE: This is Dan Pappone with G.E.

The real concern is the equipment. If the dry well structure penetration seals, relief valves, solenoids, things like that, and what we get from the long-term containment analysis or short and long-term containment analysis is an EQ envelope, environmental qualification envelope that then is used for qualifying all of the equipment there.

And that's where we're looking at the short term of this excursion above the 330. It was only for half a second, I believe, and that's where making the judgment that the response time, you know, to actually heat up the components that we're concerned about is so short.

Remember they're starting out at, say, 150 degree temperature, the initial dry well temperature. So there's a long time lag before they would reach that 330 degree temperature limit, and this is such a short pulse before we drop back down.

CO-CHAIRMAN WALLIS: Okay.

MR. LOBEL: Okay. We also look at NPSH of the ECCS pumps and spray pumps, and there wasn't any change to the design temperature. Calculations were done at the design temperature so that the power up rate didn't affect those.

And Clinton does not take credit for over pressure. So that wasn't an issue.

Just briefly, some of the other significant systems that we looked at I'll mention. The ultimate heat sync was originally designed for two units, and so there's plenty of margin for --

CO-CHAIRMAN WALLIS: It was also built for two units, not just designed? It was actually built for two units?

MR. LOBEL: Built and hopefully designed and built.

MR. HOPKINS: Yes, the slide should say megawatt electric.

MR. LOBEL: Oh, yeah.

CO-CHAIRMAN WALLIS: Yes, it's a pretty small pump.

MR. LOBEL: Yeah, right. The component cooling water system is an important safety system. The only loads that increase with power is a small change to the reactor coolant pumps, and the spent fuel pool loads, and the temperature increase is small, I think, just a couple of degrees.

The spent fuel pool --

CO-CHAIRMAN WALLIS: This is sealed cooling or something?

MR. LOBEL: Yeah, for the reactor coolant pumps, recirculation pumps.

The spent fuel pool cooling, the peak temperature is less than 120 degrees with the ultimate heat sync at its tech. spec. number of 95 degrees, and one train of cooling. For a normal off load, which is a portion of the core for Clinton, the guidance is that the limit has to be met, assuming a single failure with one train, and the Clinton calculations show they do that.

An abnormal off load for Clinton would be a full core off load, and the peak temperature is less than 140 degrees, with the ultimate heat sync temperature at 95 degrees, and since it's an abnormal off load, they can take credit for both trains of cooling.

CO-CHAIRMAN WALLIS: This is an average temperature in the pool? This is one 40 degrees?

MR. LOBEL: Yes.

CO-CHAIRMAN WALLIS: The pool mixes rapidly enough that you don't get concerned about variations around the pool?

MR. LOBEL: I don't think that's a problem. Is there somebody else that can answer?

I think that's been looked at and --

CO-CHAIRMAN WALLIS: I think it would have to be.

MR. LOBEL: -- the decision has been made that it's not an issue. I can't quite where, but I remember reading something at one time that that's been looked at.

MR. SHUM: David Shum from Plant Systems Branch.

Could you repeat that question, please? I couldn't hear.

CO-CHAIRMAN WALLIS: Well, we're talking here about an average pooled temperature. I'm just asking how much does the temperature vary from, say, the region of the fuel to the remote region of the pool.

MR. SHUM: Well, we didn't look at the temperature at the fuel. From the fuel pool cooling standpoint, we look at the average in the --

CO-CHAIRMAN WALLIS: Do you assume the

average is good enough?

MR. SHUM: Un-huh, but from another plants we always look at it, and we have no problem before.

MR. LOBEL: My recollection is that that's been looked at, studied, and the mixing in the pool from natural circulation is enough that the temperature is uniform. But I'll take it as an issue if you'd like to try to find out where that's addressed.

CO-CHAIRMAN WALLIS: It would be nice if someone knew definitely. Yeah, maybe you could find out.

MR. SHUM: Yes, we will be able to find that out.

MR. LOBEL: Okay. In conclusion, the balance of plant containment systems for Clinton comply with NRC regulations and guidance at EPU conditions.

CO-CHAIRMAN WALLIS: And this is the end?

MR. LOBEL: The end.

CO-CHAIRMAN WALLIS: Any closing statement?

MR. MARSH: I have a closing statement unless, Jon, do you have anything you want to conclude with up there? No?

MR. HOPKINS: I just wanted to say this was the end of the staff presentation, and it would just be questions and if there are questions on other topics. This was the end of our presentation.

MR. MARSH: I've got some closing comments, Mr. Chairman, unless you'd like to.

Okay. Thank you.

I'd like to thank the committee for the time and the opportunity to present to you both Arkansas and Clinton's incentive power up rate. I want to emphasize again that the staff has undertaken extensive reviews of these applications, and all areas affected by the power up rates have been reviewed and evaluated.

The staff has critically examined methodologies and their application for these two cases. We've concluded that all of the analytical codes, methodologies used for licensing analyses are acceptable for these applications. The results of the deterministic analyses have demonstrated that the proposed increases in power for Arkansas and Clinton plants are acceptable and meet the regulatory requirements.

Now, this concludes the presentation. Now, we, of course, would be glad to answer any questions, but I've got a couple other thoughts I'd like to leave with you.

Based --

CO-CHAIRMAN WALLIS: These are going to the full committee?

MR. MARSH: next month.

CO-CHAIRMAN WALLIS: Next month?

MR. MARSH: Right.

CO-CHAIRMAN WALLIS: Both of these?

MR. MARSH: Both of them, right. So any --

CO-CHAIRMAN WALLIS: And both the applicant and the staff will have considerably less time.

MR. MARSH: Yes, sir, right.

CO-CHAIRMAN WALLIS: And therefore, you have to bear that in mind regarding your presentation.

MR. MARSH: Yes, sir. Any guidance you'd like to give us in terms of what you'd like us to present would be great.

Let me add one more thing, if I can. Some of the issues that came out in yesterday's presentations we're going to respond to. There were some to do items and things. We'd like to respond in writing if you don't mind. We want to make sure that we answered those thoroughly and completely and formally. Okay?

So we're going to be getting the transcripts and making sure that we understand the questions and respond in the right manner.

And as you say, we don't have a lot of time for the full committee. So any -- we did talk yesterday about a potential approach for the full committee. What we talked about yesterday was, of course, we don't have the time to go through all of the issues, but you suggested picking a couple of key topics in each one of these areas and demonstrating to the full committee some depth of reviews and some issues that we went through.

So perhaps we'll identify if it's acceptable to you some key issues in each one of these plants' reviews, and we will go through with some detail to the full committee.

MEMBER POWERS: I think you need to be more cautious with your ANO than you do with the Clinton because this is effectively the third one.

MR. MARSH: Right.

MEMBER POWERS: One of these, I mean, it may be a BWR-6 and so it's somewhat different.

MR. MARSH: Right.

MEMBER POWERS: My thought here would be saying that, look, this is yet another of the BWR up rates. They've done it a little differently than others. Here's the exceptions, and discuss the disposition of your exceptions.

I think you're going to have to discuss again the transient testing issue.

MR. MARSH: Okay.

MEMBER POWERS: I mean, I just think it's unavoidable simply because we had added comments to one of our letters, in which there's a dissent from the majority opinion discussion.

That's my personal thought on this subject. I don't think you need -- my point is I don't think you need to be as careful with this one as you do with the ANO just because it is a repetition.

And, by the way, I will thank you publicly for allowing your staff to meet with us this morning, and we could discuss BWR stability and the mathematics there and not bore everyone else to death.

MR. MARSH: Good.

MEMBER POWERS: It was a very productive meeting.

MR. MARSH: I'm glad it was helpful.

When you say "careful," are you suggesting that we spend more time discussing the Arkansas application?

MEMBER POWERS: Oh, I think you have to.

MR. MARSH: Okay.

MEMBER POWERS: Because it's new and it's --

MR. MARSH: It's the first of this type.

MEMBER POWERS: The type, sure, and whatnot.

MR. MARSH: Okay. We'd be glad to do that.

MEMBER POWERS: I mean, I personally don't feel the need to be that cautious and careful with Clinton. It seems to me that the focus there is really on the exceptions issue because they're different, and among the exceptions, of course, is transient testing.

MR. MARSH: Right.

MEMBER POWERS: And I would try on the transient testing to really go through your logic very carefully just because we have a dissenting opinion.

MR. MARSH: We'd be glad to.

PARTICIPANT: We'll continue to.

MEMBER POWERS: Yeah, I mean, I don't know that you're going to persuade him.

MR. MARSH: But we could at least say it to make sure that people understand our rationale for it.

MR. MARSH: Sure, sure.

MEMBER SIEBER: Well, you want it on the record also.

MR. MARSH: Yes.

MEMBER POWERS: And you want to give us ammunition to beat him.

MR. MARSH: No, we don't.

MEMBER POWERS: Yes, you do. Trust me. You do.

MR. MARSH: Whatever you say.

Well, Mr. Chairman, that concludes our presentation.

CO-CHAIRMAN WALLIS: Thank you.

MR. MARSH: And we thank you very much again.

CO-CHAIRMAN WALLIS: That's all right. Anything else that the members wish to say at this time?

(No response.)

CO-CHAIRMAN WALLIS: Well, thank you for helping us to finish early.

We will not reconvene until one o'clock, and then we'll take up a completely different topic.

Thank you all for your contributions to the meeting.

(Whereupon, at 11:38 a.m., the Subcommittee meeting was recessed for lunch, to reconvene at 1:00 p.m., the same day.)

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

(1:03 p.m.)

CO-CHAIRMAN KRESS: This meeting will now please come to order.

I think this is a new Subcommittee meeting from what we had this morning. This is combined Subcommittees on Thermal-Hydraulic Phenomena and Future Plant Designs.

I am Tom Kress, Chairman of the Future Plant Designs Subcommittee, and we have with us Graham Wallis, who is Chairman of the Thermal-Hydraulic Phenomena Subcommittee. We also have ACRS members Dana Powers and Bill Shack and Jack Sieber, and our ACRS consultant, Virgil Schrock.

The purpose of this meeting is to review the staff's review of Phase 2 of the pre-application review of Westinghouse AP 1000 plant design. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate for deliberation by the full committee.

Mr. Medhat El-Zeftawy is the cognizant ACRS staff engineer 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 January 29th, 2002.

A transcript of this meeting is being held and will be made available as stated in the Federal Register notice. Therefore, it's requested that speakers first identify themselves, use the microphone, and speak with sufficient clarity and volume so that they can be readily heard and copied on the transcripts.

We have received no written comments or requests for time to make oral statements from members of the public.

I have no introductory comments. It's a self-introductory subject. Do any of the members wish to make anything before we start? Any comments?

MEMBER POWERS: This is really just a 67 percent power up rate; is that --

CO-CHAIRMAN KRESS: That's basically what it is, yeah. It's another power up rate review that we're doing.

CO-CHAIRMAN WALLIS: It's for a nonexisting reactor. So it's not quite the same thing.

MEMBER POWERS: So it's in the imaginary space.

CO-CHAIRMAN KRESS: Well, we will now proceed with the meeting, and I'll call upon Jim Lyon, our friend from the past, to open the meeting for us.

MR. LYON: Thank you, Dr. Kress

I appreciate being here today.

MEMBER POWERS: Well, you didn't. You left us.

MR. LYON: Well, you know.

MEMBER POWERS: Short exposures are okay.

MR. LYON: Short exposures. A very helpful one and a very enlightening one.

As Dr. Kress alluded, we're going to talk about Phase 2 of the AP 1000 design certification review. This is the final portion of the pre-application review, and I think just to get us going I'd like to turn it over to the two project managers that are working on this at this time.

First, Andrzej Drozd, who is the acting project manager and has been helping us out since, I guess, about October time frame.

And Larry Burkhart, who will be the permanent project manager as Andrzej goes back to his old duties where he's going to help us a lot doing the review of this and other advanced reactors.

So with that I'll turn it over to Andrzej.

MR. DROZD: Good afternoon. My name is Andrzej Drozd, and for the last four months I had the privilege to and pleasure to coordinate Phase 2 review of AP 600 pre-application review.

In today and tomorrow's presentation, I will give a quick background and the status of the project, and then we'll turn into a technical panel to discuss Phase 2 issues.

I will do the hopefully simple and straightforward regulatory exemptions issues, and then Jerry Wilson, Dave Terao and Goutam Bagchi will address design acceptance criteria.

After that, testing of AP 600 and its applicability to AP 1000 will be addressed by Steve Bajorek, and then Walt Jensen and Ed Throm will discuss with you and present to you the application of safety analysis codes.

Just to recall, some time in December 1999, LC certified the AP 600 start-up plant design, and just about the same time Westinghouse in various forms expressed interest in doing power up rate, as Dr. Power says, that is, to apply for a certificate of a similar, if not identical, plan, but with the power of about 1,000 megawatts output.

Needless to say, there were a lot of

introductory discussions followed by a meeting in April when staff and Westinghouse discussed what would be the best way to approach certification review of the new plant.

And the three-stage approach seems to be the most appropriate. The Phase 1 would be or was just identification of the issues to be reviewed in Phase 2, and Phase 2 would be review of those issues and potentially, depending on the results of Phase 2, the full design certification review as a Phase 3.

In May 2000, Westinghouse requested the NRC staff to proceed with Phase 1, and after several discussions and letters and meetings, NRC has provided six review issues and its estimated how much it would take to review it.

Based on that suggestion, in August 2000, Westinghouse asked NRC staff to proceed with Phase 2 and focus only on four issues, that is, applicability of the test program, APC funded test program to the new design, as well as applicability of safety analysis code used for AP 600 to AP 1000.

They asked us to review proposed design acceptance criteria approach, as suggested by Westinghouse, and as well, applicability of certain regulatory exemptions for AP 1000.

As I understand it, by the end of August we made presentation to you for AP 1000. Therefore, I don't have any specific presentation on the design itself. However, I do have some back-up slides if needed.

CO-CHAIRMAN KRESS: I think we're familiar enough with the design at this point.

MR. DROZD: Thank you, Tom.

Briefly, status of the review. Phase 1 was complete in July 2000, and Phase 2 is being completed as we speak. Technical review was done just about a month ago, and as a result, we are writing two SECY papers.

The Phase 2 issues were divided into two packages sort of. One package is a policy oriented, which is application of design acceptance criteria approach to design certification, and more technically oriented or utilization oriented testing of the codes.

Both papers went through internal iteration, and final drafts are being reviewed and concurred. Some were in our administrative space.

Today and tomorrow we'll present to you the results of our Phase 2 review, and eventually in about three weeks or in about a month, we'll make a presentation to the full ACRS Committee explaining what we did and asking for the approval or suggestions.

CO-CHAIRMAN KRESS: You'll want a letter in the March meeting.

MR. DROZD: Or asking for a letter of recommendations.

CO-CHAIRMAN KRESS: When do you go to the commissioners with this?

MR. DROZD: The week after. The paper is due to the Commission in March 28.

CO-CHAIRMAN KRESS: Okay.

MR. DROZD: And as we discussed with Westinghouse our findings, there is a good chance that Westinghouse will go ahead with full design certification application some time the end of March, beginning of April this year.

CO-CHAIRMAN KRESS: Does Westinghouse know what's in these draft documents?

MR. DROZD: Yes.

CO-CHAIRMAN KRESS: You've already been in discussion with them?

MR. DROZD: Not the letter of our findings, but major points were conveyed to Westinghouse, yes.

MR. BURKHART: We're still working out

some of the what may be policy issues on design acceptance criteria. There's been some late developments.

In fact, we just received a letter today.

My name is Larry Burkhart. I'm the new and it is hoped the permanent project manager for this project.

So that aspect, the design acceptance criteria, is kind of in an evolutionary phase. We're towards the end of it where we still have a little bit of work to do.

MR. DROZD: Well, if there's no more questions regarding status of the project, let's turn to the issues, Phase 2 issues.

One, the first one that I'd like to address is regulatory exemptions. During AP 600 certification review, Westinghouse asked for several regulatory exemptions, and three of them are being suggested to be granted also for AP 1000.

The three are the exemptions regarding the safety parameters display console, the auxiliary feedwater system, as well as off-site power sources.

The rationale for granting those exemptions for AP 600 are summarized right here for the display console. The reason that the exemptions for this specific console, this specific part of the design was that the safety parameter display console was integrated or is to be integrated with the control room design. Therefore, there was no need for a stand-alone requirements for safety parameter display.

CO-CHAIRMAN KRESS: Then the control room design is a COL item, put off until the COL or --

MR. DROZD: That is put up at the COL, yes.

MR. WILSON: Dr. Kress, this is Jerry Wilson.

We'll discuss that in the next presentation.

CO-CHAIRMAN KRESS: Oh, okay. This is just an overview of it, and you'll go into that a little more. Okay.

MR. DROZD: The two other technical areas that Westinghouse is seeking a regulatory exemptions are auxiliary feedwater system, as well as off-site power sources. Both of them are stemming from the passive nature of safety system and passive nature of safety injection systems.

CO-CHAIRMAN KRESS: These are general design criteria, these?

MR. DROZD: The off-site power deals with general design criteria, and aux. feedwater is -- I don't remember -- 50, 30 something. I'm sorry. I don't remember exactly which paragraph it is, but they were discussed during AP 600 certification review, and the issues are identical.

CO-CHAIRMAN KRESS: And the basis for granting approval of these exemptions is that you feel like the underlying purpose of the rule is met?

MR. DROZD: We feel that the new design has identical safety system function as AP 600, and at least the intention of the requirements are being met. Therefore, we don't see any reason why not to grant those exemptions.

CO-CHAIRMAN KRESS: It meets the intention of the rule.

MR. DROZD: The intentions are being met, yes.

CO-CHAIRMAN KRESS: Okay. We're going to get into a lot of detail on this testing and codes --

MR. DROZD: Oh, definitely.

CO-CHAIRMAN KRESS: -- and the DAC and so on. You're giving us the bottom line right now.

MR. DROZD: I'm giving a very high level summary of our positions and findings.

CO-CHAIRMAN KRESS: Good.

MEMBER POWERS: This is a high level bottom line.

CO-CHAIRMAN KRESS: That's a little --

MEMBER POWERS: I will think about this.

(Laughter.)

MR. DROZD: Well, if there's no more questions on the exemptions, let me give you the high level bottom line position on the design acceptance criteria. The standardization review, review of standardized plans are laid out --

CO-CHAIRMAN KRESS: Somebody has fouled up on viewgraphs, and they didn't give us that one.

CO-CHAIRMAN WALLIS: I have it.

CO-CHAIRMAN KRESS: It's not in my package.

MEMBER SCHROCK: That's because you're Chairman.

CO-CHAIRMAN KRESS: Well, I guess so.

MEMBER POWERS: You are supposed to know all of this stuff.

CO-CHAIRMAN KRESS: I got two copies of your other slide though, the next one. So I guess that was -- okay.

MR. DROZD: It was a voluntary gift.

CO-CHAIRMAN KRESS: Okay. Now, you may

proceed.

MR. DROZD: Thank you.

The ground rules for reviewing design certificate applicants are set out in Part 52, and the key words, the key approach in staff's view is the completeness of the design that's being submitted for review.

The design acceptance criteria approach were developed and applied during ABWR system 80 plus reviews, as well as AP 600.

CO-CHAIRMAN KRESS: Now, what exactly does 5247(a)(2) say? Does it ask --

MR. DROZD: That will be covered with --

CO-CHAIRMAN KRESS: That will be covered later? Okay. We'll wait.

MR. DROZD: Just in a couple of minutes.

CO-CHAIRMAN KRESS: We'll wait a minute.

MR. DROZD: In a couple of minutes.

The bottom line position as of now, as of today is that based on the experience that we had with the previous design reviews, we don't see that approach as the preferred way of regulating, in general.

And we do agree that there are technical areas that are affected by rapidly evolving technologies, like instrumentation and control or human factors, control room design. Therefore, we do see good basis for granting design acceptance criteria approach, because of the nature of the evolving technologies.

Other areas are less obvious to staff, whether DEC should be applied or not. I'd like to make a note that the DEC approach granted or used for piping, for example, and radiation protection, that was used in ABWR System 80 Plus, we don't think it applies to the case of AP 1000, and the rationale for that would be presented in just a couple of minutes.

Also, we strongly believe that the level of design details submitted for AP 1000 certificate should be equivalent, if not the same, as the one that was submitted for AP 600.

And maybe before you ask anymore specific questions, I turn over the issue to technical panel, Jerry Wilson, Dave Terao, and Goutam Bagchi. They will address all there is to know about DAC approach.

Gentlemen.

CO-CHAIRMAN KRESS: I see they got together some of the people that reviewed AP 600 for this.

MR. WILSON: Yes, sir.

MR. DROZD: Sixty-seven percent up rated.

(Laughter.)

CO-CHAIRMAN KRESS: One third.

MR. WILSON: Mr. Chairman, I'm Jerry Wilson with the new reactor licensing project office, and I'm joined by my colleagues from the Division of Engineering that will participate in this presentation.

Now, as Andrzej introduced, we're here to talk about the request from Westinghouse to use design acceptance criteria, and by way of background to understand our recommendation, I thought I'd give a little review of how we got to this point.

Now, the origin of this issue comes from when we were building plants, a lot of plants in the '70s and '80s, and electric companies got construction permits based on basically preliminary design information, and they completed their design while they were building the plant, which led to a lot of problems that we're all familiar with.

And so when the Commission set out to reform the licensing process and issue Part 52, a key aspect of that was to require design information be complete before construction was initiated.

So to resolve this problem, we have in

Part 52 and also in the design certification process in Part 52, a requirement to provide complete and final design information.

And to get to your question you just asked, if you looked at page 3 of our handout, you'll see a summary of that requirement, and basically what we're looking for is final design information equivalent to what you would see in a final safety analysis report for an operating license application and for essentially complete design information.

CO-CHAIRMAN KRESS: Now, let me ask you this. What would be the practical implications if you granted this, the DAC on the piping, seismic loadings for the -- what would be the practical implications with respect to your completing your review and making a safety decision?

MR. WILSON: I'm going to get into this a little bit more, but to introduce the concept is that what's being used is design acceptance criteria in lieu of detailed design information, and so in those particular areas where it is used, the staff and the applicant agree on the approach to finalize the design at a later date.

And what we're looking at is the desirability to develop design acceptance criteria that would lead to an acceptable design when the applicant who references that certification actually completes it.

Now, picking up a legal aspect of this deck or a subset of ITAAC and the way ITAAC is set up in the regulations, an applicant is required to complete these design information until after they had gotten a combined license. So you could have a situation where we would get back to where we were in the past where an applicant was completing their design information while reviewing the plan.

CO-CHAIRMAN KRESS: You'd have to review it again then.

MR. WILSON: Yeah, we'd have to verify that they did implement the design acceptance criteria correctly and thereby coming out with an acceptable design.

CO-CHAIRMAN KRESS: Yeah, okay. I understand.

MR. WILSON: So when we issued Part 52, we were initiating reviews of design certification applications at that time, and the staff did a study of this issue of what's appropriate and necessary level of design information to support a design certification application and gave SECY papers to the

Commission on that subject.

If you skip ahead and look at Slide 4, you'll see these papers listed here, but, in particular, SECY 90-241 and SECY 90-377.

The result of that led to a staff requirements memorandum that had a lot of important guidance to the staff on how to perform the design certification reviews, and in there the Commission said with regard to level of detail, "We meant what we said when we issued Part 52. Meet the requirement. Meet the 5247(a)(2) on level of detail."

Furthermore, the amount of information should be proportional to the safety significance of a particular system. So more significant safety systems you would expect to see, more design discussion.

And finally, they said, "Don't use ITAAC as a means of resolving this design information."

Now, after that --

MEMBER POWERS: I guess they made it pretty clear then, didn't they?

MR. WILSON: Yeah. At this point G.E. as the lead applicant came to the staff and expressed some concerns they had with actually completing their design, and they brought up two areas of concern.

The first area of concern, as Andrzej introduced, was rapidly evolving technology. They were referring to the digital instrumentation and control systems and also the human factors design aspects of the control room.

And what they said is that these areas of technology are rapidly evolving or concerned if we completed that design at that point in time; that you would be locking up a design that if implemented later could be significantly out of date.

And the other area of concern that they raised is G.E. claimed that they couldn't complete the piping and radiation protection design information because they needed as building, as procured information to do that.

CO-CHAIRMAN KRESS: So in those two general areas of a possible DAC criteria, it seems to me like if you have those conditions, you disregard bullet three about being able to reach a final conclusion on any safety question?

MR. WILSON: Yes. What you'll see as I go through this history is we didn't fully implement the Commission's guidance in its SRM.

CO-CHAIRMAN KRESS: Right.

MR. WILSON: So because of that, we went

back to the Commission with a new round of SECY papers, and once again, if you jump ahead to slide four, you'll see a number of SECYs issued in the '92 time period where we explained these issues to the Commission and now we proposed to come up with design acceptance criteria in lieu of design information.

And the result of all of that effort was that the Commission allowed us to use design acceptance criteria in lieu of detailed design information in those first two applications in the areas of rapidly evolving technology and the as built, as procured area.

But they admonished us that use of DAC should be limited and if in the future that staff planned to use it anymore, we had to come back to the Commission.

CO-CHAIRMAN KRESS: They didn't prohibit it. They just said, "Be sure it's limited, and if you're going to do anymore DACs, come back to us with it first."

MR. WILSON: That's correct.

CO-CHAIRMAN KRESS: Okay.

MEMBER SIEBER: I presume they specifically approved the areas that you identified, right?

MR. WILSON: Yes, and that's what I'm going to show on the table in the next slide.

So what you see is that for ABWR and for System 80 Plus, they used design acceptance criteria for instrumentation and control and human factors, radiation protection, and piping.

Now comes AP 600.

CO-CHAIRMAN KRESS: Now, he's a case where piping was included in a DAC.

MR. WILSON: That's correct.

Now comes AP 600, and in AP 600, Westinghouse continued to use the I and C and human factors DAC, once again applying the rapidly evolving technology criteria, but they did provide sufficient design information for radiation protection and piping.

CO-CHAIRMAN KRESS: Now, why was it deemed that, for example, System 80 Plus couldn't provide sufficient design information for piping whereas AP 600 could? What is different about the two?

MR. WILSON: Yeah, I'm going to ask you to hold that thought for a minute, and I turn it over to Mr. Terao and he's our piping expert and it would be better if he answers that.

MEMBER SIEBER: I have a question about

radiation protection. To me you can split that into two broad areas. One is the physical features of the plant, like shielding and ingress and egress pathways, et cetera, and the other half of that or part of it is all of this instrumentation, area monitors and effluent monitors and things like that.

MR. WILSON: And what we're talking about here is the aspect of the barriers, the shielding and that sort of thing, protection, and really what sources are you going to get from various components and how that would affect the design aspects of the shielding.

MEMBER SIEBER: And I take it that all instruments fit into the instrument and control areas, which would be another DAC.

MR. WILSON: I believe so.

MEMBER SIEBER: Okay.

MR. WILSON: So on AP 600 they will provide that information. They didn't require design acceptance criteria. From the staff's perspective this was an improvement, and we came closer to meeting the Commission's goals, and our regulations for complete and final design information.

Now, we come to the pre-application review for AP 1000, and as you've heard from us previously, Westinghouse has asked four questions of the staff, and the one we're focusing on today is can you use design acceptance criteria on AP 1000 in three areas, piping structures and seismic analysis.

Well, when we went to look at this, we looked at it both from a technical perspective and from the policy perspective. First of all, the question is, well, is it technically feasible to develop design acceptance criteria when all three of these design areas are not complete?

And then the other part of it is where are we with regard to meeting the Commission's goals.

So what we concluded -- and I'm going to turn it over here to Mr. Terao to talk about our ability to develop, for example, a piping DAC when the structural design and seismic analysis hasn't been formed, hasn't been completed -- but let me back up for a minute and say, first of all, in the rapidly evolving technology, that decision was originally made in the '92 time period, and so I went back to our technical staff, and I said, well, a decade has gone by. Does the basis for allowing the use of design acceptance criteria for instrumentation and control and human factors still apply?

And my technical experts said, yes, it

does in those areas. So if Westinghouse requests that, we are supporting the use of design acceptance criteria in those areas.

However, from the standpoint of piping structures and seismic, Westinghouse was able to complete that at AP 600, we believe, for the reasons that we started out down this path, that we should have complete design information in those areas, and so from a policy perspective, we would recommend that Westinghouse should provide that information also for AP 1000.

CO-CHAIRMAN KRESS: You don't happen to have an example of one of these DACs? For example, what do they look like? Are they just a set of criteria that have to be met in terms of general criteria?

MR. WILSON: Dr. Kress, I've met with you so many times that I anticipated this question.

(Laughter.)

MEMBER POWERS: You were predictable?

CO-CHAIRMAN KRESS: I hate to be so predictable.

MR. WILSON: Med, could you give me a hand here?

I don't have a lot of copies, but I have some for the reporter and perhaps for the Chairman and let Westinghouse have one.

What I've done is I've used human factors as an example probably because I understand it the least, but first of all, in order to understand how design acceptance criteria is different, what I've given you is a handout from some human factors criteria, and there's two parts of it. The part I'm going to really talk about is in Section 3.2 there.

First of all, let's talk about what a regular ITAAC looks like. An ITAAC is a verification process, and so if you went into the Tier 1 documentation for AP 600, for example, you would see that ITAAC ware organized by structures and systems. Most of them are systems based ITAAC. There will be a high level design description of the system, will pick out key elements of the system key design commitments. That will be in your left hand column, and will then specify whether that verification is going to take place by a test or analysis, physical inspection or combination thereof.

So you can see in the first example here, the design commitment has to do with the technical support center. We're going to verify it with a physical inspection, and we have our acceptance criteria.

This one is pretty straightforward. Most ITAAC aren't quite that straightforward, but it's good enough to give you the concept of what you would normally find for a regular ITAAC.

Now, when it comes to design acceptance criteria --

CO-CHAIRMAN KRESS: And ITAAC is for something that's already designed?

MR. WILSON: That's right. That was the idea.

CO-CHAIRMAN KRESS: And this is just a verification.

MR. WILSON: You finish the design, and then this ITAAC sets for the verification process we're going to use to verify that they built it the way they committed to do it.

CO-CHAIRMAN KRESS: Right.

MR. WILSON: Now, when it comes to a situation where the design isn't complete, we need an ITAAC that has a design process built into it, and this is just kind of a flow chart of what I'm going to go through, and I'm not going to show you all of it, but the idea being that we set up a group to do the human factors design. They do an analysis and design, and then they verify it at the end of the day.

And so if you looked at that ITAAC, you would see a discussion of the process used to do human factors design, and then we would get into the ITAAC or in this particular case, DAC, and you would see things like, okay, you have to perform a TAC analysis, and it talks about what should be done in that task analysis, and I'll skip ahead here, and you'll see that -- make sure that that's done correctly. I'm trying to find a good example here.

Once the design is complete, then they'll see some more traditional verifications in the main control room and key things you're looking for in there, and acceptance criteria for that.

CO-CHAIRMAN KRESS: And I presume something equivalent to this exists for piping DAC for System 80 Plus?

MR. WILSON: Yeah. Now, if you looked at the instrumentation and control DAC, you'd see it's very similar to what I've just shown you from human factors, and it even has a similar flow chart that I had up earlier, and which I can't put my finger -- yeah, here we are.

So you'll see instrumentation and control looks very similar to this. So that gives you an idea that instead of a straight verification of a design that's completed, you first have to go through a process where we have criteria on completing the design, and then once it's complete, you would verify.

CO-CHAIRMAN KRESS: There was something thought about piping and structures and seismic that prevent you from developing such a DAC high tech?

MR. WILSON: Yes, and with that question, I'll turn it over to Mr. Terao.

MR. TERAO: I'm David Terao. I'm with the Mechanical and Civil Engineering Branch in NRR, and before I go into my presentation, just to answer your question, Dr. Kress about piping DAC, each of the DAC actually has slightly different format, and for piping, we did have ITAAC, but the DAC were actually the design and acceptance criteria that were spelled out in the FSAR by G.E. and System 80 plus, and they were in different parts of the FSAR.

Since the FSAR doesn't have a section called piping, they have a section called seismic and mechanical design and relief valve designs. So the DAC were just spread out in all different parts of the SSAR, the standardized safety analysis report.

What the staff then did was to be consistent in addressing DAC, we wrote in our safety evaluation for ABWR and System 80 Plus. We had a specific section, Chapter 3.12, which was devoted solely to piping and piping DAC and piping ITAAC.

And in those sections what we addressed were all of the different design and acceptance criteria that we reviewed and devaluated as part of our Part 52 reviews, and there are actually seven different areas that we looked at in piping design, and these are some of the areas.

They're broken into different sections. For example, we looked at the codes and standards. We looked at the analysis methods. We looked at the piping modeling techniques. We looked at the pipe stress analysis criteria. We looked at the pipe support design criteria. We looked at energy line break criteria, and we looked at leak before break criteria.

And each of those had many subissues that we addressed in our safety evaluation. So there are many issues that we had to review specifically for ABWR and System 80 Plus.

MR. WILSON: Now, those two slides aren't in your handout, but we'll provide you copies.

Do you want to go to this one next or the next one?

MR. TERAO: Yeah. Actually since we got diverted a little with this discussion of DAC, let me try to refocus where we are and try to put my presentation in perspective again.

Staff was requested to review the acceptability of the DAC approach for AP 1000 for seismic analysis, structural design, and piping design. And I stress that because, first of all, this is a pre-application review. This is Phase 2. So we aren't reviewing the actual DAC themselves, as I put up on my slide. We aren't at that level.

That would be done in Phase 3 when Westinghouse submits its application for design certification. So right now we're looking at the acceptability of the DAC approach.

And I guess the two big picture questions that we asked ourselves were, one, since seismic analysis and structural design DAC are new, they've never been used before; can we accept that approach?

And then the second question was on the piping DAC which had been used before on ABWR and System 80 Plus. We said, well, why wouldn't it be acceptable for AP 1000.

So those are the big picture questions. That's what I addressed today.

CO-CHAIRMAN KRESS: Well, what I was fishing around for is is there something about piping structural and seismic that actually makes it extremely difficult for you to do a DAC or is it just a policy question.

MR. TERAO: Those are the details I'm going to get into right now.

CO-CHAIRMAN KRESS: Okay.

MR. TERAO: Yes, for each of the areas.

So in answering the question of what is the acceptability of using the DAC approach, the first question that came in our mind is: well, what criteria do we use for establishing acceptability of DAC?

And this is why we went into a lot of detail about the policy issues, because we reviewed the DAC for three different areas:

One, does it meet established policy issues as described in the SECY paper?

Two, does it make technical sense? In other words, by that what I mean is when we look at the seismic design of a plant, we start with the ground motion, the earthquake ground motion accelerations. We look at those ground motion accelerations onto the building. We perform a building analysis. The building analysis generates the amplifications, the accelerations that are used for the piping analysis.

The piping analysis then is performed and the results are used to calculate break.

CO-CHAIRMAN KRESS: Which is something you can do if you have a site, and the site described.

MR. TERAO: I'm sorry?

CO-CHAIRMAN KRESS: Well, you can do all of that if you have a site, and the site characteristics.

MR. TERAO: yes.

CO-CHAIRMAN KRESS: But if you don't have a site, what then do you do? Use a bounding analysis for those things?

I mean, I can see how you can do all of that for a plant where you have a specified site.

MR. WILSON: The way we handle the site characteristics and design certification is the applicant specifies what we call site parameters, and then we review the design to the site parameters.

So, for example, the applicant may specify that he's designing the plant SSE of .3 G. He'll specify ground motion associated with that. He's specify flood levels and those sorts of things.

So part of the definition of the design includes that site parameter.

CO-CHAIRMAN KRESS: Okay. So the design then would -- I mean, if someone built one of these things, it would be limited to the site, to at least fall within reference categories, and that would be an ITAAC? You would have to --

MR. WILSON: No, it's just part of the review at the combined license stage to verify that that particular applicant is referencing AP 600. We checked the site they planned to put it on and made sure that that site fits in with those parameters that Westinghouse specified when they did their design.

MR. BAGCHI: My name is Goutam Bagchi.

I just wanted to give a perspective as to what constraints we had. AP 600 design layout is the basis for AP 1000, the same footprint, the same structural element, except everything is higher. More mass, more of everything.

We know that while doing our AP 600 reviews the site parameters were varied over a wide range, and certain sections became quite critical, and it is our concern trying to locate AP 1000 under all site conditions my not even be feasible. That was the concern.

So we could have perhaps in a theoretical sense used the structural design acceptance criteria had it not been constraining based on AP 600.

MR. TERAO: Okay. Coming back to my slide -- thank you, Goutam --

MEMBER POWERS: Just to make sure you don't get through this slide --

(Laughter.)

MEMBER POWERS: You've discussed over and over again and the slide discusses, you know, what makes things acceptable, and I'm saying, gee, I wonder why you don't also look at what makes things unacceptable. That is, why don't you include going back to 52.47 and say why is it that the Commission would impose such a rule.

And in the introduction, I thought a pretty good synopsis was given, that they put this rule in because when you didn't do this, you got a lot of on-the-fly design activities that resulted in just an enormous number of headaches.

MR. TERAO: That's a very good point, and we certainly did consider it. And that's the third point that I'm trying to make if I can get to it.

(Laughter.)

MEMBER POWERS: Oh, no. That's our job,

to try to keep you --

MR. TERAO: You saw that, didn't you?

MEMBER POWERS: -- to keep the flow of your presentation --

MR. TERAO: So the three areas, the policy issues we looked at. We looked at technical issues, and we also looked at the safety issue on 5247, and I believe Dr. Kress asked what does 5247 actually say.

These are the relevant words: application must contain the level of design information sufficient to enable the Commission to reach a final conclusion on all safety questions associated with the design before the certification is granted.

CO-CHAIRMAN KRESS: There's that word "sufficient" in there.

MR. TERAO: Sufficient.

CO-CHAIRMAN KRESS: That's a judgment call.

MR. TERAO: That's a judgment call. That's correct. But the key words I'd like to focus on are before the certification is granted because there is certainly a timing issue involved here on when the staff can resolve any safety questions or potential safety questions.

And that's a crucial issue here because

with the Westinghouse DAC approach, they propose in their topical report to provide certain information after design certification, and that leads me into my next slide.

CO-CHAIRMAN KRESS: But aren't the DACs --

MR. TERAO: I'm sorry?

CO-CHAIRMAN KRESS: Are the DACs that have already been granted for the other types sort of a precedent for that?

MR. TERAO: Well, yes. We did establish a precedent for I and C, human factors and piping, and RAD protection, but seismic and structural, we have not.

CO-CHAIRMAN KRESS: I know, but precedents are established by doing it.

MR. TERAO: Yes. The precedents were set, and what I'm saying is that Westinghouse is not using the exact approach. They're proposing something different than the DAC approach that were used in these other plants.

CO-CHAIRMAN KRESS: Is there some reason why they have to be exactly like the others?

MR. TERAO: Well, that's what I'm trying to point out. They may not be. It may be acceptable, but what I'm trying to point out here is where they deviate from the DAC approaches in the other plants, where do they not meet established policy issue , technical issues or safety issues? That's what I'm trying to point out here.

CO-CHAIRMAN KRESS: Okay.

MR. TERAO: Okay? Thank you.

What this slide shows, what I'm trying to show in this slide is what design information will be provided and when, and for three different areas: for seismic analysis, for structural design, and for piping design.

And the second column shows the information that would be provided at the design certification stage, and the third column shows the information that would be provided at the combined operating license stage.

CO-CHAIRMAN KRESS: Now, this is Westinghouse's proposal.

MR. TERAO: Yes, yes. This is in their topical report.

CO-CHAIRMAN KRESS: Okay.

MR. TERAO: And so at the combined operating application stage, that's just prior to construction, and then the last column shows what information would be provided once the plant has been licensed and construction has started.

So for seismic analysis, Westinghouse is proposing to develop stick models for the AP 1000 at the design certification stage, and then perform a more finite element analysis for AP 1000 at the COL stage.

We didn't see any major problems with that. You go down to the next area, and what Westinghouse did here is they broke down their proposal between rock sites and other than rock sites, and for purpose of simplicity, we'll just call them soil sites. But soil sites means other than rock sites.

So for rock sites, the seismic analysis is actually rather simple because you don't get the soil-structure interaction, and so they can -- Westinghouse is proposing to perform a fixed base seismic analysis and generate the amplified response spectra for the piping design, and they would also perform the overturning and stability analysis for the plant. And we agree with that.

But when you get to the soil sites, Westinghouse proposed to not do the analysis, but rather, they proposed to develop the seismic analysis DAC, and that would tell you how to do the analysis, say, to generate the soil structure analysis, how to generate the amplified response spectra, and how to do the overturning of stability analysis.

And that analysis, we believed, is very complicated. There's a lot of uncertainties. The amplifications can be much larger, and in fact, let me from here jump to the next slide, and I'll come back to this slide.

For the seismic analysis, as we're just discussing, it is a first time DAC approach, and it's applicable to only non-hard rock sites, but you would see that the applicant would be required to complete most of the seismic analysis, including the soil structure interaction, the amplified response spectra, overturn the stability analysis.

And we found that this was inconsistent with the policy issue of level of detail that's in SECY 90-377. And specifically what it said in SECY 90-377 is that the level of detail should be equivalent to or no less than an FSAR at the operating stage for a recently licensed plant.

So at that stage obviously the seismic analysis has been completed. So we identified this as a policy issue, but more than that, in the next bullet, we believe that there are some safety concerns or safety questions that will not be answered until after design certification, and as Goutam Bagchi has described briefly, the AP 1000 plant is taller and heavier than the AP 600 plant. So there is a question about the overturning stability and you would have higher seismic amplifications on soil sites.

CO-CHAIRMAN KRESS: But it's not a safety concern until the plant is built and turned on, is it?

MEMBER POWERS: Can't one say that just about anything in the design?

CO-CHAIRMAN KRESS: Well, my point is you have another chance to say no.

MR. TERAO: Yeah, but, no, we don't.

MEMBER POWERS: Don't you do that on everything?

CO-CHAIRMAN KRESS: Can't you at the COL stage -- can't you say, "No, this has a safety problem. That's not sufficient"?

MR. WILSON: Let me get in here and amplify what Dave said, is what we're laying out are ITAAC, in this particular case certain types of ITAAC that's set forward process and acceptance criteria for doing the design and then verifying the design.

So if we wrote an ITAAC and they met the ITAAC, then we would have to find that acceptable, but if we didn't write one sufficiently robust that would lead to what we would normally refer to as an acceptable design, if we were reviewing the design at that stage, then, yeah, we would have a significant problem now.

Because in effect, the way the process is set up is if they met all of the ITAAC we're obligated to give them an operating license. And so the burden would be on us then to say --

CO-CHAIRMAN KRESS: Yeah, so what that means i you'd have a real burden trying to anticipate all of the things that might be safety related and being sure you have a DAC and ITAAC written in such a way that it covers those.

MR. TERAO: That's exactly right. In fact, what I was going to say is that was the difficulty when we established the DAC, the piping DAC for ABWR. I was intimately involved with that. What we had to do is identify what type of issues, anticipate what type of issues can come up in piping and to assure that we have designed an acceptance criteria that will address how those issues are to be analyzed at the COL stage.

And it required us to go back and look at all the bulletins, generic letters. At the time there were issues with Comanche Peak on piping and pipe support designs. We did quite a -- and plus, the five Stone & Webster plants that were shut down.

So there were many issues that we tried to incorporate in addressing that.

CO-CHAIRMAN KRESS: Well, let me ask you another question about that. If you're doing the design certification at the design certification review stage, don't you have to do that anyway at that time?

MR. TERAO: I'm sorry?

CO-CHAIRMAN KRESS: Don't you have to know what the issues of the safety problems with the seismic are and be able to review the SAR and looking for those issues and going back and checking all of the letters?

MR. BAGCHI: This is Goutam Bagchi again.

Dr. Kress, if we had the freedom to change the base size to anything the applicant wants, then we could do that. However, we are constrained by the size. We are constrained by the design. That is the certified design. The Commission has certified that design.

MR. WILSON: Also, Dr. Kress, in your question, you said at the design certification stage.

So understand we don't have that design information at that stage.

CO-CHAIRMAN KRESS: If you had that information thought, you would have to do exactly what he said.

MR. WILSON: That's correct.

CO-CHAIRMAN KRESS: So it would seem to me like the question is do you do that now or do you do it later?

MR. WILSON: Yeah, but can you write the design acceptance criteria to appropriately pick up all of that information so that the output product is acceptable, and that's what he's talking about.

CO-CHAIRMAN KRESS: And I think that's a legitimate question there, is can you do an ITAAC or a DAC robust enough to cover everything at that time.

MR. TERAO: So I guess the bottom line here is that we felt that there were too many uncertainties or unanswered questions that would remain at the design certification stage for us to say that this was a viable approach to use seismic analysis DAC.

Even though it's technically feasible, we may be able to come up -- and I say technically feasible with uncertainties here because this is a first time approach, and we don't know what we're going to encounter or whether we can anticipate all the type of problems for seismic analysis.

CO-CHAIRMAN KRESS: And all you're left with is you have to make a judgment, and it's a judgment call.

MR. TERAO: That's right, and also remember that PAR 52 means design finality. So once the design is certified, this staff -- and this is to assure regulatory stability and predictability so that the staff cannot ask anymore questions on that part of design that's certified at the COL stage.

CO-CHAIRMAN KRESS: But I view DAC as an exception to that.

MR. TERAO: No. Oh, no, as a matter of fact. It is not because once we approve the DAC, then the CO applicant only has to complete the piping design and verify it using ITAAC.

MEMBER SIEBER: And the only set of rules come from the DAC.

MR. TERAO: That's correct. That's correct. The only set of rules come from the DAC.

MR. WILSON: Are you ready for the next slide?

MR. TERAO: Let me go back to this one.

So we discussed seismic analysis. The second item here on structural design, what Westinghouse is proposing is to provide some preliminary assessment of the key structural elements for both soil and rock sites at the design certification stage, and then they would establish structural design DAC that would be used at the COL stage to complete the piping structural design.

And then at the COL or after the plant started construction, then they would verify the as built structural design using ITAAC.

MR. WILSON: Ready for the structural one?

MR. TERAO: So to address the structural DAAC, again, this is the first time DAC approach. So this is a new policy issue, and this is appropriate for the use of the structural DAC is to be applicable to all sites, hard rock and soil sites.

The CO applicant would then complete the structural design. So a substantial amount of design would remain for the CO applicant to complete, and we found that the level of detail here again is inconsistent with the policy issues in SECY 90-377, where a complete design -- in other words, it's not consistent with the type of information that's in an FSAR at the operating license stage for a recently licensed plant.

And obviously we will lose benefits of standardization if we don't know what the final design of the buildings look like.

The approach is technically feasible though. We believe it can be done, especially for hard rock sites. For soil sites, we think it's technically feasible, but there are some uncertainties that we might anticipate. It gets a little bit more complicated when you have not completed the analysis up front.

So we anticipate that there could be some problems later on for other than hard rock sites.

And finally, for the piping DAC, the piping DAC is similar to ABWR and System 80 Plus approach. The only difference is that you can see in the third column there on the COL application what Westinghouse is proposing is that the analysis for leak before break qualified piping be provided after design certification, and this is different than what we accepted on System 80 Plus.

For ABWR, obviously they didn't use the leak before break approach.

Let me address the piping DAC in two slides. One, we'll discuss the policy issues with piping DAC and the second slide will discuss the safety issues.

So the policy issues here, piping DAC was used in ABWR and System 80 Plus, and both of those are evolutionary plants. AP 600 completed its piping design, and obviously it's a passive plant.

So the question was: how was Westinghouse able to complete the piping design for AP 600 while G.E. and ABB Combustion Engineering were not able to?

And staff would note that in a passive plant, there are significantly fewer number of safety related piping subsystems that have to be modeled, and most of those, if not all, are inside the containment, and that the passive plant by nature does not have large motor operator valves with offset actuators. They don't have pumps, heat exchangers where the pipe nozzle is dependent on the vendor design.

So because of the simplicity of the design, I mean, you do have check valves, but check valves are relatively easy to make assumptions on its weight. It doesn't have offset center of gravities. So you can make reasonable assumptions to complete the piping design.

And that is exactly what Westinghouse did for AP 600, but not for AP 1000. The diameters have changed, and Westinghouse is proposing to use the DAC for the AP 1000 piping.

Now, the question came up and we've had -- yes?

MEMBER SIEBER: In the AP 1000, the number of components and the type of components would be the same. It's just the size that's different. Is that true or not?

MR. TERAO: That's correct. You may have a slightly larger check valve.

MEMBER SIEBER: That's right. Larger diameter piping, larger heat exchanger, larger pumps.

MR. TERAO: But they wouldn't have pumps and heat exchangers in either passive plants.

MEMBER SIEBER: Right.

MR. TERAO: Right. So the question is: why could we not let Westinghouse use DAC approach for AP 1000?

And, again, this is more of a policy issue because -- what I'm addressing now -- because we have to go back to the basis for using DAC in ABWR and System 80 Plus, and the basis for using the DAC or a rapidly evolving technology, which doesn't apply here, but the other basis was that as built and as procured information was insufficient to complete the design.

So for evolutionary plants when you had the motor operator valves or heat exchangers or pumps and didn't know where the nozzles were going to be on these vendor specific equipment, it wasn't reasonable for us to have General Electric and Combustion Engineering route the piping when the piping routing can change significantly when they actually purchase the equipment.

So the bases was as built land as procured information is insufficient to complete the piping design, and that we felt did not apply here with the passive plant; that the information is sufficient to complete the design.

Now, can it be done? Yes, it can be done. We've proved that it can be done, but unless we raise to the Commission that there's a different basis here for approving the use of piping DAC for AP 1000, we felt that this is a policy issue that needs to be brought to the attention of the Commission.

CO-CHAIRMAN KRESS: Could be done, but it would have to be on a different basis, and then you've done it before.

MR. TERAO: That's true, and we asked Westinghouse if they can provide us that type of basis, that rationale for using piping DAC since the basis of as procured information being insufficient does not seem to apply in their case.

A separate issue, but nonetheless just as important, is that the leak before break approach is inconsistent with SECY 93-087. On my previous slide, I showed that they would provide the leak before break analysis at the COL stage.

In SECY 93-087, it states that leak before break may be used by establishing bounding limits using preliminary analysis results during the design certification phase and verified by ITAAC at the COL phase.

So that's the one difference that we felt that for leak before break on AP 1000, that it was not consistent with the SECY 93-087 policy.

And there are some safety issues, as well, which I'll discuss in the next slide that's related to leak before break.

Piping safety issues. We found that there's actually three areas that we identify that's related to safety, that identify safety issues. Some of these we've discussed with Westinghouse, and actually some of these we have not because they actually came out as a result of our discussions on developing our internal position on these issues.

So I apologize to Westinghouse that they may not have heard some of these issues, but the first issue on leak before break, when we approve leak before break, it is usually for an operating plant, and for an operating plant, you know the seismic stresses. You know the piping materials. So for a standard plant, for a paper plant, the staff had to address three critical areas to assure that leak before break can be used.

And those three areas were the margins on load, the margins on flaw size, and the margins on leakage rate. And what we approved for System 80 Plus was System 80 Plus established bounding surveys for those three areas of loads, flaw size, and leakage cracks.

And then what System 80 Plus did is they used preliminary stress analysis at least for those leak before break lines or the critical size leak before break lines to verify that there was sufficient margin available so that when the plant is finally built and they get the final stress analyses and the material properties, that we felt that there was enough margin to not have any questions raised at that time.

But Westinghouse is proposing to do this analysis at the COL stage. So what we feel is that these margins will not be confirmed at the design certification stage. So we believe that that's one issue that does not meet 5247(a)(2).

Another issue, the second issue here emerges as a result of the leak before break uncertainty, and this is an issue on subcompartment pressurization and flooding because without knowing what is the minimum size line that we will approve for a leak before break, the question is: well, what is the pressurization one would use? What size pipe break would one use to establish your subcompartment pressurization for flooding effects?

And in fact, this was an issue that was raised by the ACRS back in June, in an ACRS letter dated June 16th, 1992. So we were well aware of ACRS' concerns at that time of compartment pressurization and flooding of DACs, that it be addressed as part of the DAC.

And Westinghouse has not addressed this issue. It's not say that it cannot be resolved, but at this time, we have not discussed with Westinghouse how thy plan to address those issues.

The third issue is a relatively new issue, and this deals with that the passive piping design needs to be finalized because the thermal hydraulic characteristics of the passive safety systems are very sensitive to the piping volume.

And so when they change their piping sizes, we need confirmation that those final piping sizes are going to be the final piping size, and they will meet the seismic stresses and thermal stresses and the routing.

So without that confirmation, it does interface with the thermal hydraulics area.

So in summary, just summarizing what I talked about, so the seismic analysis DAC, what we found was there were safety issues involved and policy issues involved, but technically it's a feasible approach with some uncertainty.

With a structural design DAC, it's mainly just policy issues, and we feel that it's technically feasible even though there are some uncertainties since this is the first time we're using this approach, and for the piping design, we find that there were policy issues, safety issues, but we believe it is technically feasible.

So that concludes my presentation.

MR. WILSON: So, Mr. Chairman, in summary then, similar to what Mr. Drozd pointed out, what the staff is recommending is that we not accept the use of additional design acceptance criteria on AP 1000.

And with that we'll turn it over to you. If you have anymore questions in this area before we turn the presentation back to Westinghouse.

CO-CHAIRMAN KRESS: Well, I think you've answered most of my questions. Do any of the other committee members?

MR. LYON: This is Jim Lyon from the staff, and before Westinghouse comes up or, you know, we're making this shift, we presented this information to Westinghouse a couple of weeks ago. We've been having some conversations with them, and one of the things that we had raised to them is that in the seismic area especially, seismic area, that doing a design acceptance criteria for the seismic area for the soil sites could be alleviated by limiting the plant to a hard rock site, providing us the type of information that they were going to provide us, you know, and then providing us the structural design on that.

Westinghouse has been talking to us, and they actually sent us a letter this morning that talks about, you know, one of their ways of maybe providing limiting AP 1000 to a hard rock site, then a plant that would be built at an other than hard rock site would then have to be reviewed at the COL stage for that other than hard rock site. It would become basically a site parameter. One of the site parameters would limit it to a hard rock site.

That's something that then could be reviewed at the combined license stage for an applicant that wants to reference the AP 1000, but put it at a site other than a hard rock site with all of the site parameters.

CO-CHAIRMAN KRESS: What that does for you other than having a DAC is it gives you a handle to say no?

MR. LYON: Right, and what it allows us to do is resolve all of the issues at the combined license stage prior to issuing --

CO-CHAIRMAN KRESS: You can make a safety review then.

MR. LYON: Right.

CO-CHAIRMAN KRESS: And see if it satisfies your criteria, and if it doesn't, you can say no.

MR. LYON: Right.

MR. WILSON: In that situation, similar to what you asked before, then they would -- we would have an opportunity to review the actual design before the granting of the combined license.

CO-CHAIRMAN KRESS: And that's what I was misinterpreting the DAC to allow you to do, but apparently it doesn't, but this process would allow it to --

MR. LYON: That's right, and so we're considering -- and I think in that scheme, then if you take the piping DAC by itself, we may be able to work with that, and that's something that we're kind of in discussions with Westinghouse on now to try and move forward.

So I think that's probably a good, you know, lead-in to segue.

CO-CHAIRMAN KRESS: A good segue into the Westinghouse.

MR. LYON: Into their discussion.

MEMBER SIEBER: I wonder about that a little bit though. If you limit this to just hard rock sites, I don't think there are that many hard rock sites around, are there?

If you look at river sites, you have to have cooling water somehow. If you look at river sites, every one of them is -- or not every one, but a log of them have flood plains there. So that's not hard rock. In fact, soils liquification is pretty high on those kinds of sites.

Building them on pilings is not good because that effectively just raises the height of the plant, which seismically makes it worse.

Lake and ocean front sites, those are pretty tough, too, and so it may solve the licensing problem and the technical problems that you have, but then you end up with a certified design that nobody wants to buy.

MR. WILSON: Well, what it would mean it would be more likely if the plant is by reference, that there would be additional design work that would have to be reviewed during the combined license review process.

MR. BAGCHI: As I recall though, Seabrook site is hard rock. Catawba is hard rock. There are hard rock sites.

MEMBER SIEBER: There are some sites, but most of them are not, it seems to me.

CO-CHAIRMAN KRESS: I presume Westinghouse is sufficiently sagacious to design their system to make use of the sites they want to make use of even though they may have not put an end to this SAR yet. They probably would design it to make use of the various sites.

MR. WILSON: Why don't we let Westinghouse answer that?

CO-CHAIRMAN KRESS: With that we'll turn it over to whoever is taking the floor for Westinghouse.

MR. ORE: Good afternoon. My name is Richard Ore. I'm with Westinghouse. I have responsibility for the seismic work, for the structures, for the piping.

I would like to start by thanking the staff for sort of an excellent summary. It allows me to jump through some of my presentation very quickly, but I would like to sort of make a few points from it.

Firstly, --

MR. CORLETTI: One second, Richard.

This is Mike Corletti.

His presentation starts on about page 15 of the handout.

MR. ORE: And the first slide I'm going to use is number 11.

Firstly, to address the --

CO-CHAIRMAN WALLIS: What is this? Excuse me.

MR. ORE: We did indeed --

CO-CHAIRMAN WALLIS: Excuse me.

CO-CHAIRMAN KRESS: We're still trying to find it.

CO-CHAIRMAN WALLIS: This thing leaps from slide five to slide 14.

MR. ORE: There should be a package that is entitled AP 1000, approach to design acceptance criteria.

MEMBER SIEBER: Yeah, that's slide 15.

MR. ORE: And that was slide 15, and in the handout package, four back, is one that is identified as slide 11.

CO-CHAIRMAN KRESS: N, that's not in ours.

MR. CORLETTI: Richard, you added that. I'm sorry. I didn't put that in there.

MR. ORE: My apologies. Would you arrange for a hard copy for them?

We had submitted a request in Phase 2 to review the approach of using design acceptance criteria on both structures and seismic analyses. We had one meeting with staff early last year, and we have had another meeting recently and additional phone calls and resulting from that we transmitted a letter yesterday that said that in design certification, in the design control document that we propose to submit at the end of March, we will request design certification including seismic analysis and structural design for a hard rock site.

Now, in response to the question earlier, on AP 600 we did a review of 22 existing nuclear power plant sites, and we found 50 percent of them --

MEMBER SIEBER: Are hard rock.

MR. ORE: -- the nuclear island is founded on rock, yes. Sometimes it's down at the -- our excavation depth is 40 feet. I think there were one or two cases where the rock was down 50 or 60 feet, where perhaps I've taken credit for a rock site because you would go down to it with your foundations.

MEMBER SIEBER: Yeah, i think I know where that one is.

MR. ORE: Fifty percent of the existing plants are on rock.

MEMBER SCHROCK: Is there any potential ambiguity about the definition of a hard rock site?

MR. ORE: I don't believe so. There is a site parameter that is established in the first section of the design control document. For AP 600, we requested and obtained certification for sites where the shear away velocity of the soil exceeded 1,000 feet per second.

For AP 1000 we have changed that to a shear away velocity exceeding 3,500 feet per second. In the AP 600 we did a series of analysis. One of them was at 3500 feet per second. In order to demonstrate there that soil structure interaction effects were negligible.

In fact, in one of the previous revisions of a standard review plan I believe that that cutoff of 3,500 feet was given then for whether you needed to look at soil structure in traction or not.

CO-CHAIRMAN KRESS: So given that comment, basically what Jim Lyon suggested, it looks like it's going to come about.

MR. ORE: Yes.

CO-CHAIRMAN KRESS: And all we have to deal with then is the piping deck.

MR. ORE: That's correct. So now I would like just to talk about the piping deck unless there's any questions related to the seismic analyses or construction design.

CO-CHAIRMAN KRESS: No, I think we're h pretty good shape there. So we can go straight to the --

(Laughter.)

MR. ORE: Now I will continue on the

piping, and this now starts at slide 22 of the handout package that I believe you have. And this will be fairly brief because it's been covered by the staff extensively.

The DAC and ITAAC approach was permitted, was used for ABWR and for System 80 Plus. The way it's done is in the design control document we agree on the design acceptance criteria and for the piping design criteria and the analytical methods and the acceptance criteria.

The implementation is verified in the ITAAC, and basically the verification is that there is a series of ASME design reports on every piping line, and that the scope of that is clearly defined in ASME. It includes any reconciliation of as built changes, and in addition, we have an evaluation against the acceptance criteria for leak before break to demonstrate that those lines that we intended to apply LVP to were qualified to the acceptance criteria.

CO-CHAIRMAN KRESS: What about this comment that small changes in the piping layout or sizes could have significant safety implications because you're highly driven by passive systems that rely on natural convection driving forces?

MR. ORE: We don't believe so. I've got

some additional slides. The AP 1000 -- let me just -- I think I prefer just to defer that if I could get to it, if I may.

MR. CORLETTI: Richard, this is Mike Corletti. If I could just speak to that a little bit.

In regards to changes in the pipe routing and how it could affect the passive system performance from a thermal hydraulic safety point of view, those characteristics are already captured in the ITAAC and are set in other portions of the ITAAC. So information that we had a range of piping resistance, L over D information, for the inlet and the outlet of, say, the core make-up tank lines.

The elevation of those core make-up tanks are also set. So from the things that would affect the safety analysis from like elevations and resistances, those are already covered in the ITAAC.

MR. ORE: As described by NRC, for AP 600 we did extensive analyses of all safety related piping. I believe it was all piping larger than two inch in diameter. In doing those analyses, we made certain assumptions on vendor data, particularly things like valves, valve weight, valve operators.

These calculations were audited by NRC and found acceptable. The question we ask ourselves though is: what have we gained when we end up with a verification process, the ITAAC, that is virtually identical to the ITAAC required of the other vendors, of the other plants?

This now goes to slide 25. What we gain from our AP 600 work, very definitely we gained confidence that all of the line routings work in the audit. So with NRC staff we got agreement on the methods and the implementation particularly of all of those methods.

We believe on AP 1000 we gain significant benefit from what we did on AP 600. Our line routings are substantially the same obviously, with a slightly bigger diameter pipe, with some slight changes, but nothing significant.

The analyses will use the same methods as AP 600, and the design specifications, transient conditions, the operating conditions are all substantially the same as AP 600.

Now perhaps I can go back to the question of the LBB lines. Mike had addressed the response on thermal hydraulics may be different. Clearly with the larger diameter there's going to be slightly different stress conditions, but we do not believe that there will be significant changes required.

On AP 600, in the ITAAC that we have on each system, we have a requirement that we meet all of the acceptance criteria, and in the extreme, if we had to reroute pipe, we would have to still meet all of the acceptance criteria, which includes subcompartment pressurization issues, flooding, all of the sort of pipe rupture hazard type issues if you have to reroute a line.

We recognize that there are some sort of issues related to subcompartment pressurization that we don't want to defer until after the plant is built. Therefore, we have included in the design control document and a preliminary mock-up of this was actually informally given to the staff month ago, and we specifically say combined licensed applicants referencing the AP 1000 certified design will complete the leak before break evaluation, and this is sort of at the time of the combined license application, and they will demonstrate that they meet bounding curves that are provided in the AP 1000 design control document.

An example of this, which will be in the submittal, it was in the preliminary one a month ago and will be in the one at the end of March. We define for the piping analyst when he is qualifying the system a bounding curve that shows if he's at an area below the curve, designated here as .1, and this is a relationship between the stresses under operating conditions to the stresses under the safe shutdown earthquake condition; if he's below that curve, he meets to leap before break acceptance criteria. If he's above it, he doesn't.

These bounding curves include all of the margins required by NRC. There are margins on load and margins on leak rate built into these curves. So if the combined license applicant can demonstrate that he meets these curves, then his piping layout satisfies the leak before break requirements.

MEMBER SCHROCK: Could you restate the meaning of those terms on the axes of that graph?

MR. ORE: Certainly. On the X axis the normal stress. This is the stress, the membrane stress in the pipe, membrane plus bending, and normal operating conditions.

CO-CHAIRMAN KRESS: The internal pressure?

MR. ORE: No, this is -- well it's internal pressure and it's dead weight. It's normal thermal, and under a given condition, he identifies what his stress in the pipe is, and he can then go up to the bounding curve and see this is the maximum stress then that I can accept when I combine it with the safe shutdown earthquake, the faulted conditions.

And if, indeed, he's above this curve, he does not meet the criteria for leap before break. If he's below this curve, then he does. And this is similar to the approach that was used on the CE plants.

CO-CHAIRMAN KRESS: The only difference between the two axes is the loadings you'd get from seismic?

MR. ORE: Pardon?

CO-CHAIRMAN KRESS: The only difference between these two axes is the loading you'd get from seismic?

MR. ORE: One of them is normal operating. The other is faulted. I think the primary difference is just seismic, yes.

MEMBER SHACK: To be certain, to make sure that you have enough stress to get a measurable leak compared to the size of stress it's going to take to actually fail the pipe.

MR. ORE: That's correct.

MEMBER SHACK: Which is sort of what you're comparing.

MR. ORE: And that's why actually if the

operating stress is higher, you can go to a higher or safe shutdown.

MEMBER SHACK: It's better news, yeah.

MR. ORE: It doesn't sound right, but effectively you're stressing the pipe enough under normal operating conditions if there is a crack, it will be a visible leak.

CO-CHAIRMAN KRESS: And why do these things flatten off at the ends? Is that just a safety --

MR. ORE: What we do is we take sort of two points actually sort of as a lower extreme and an upper extreme based on sort of typical practice. I think the upper extreme is the sort of highest that you can go under ASME.

CO-CHAIRMAN KRESS: So you know you're not going to be --

MR. ORE: You're pretty much up to yield at that stage.

CO-CHAIRMAN KRESS: Okay. I understand. There's just not any significance to those lines really since you're not going to be in there.

MR. ORE: You will never be able to qualify a line outside these ranges.

So sort of in conclusion, we intend, we

are proposing to follow a path that we believe is consistent with the approach used on ABWR and System 80 Plus. I was very pleased to see the overhead from Dave Terao that said he believes that such an approach is technically feasible.

Yes, there may be some sort of discussion on it, but we believe the overall approach is appropriate.

CO-CHAIRMAN KRESS: How do you argue against or debate their point that passive systems, piping is not nearly as complex as, say, System 80 Plus piping, and therefore, it shouldn't be that difficult for you to really lay out a similar thing to AP 600 that you did?

MR. ORE: We have effectively laid it out the same as AP 600. Now, systems are clearly simpler because of the passive systems. Unfortunately, we do still have certain sort of valves and things like that, and Part 52 specifically says you do not have to select vendors on things like that.

So you cannot do final analyses anyway, and the question really is: well, why do very elaborate initial analyses for review by NRC and then have to redo them at the as built stage?

CO-CHAIRMAN KRESS: So you think it might fit that second criteria there. You really can't do it until you get the as procured and as built?

MR. ORE: You are not going to be able to have final confirmation until you have done the as built.

MR. CORLETTI: As you all know -- this is Mike Corletti again -- as much as I'd like to agree that we only have check valves in our plant, we do have quite a bit of motor operator valves. All would have to be procured. All with end to end dimensions and centers of gravity.

So whereas on AP 600, we did do analysis making assumptions, we learned, I think, the hard way that we still had to come back to that at the end and redo it again with all of the final, as procured valve information.

CO-CHAIRMAN KRESS: If you were to build an AP 600, is there some chance that you'd find yourselves in a bind because you said one thing in your FSAR or your certification rule and you find out that when you get ready to build it that your assumptions were bad?

MR. CORLETTI: We certainly hope not, but again, our DAC approach and the fact that we've gone through that on AP 600 gives us significant confidence that even for AP 1000 we're not going to have to face that same problem.

MR. ORE: Okay. That concludes my presentation.

MR. BURKHART: Mr. Ore, this is Larry Burkhart, the project manager.

You say that it's similar. Can you quantify the differences between the approach compared to the System 80 Plus?

You're saying it's similar. Is it exactly the same? What are the differences?

MR. ORE: Our intent is that it be exactly the same, yes, that we would, indeed -- we have got all of the design criteria in the design control document. We will provide a similar reference in the CE approach in Chapter 1, I believe it is.

There's a reference to all of the subsections containing design criteria for piping. We would have a similar table and that all becomes Tier 2 stuff.

MR. BURKHART: So it sounds like your approach is the same, not just similar. I just thought there --

MR. ORE: The intent is that it be the same.

MR. BURKHART: Okay. I just wanted to know --

MR. ORE: Without going line by line, I did not want someone to pick me up and say, "Well, something is slightly different.

MR. BURKHART: I just wanted to know if there were any differences that you knew of.

MR. ORE: No, the intent is that it be the same.

MR. CORLETTI: And this is Mike Corletti.

It is certainly our intent to follow that precedent, and we'd be very interested to work with the staff in regards to places where we perhaps have deviated. We don't believe we have, but we certainly look forward to working with them to resolve that.

CO-CHAIRMAN KRESS: Any other questions on the DAC from the members?

(No response.)

CO-CHAIRMAN KRESS: At this point in time I propose we take a break. We were supposed to be scheduled for one at three, but we can start a little early, and I'd say be back from the break at three, and we'll start on the applicability of the scaling.

Is that all right with everyone?

Okay. Let's recess for a break.

(Whereupon, the foregoing matter went off the record at 2:43 p.m. and went back on the record at 3:03 p.m.)

CO-CHAIRMAN KRESS: Let's reconvene.

Before I turn this over to you to continue with the tests and scaling, I think Mike Corletti wants to make a few words for Westinghouse, if you don't mine.

MR. CORLETTI: Yes. I just thought I'd just take two minutes to brief you on really where we think we are in the overall program for AP 1000.

As you know, we started the pre-certification review. Really it began last December. We've been answering the RAIs with the staff, the staff RAIs. We believe we're just about to the end of this phase.

As part of that, we've just recently submitted to the staff a red line and strikeout, what we call our highlight and strikeout version of our DCD, of the AP 600 DCD, that really illustrates the differences between AP 600 and AP 1000, and this is one of the books.

There's 20 volumes, and it's being provided to the staff now as they plan the design certification review, as they get their estimates to see what they think it will take to certify AP 1000.

CO-CHAIRMAN KRESS: That's that little line with the pointed end on it

MR. CORLETTI: Yes, here. We're right here in the number three, pre-certification review, and we are preparing and we are prepared to submit our application at the end of March. March 28th is our scheduled date when we will be submitting the complete design certification document and the PRA.

What we've submitted so far is everything except for Chapter 15 and except for the PRA.

So our plan is to submit March 28th. The other two lines you see there is our projections for where the rest of the marketplace is as far as utilities are now getting ready to submit early site permits, and hopefully a COL application, which we believe is a critical path item.

Our goal is to make AP 1000 design certification not to be critical path, so to be finished prior to the utilities having their early site permits and, therefore, AP 1000 would be a viable product for them.

CO-CHAIRMAN WALLIS: How many utilities are involved in this?

MR. CORLETTI: There are several that are considering early site permits at this time, at least two or three that we know of.

CO-CHAIRMAN WALLIS: Haven't made a downpayment or anything.

MR. CORLETTI: No, not to our knowledge.

(Laughter.)

MR. CORLETTI: But we're working on it.

So that's all. I can pass this around. We have this on a CD, which we could also make available to the ACRS. I can get you copies if that's appropriate.

Paul we could do that.

CO-CHAIRMAN KRESS: Well, I think we definitely want that.

MR. CORLETTI: Okay, great. And you can look for the complete edition coming March with.

CO-CHAIRMAN KRESS: Okay.

MR. CORLETTI: So thank you.

CO-CHAIRMAN KRESS: Thank you.

Okay. With that I'll turn it back to you, Andrzej.

MR. DROZD: The last two remaining groups of issues from Phase 2 review are testing or a more precise applicability of AP 600 testing to AP 1000, and the applicability of safety analysis codes that were used in AP 600's review into 1000.

Today, this afternoon Dr. Steve Bajorek and Dr. di Marzo will address testing and scaling issues that were  analysis and applicability and its applicability to AP 1000 design.  I just want to briefly summarize major points that staff will be including in a proposed SECY paper to Commission on safety and testing.

First of all, we will notice that there are no new phenomena identified from what we see. That is, what other questions and problems there were with the design during AP 600, the certificate review, we see the same issues being addressed or needed o be addressed during AP 1000.

Therefore, in general, in general, we do see that whatever was used to analyze and/or support codes during AP 600 certificate review is applicable to AP 1000 review.

That doesn't mean that we do not have certain concerns.  First of all, we notice that some physical models that are the basis for various subroutines and various analysis used in analyzing safety behavior of the plant needs to be either modified or verified or both, and specifically liquid entrainment model is one of the outstanding issues that we think needs to be verified and/or modified because it's a basis for many other applications, for transient analysis or small break LOCAs.

CO-CHAIRMAN KRESS: It's the same entrainment model they had for AP 600?

MR. DROZD: That is the same issue.

CO-CHAIRMAN KRESS: And we found AP 600 acceptable because of what?

MR. DROZD: Well, Dr. Bajorek will show and prove the application for this particular model may increase -- the application of this model to AP 1000 increases certain uncertainty of behavior. Therefore, we need some improvements.

CO-CHAIRMAN WALLIS: There's one liquid entrainment model or it applies everywhere liquid is entrained?

MR. DROZD: Might as well jump in.

(Laughter.)

MR. BAJOREK: This is Steve Bajorek from Research.

There are two models that we're going to discuss. I believe that in NOTRUMP and in other codes that Westinghouse would use there are different models and correlations in that code which would try to model both of these processes.

MEMBER SCHROCK: Isn't the question where? I mean, there are different entrainment problems in the whole system. Which one was we talking about?

CO-CHAIRMAN WALLIS: Yeah, there's entrainment from the core. Let's say there's gas coming out, vapor coming out the core. Does the entrain drop?

Then there's the question of whether or not drops are entrained into the ADS-4 line. From a pipe there's maybe a completely different problem.

MR. BAJOREK: There's two different processes. Let me start and get to it.

CO-CHAIRMAN WALLIS: Did I force you to go? Did I drive our friend away?

(Laughter.)

CO-CHAIRMAN WALLIS: As soon as I mentioned simple hydraulics.

MEMBER POWERS: The man has the good sense to evacuate the scene.

(Laughter.)

MR. BAJOREK: Okay. There are two packages coming around. The first one will say 81,000 top down and bottom up scaling evaluation, and there's another one coming around that we'll get to in a moment.

We'll start on the top down/bottom up scaling, though I'm going to switch the first couple of overheads, and I want to explain exactly what the role of research was in the review.

We were asked to participate by reviewing the PIRTs that Westinghouse had supplied, look at the test programs that they applied to the primary system, and determine to what extent Westinghouse's contention that all of the test programs that were submitted as part of the AP 600 still were valid and could be applied to the AP 1000 conditions.

So we started off by taking a look at the PIRT. We basically agreed with what we saw there at Westinghouse. They increased the rankings of some processes; others stayed the same. By and large, we did not have any major objections there.

We asked them to add condensation induced water hammer and deal with that, and that was pretty much what we ended our analysis of the PIRT.

And then we looked at scaling for the primary system tests. We looked at AP 1000. We revisited AP 600 because we wanted to make sure that as we did the evaluation, we were consistent with the decisions, and we were seeing the same types of problems that we saw in the AP 600.

We also took a look at SPES APEX and we threw ROSA into the mix as well. To make sure that I clarify what we looked at, we stuck primarily to the test data and the test programs. We did not get intimately involved in looking at the codes or the analysis as part of our review.

We did not look at the containment issues. These were things that NRR decided that they would prefer to handle themselves.

So I'm going to look primarily at the test, the range of conditions. Is that data applicable now so that you can take a NOTRUMP, a LOFT TRAY (phonetic), and a COBRA TRAC, whatever code they might apply, and use these experimental data for validating --

CO-CHAIRMAN KRESS: You're looking strictly at the integral effects test and not any of the separate effects?

MR. BAJOREK: We looked at the separate effects test. I'm not going to talk about those today primarily because the separate effects tests were either unchanged relative to how they would be applied, meaning ADS-1, 2, or three was not changed in AP 1000. The conclusions from those tests still apply.

Westinghouse did produce some scaling rationale and some arguments for the separate effects test. They showed that they were very close or within the range for AP 1000.

In some cases, for example, the PRHR, if you remember, that was a test, three vertical tubes and they developed a heat transfer correlation. To comment on those tests was a bit difficult for the AP 1000 because approval really hinged on their ability to model the PRHR component in the ROSA facility.

So we're starting to get away from the applicability of the tests, even in AP 600. So the focus of our work was on the integral tests.

How we're going to structure our presentation this afternoon is along the lines of the three main elements that we perform for scaling. I'm going to talk initially about top-down scaling and how we evaluated ROSA, SPES, APEX and compared that to AP 600 and AP 1000.

Dr. de Marzo is going to talk about some supplemental calculations that he performed to take a look at the transient process in going from ADS 1, 2, 3 through the IRWST.

What I will be doing for the top-down scaling looks at many of these processes in their steady state performance mode. What Dr. di Marzo will take a look at is the transient effects in going through some of these important changes in the transient.

Once we get done with that, we're going to focus on some of the bottom-up scaling issues, and that's where we're going to spend more time talking about entrainment. So what I'd really like to do is to go through the top-down type of scaling in a relatively rapid fashion so that we can get to some of the things that I think are going to be more contentious.

I think on the first page, I just wanted to lay out a few of the things that as we go through the top-down scaling those parametric changes in the AP 1000 that tend to affect most of or many of the scaling parameters, certainly the power.

Other things that come into effect are the larger volumes in the AP 1000. The steam generator is larger. We've got larger CMTs, and a larger pressure rise.

So we have a larger primary system, larger pressurizer.

One of the things that was done to the AP 1000 is a change to the resistance of several lives.

In particular, the ADS-4 line resistance was reduced till it was only about 28 percent of what it had been in the AP 600.

That's good. The idea is to try to get the system to blow down faster.

They also made it easier to get water into the system by reducing the line resistance from the CMT through the DVI line. The thing I want --

CO-CHAIRMAN KRESS: Don't they do that by changing the diameter?

MR. BAJOREK: The diameter, and also there is an orifice change in the CMT itself to make it easier. The thing I want to note here as we start going to the top-down scaling, well, in the tests we had whatever the AP 600 was, or as close as they could get to it in the facility, but now we've made change to make it easier to get water out than it is to get water in, and that's going to cause a little bit of a problem in one part of the -- in one period of the transient.

Where are we going to lead with this? I think as Andrzej was starting to mention, by and large we're going to find that the tests that were run for AP 600, SPES, ROSA, and APEX largely have many of the characteristics that show that they are acceptable for use with the AP 1000. That's good. That covers much of the transient.

However, we find two major exceptions, and we feel that those are the things that we're going to have to deal with in a lot more detail in Phase 3 of the review, and those are the entrainment processes as they affect the flow quality leading to the ADS. A look of these separately in terms of entrainment that occurs in the hot leg, something that might be important for one or two inch breaks where we have levels up into the hot leg, and this is our primary mode of entrainment that carries liquid into the ADS-4.

For the DVI line break, which leads to the minimum vessel inventory and is the most severe accident for AP 1000, the process that we're going to be most concerned with is this upper plenum pool type entrainment where we have a two phase level above the core plate. Gas is bubbling through this liquid carrying droplets along the streamlines, again, out through the ADS-4.

As we go along, we're going to talk about these processes. What Marino is going to take a look at is what's the effect of this flow quality as it gets to the ADS, and how does that affect the transient nature of AP 1000?

Top-down scaling. There were several different methodologies --

MEMBER SCHROCK: I guess --

MR. BAJOREK: Sorry?

MEMBER SCHROCK: I wonder if this is the right time or maybe it shouldn't be left until later, but the modeling of this in APEX experimentally showed that you get a sloshing back and forth in this line. It doesn't look like the picture that you're showing here, but is something quite different from that.

MR. BAJOREK: We're getting ahead a little bit.

MEMBER SCHROCK: Well, okay. So you don't mean literally that what you're looking at is a steady flow that has this kind of configuration?

MR. BAJOREK: No, no. We'll have some water in the hot leg. It will have a different regime, and I'd like to talk about that when we get to it.

MEMBER SCHROCK: A pulsating discharge.

MR. BAJOREK: Yes.

MEMBER SCHROCK: Okay.

MR. BAJOREK: There were several methodologies that were proposed for doing top down scaling for the AP 600. Westinghouse proposed, too, that they used for the AP 600 one that I would prefer as a multi-loop top down scaling, another a single loop.

In the W cap that was submitted in support of AP 1000, they submitted another scaling methodology different from the first two. So I would characterize that as the third methodology.

INEL produced a scaling methodology for the NRC, and in addition, there was work done by Wolfgang Wolfe to come up with another scaling methodology. Each one has different ways of looking at the system. Each one has their good points and their bad points.

For doing an independent scaling analysis for this, we decided we wanted to stay independent. So we stayed away from the Westinghouse methodologies. We looked at INEL and the work that was done by Brookhaven and decided that it was clearer but faster to use the INEL scaling methodology and went down that path.

That methodology takes AP 600 or the AP 1000 transient, divides it up into five major periods, eight subperiods. We divided the AP 1000 transient up in the same type of detail and looked at two different scenarios, double ended guillotine break of the DVI line and also the one inch break, and developed the scaling parameters for each one of those scenarios.

CO-CHAIRMAN KRESS: Now, with the top down, you mean you write the equations for energy conservation and momentum and continuity, and you non-dimensionalize those, and you end up with your pi parameters.

MR. BAJOREK: That's exactly it.

CO-CHAIRMAN KRESS: Based on reformulating for some figure of merit of interest, like pressure or level or something. That's what's meant by top down.

MR. BAJOREK: Yes. Yes, sir.

The INEL looks at primarily the energy equation and the mass conservation equation to develop a pressure rate of change in a tank level equation, as they call it, basically a mass balance in the vessel, which is one of the things I liked about that methodology, because it focuses on mass in the vessel through much of the transient.

CO-CHAIRMAN KRESS: I don't like reopening old sores and things, but I don't think I ever got a good response to my question for AP 600, and I'd like to raise it again.

Just why is it you feel that that ratio of pi groups at range .52 is an acceptable range? What is it about that range that tells you it's acceptable? Is that a judgment or do you have some technical basis that says that if your pi groups are in that range, you don't have significant distortion of the equation so that you're outside of some limits?

I don't think I've ever received a good response to that question yet.

MR. BAJOREK: In starting this, I looked for that answer in the previous documentation, and I was unable to find that. My use of it here is primarily historical.

CO-CHAIRMAN KRESS: Yeah, that's the way it was used before.

MR. BAJOREK: Now, what I've tried to do here is at least make it scrutable and say, well, this is the criteria that as I step through the scaling, I'm going to look for numbers to fall within this range, say that they're okay. I keep an eye on things being close.

CO-CHAIRMAN KRESS: You've got to have some criteria for these pi groups to say whether they're acceptable or not. You know, why not .5 to 1.5 or .75?

You know, the question is why this choice.

MR. BAJOREK: From the top down scaling I really don't have a good answer for that, although I want to add that when we start to look at the bottom-up scaling, my opinion is that this is insufficient. You need to not only look at this relative change in some number, but also if you're headed to some type of a cliff, if you're simply looking at a froude number, well, this will give you a nice, warm feel that it's in about the same type of area of a flow regime map, but doesn't tell you if you just inched over a boundary or not.

CO-CHAIRMAN KRESS: Right, right.

MR. BAJOREK: So in the bottom-up scaling, I try to scrutinize this a little bit more that --

CO-CHAIRMAN WALLIS: That's because of CCFL. I mean, if the criterion is one and you happen to be two, that makes a tremendous difference.

CO-CHAIRMAN KRESS: Yeah, yeah.

MR. BAJOREK: Right.

CO-CHAIRMAN KRESS: That leads me to my other question about this, and maybe you can file it away, Professor di Marzo, and that is the pi groups, in my mind, are kind of coefficients on partial derivatives of these overriding equations, and there's no reason in my mind that each partial derivative should have the same influence as the other partial derivatives.

So why should I have one range that I say is acceptable? It seems like that range ought to be specific depending on the pi group I have. And also carrying on there, it looks like one could make sensitivity studies with pi groups, and you know, if you had the right way to do it, and you could find out. You could actually pinpoint some range that would give you the same change, percentage change in the endpoint thing.

You know, I don't see any of that in this at all, and that's what's bothering me about it.

MR. BAJOREK: Okay.

MEMBER SCHROCK: I had one other comment. That is that I think the INEL and Brookhaven scaling began with the HEM equations.

MR. BAJOREK: They did, yes.

MEMBER SCHROCK: And this leaves open the question of the adequacy of scaling decisions where non-equilibrium effects are of significance. I never heard an answer during the AP 600 discussions that resolved that question, and I don't know if we're headed towards one now or not, but I guess I might keep asking it.

MR. BAJOREK: Okay. I won't have an answer for that today.

MEMBER SCHROCK: Okay.

MR. BAJOREK: But just to point out how we've addressed top down scaling in this review, very similar to what we saw for the AP 600. We stayed towards this acceptance criteria between a .5 and a two.

When things fell out of that range, we asked ourselves is the distortion conservative or non-conservative. If it was a conservative distortion in the test that was deemed acceptable,, if it was a distortion in one of the parameters that on an order of magnitude basis was a no never mind quantity --

CO-CHAIRMAN KRESS: Okay. So you did take that into consideration in your judgment.

CO-CHAIRMAN WALLIS: Let's look at a specific phenomenon. The fangs in the CMT or the condensation sucked the water back into the CMT. This was later concluded not to apply to full scale plant because the hydrostatic heads were so much bigger than something.

Did that get revealed by these pi groups or by someone's wisdom from something else or what? I mean, shouldn't it have shown up in the pi group somehow or would it be a bottom-up scaling?

MR. BAJOREK: I think a bottom-up scaling is a place where that would have to be addressed. The top-down scaling tends to homogenize the entire system and wash out sharp discontinuities.

CO-CHAIRMAN WALLIS: Well, this was a balance between them, some parts were dropped due to condensation and some pressure difference due to hydrostatics. It's a balance between the things. You would think it would show up as a pi group.

MR. DI MARZO: This is Marino de Marzo.

Specifically to that phenomena there, it wouldn't be captured in top down because you don't have the description to that detail of components level that would -- so you have a PBL line and a CMD.

CO-CHAIRMAN WALLIS: No, if you look to the equations, you find you have the hydrostatic term and the pressure term that you --

MR. DI MARZO: Not at this level of detail.

CO-CHAIRMAN WALLIS: Not at this level? Okay.

MR. DI MARZO: So it is left to be addressed at bottom up.

MR. BAJOREK: This example of the top-down scaling, I just want to show you the way that we arrived at some of our results. The example is what INEL referred to as the intermediate Sub-phase 3. That refers to this period. You don't have this figure in your package. I'm sorry.

This is when the ADS 1, 2, 3 system has been triggered. The water in the CMT is below 80 percent. The CMT is injected for a period. Accumulators are starting to come on. The system is depressurizing. There's voids in the upper head, upper plenum, hot legs. As a result, the steam generators have become ineffective.

The PRHR is operable, but is under a degraded condition at this point. Lots of things going on during this period, which makes it interesting from a scaling point of view.

CO-CHAIRMAN KRESS: When you talk about pressure, pressure varies around the system. Is that pressure in the upper head or where is that pressure?

MR. BAJOREK: Generally --

CO-CHAIRMAN KRESS: Oh, it says upper head pressure at the top.

CO-CHAIRMAN WALLIS: Yeah, it does.

CO-CHAIRMAN KRESS: Okay, okay.

MR. BAJOREK: It was either that or --

well, the pressurizer wouldn't be good for this.

CO-CHAIRMAN WALLIS: Well, until you get on later on, it doesn't matter too much. Five mega Pascals is quite a big pressure compared with the hydrostatic.

CO-CHAIRMAN KRESS: Yeah, did you consider pressure a very definitive figure of merit to worry about?

Rather than say water level in the core, of course, is very important. Pressure may be, but I'm not sure I can see it.

MR. BAJOREK: Well, it makes a difference. It's used very frequently in defining the reference conditions in each one of these subphases.

CO-CHAIRMAN KRESS: Okay.

MR. BAJOREK: Okay. For the intermediate subphase, INEL defined roughly a dozen dimensionless groups to characterize the depressurization flows into and out of the system.

To apply the methodology, we got geometric information for the AP 1000, as well as for the test facilities and for the AP 600. In this case, APEX doesn't get thrown into the mix because it wouldn't be applicable for early parts of this period.

It took into account the larger area side in the ADS system. It gives us a larger flow rate for the AP 1000, lower resistance in the CMT, which increases the CMT flow rate; larger volumes in the CMT and the primary system

Recalculated all of the various pi groups; looked at the ratios of those pi groups for AP 600 to the AP 1000, ROSA and SPES, comparing those dimensionless groups. In this case ROSA comes through clean.

CO-CHAIRMAN KRESS: If your criteria of .5 to two --

MR. BAJOREK: Point, five to two. If you decrease that to about 1.5, it still wouldn't make it. So it --

CO-CHAIRMAN KRESS: Right. And the closer those are to one, the more you feel --

MR. BAJOREK: The closer they are to one they are the better. As they start to get to 1.99 or two or .5, it's at least an indication that it's starting to get out of that acceptance criteria that's been used before.

Now, in the case of SPES, there were two groups that did fall outside of that range for the AP 1000.

CO-CHAIRMAN KRESS: So when you

reformulate your equations, undimensionalized, and you get these pi groups from the top down, you need to focus on the dependent variable that you're going to come out with.

Now, these pi groups are for pressure?

MR. BAJOREK: These two are for pressure, those two that like I say I have indicated. The si are for pressure. The five or six down below are from the mass equation.

CO-CHAIRMAN KRESS: Okay. So you've got different ones in there.

MR. BAJOREK: Yes. They're both in there, but for SPES we find two that are potentially distorted. We looked at both of those. In both cases the distortion is a conservative one, meaning that performance in the plant should be better than what it was in the facility, and they're both in groups which are of relatively minor importance in the comparison of the pi groups that had the maximum, the largest values.

CO-CHAIRMAN KRESS: And how did you determine the importance? How did you determine the importance?

MR. BAJOREK: Oh, that's done by an order of magnitude.