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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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MEETING OF THE SUBCOMMITTEE ON THE WESTINGHOUSE

AP1000 DCD

+ + + + +

TUESDAY

AUGUST 16, 2011

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Harold B. Ray, Subcommittee Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD B. RAY, Subcommittee Chairman

SAID ABDEL-KHALIK, Member

J. SAM ARMIJO, Member

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

MARIO V. BONACA, Consultant

THOMAS S. KRESS, Consultant

BOZIDAR STOJADINOVIC, Consultant*

GRAHAM B. WALLIS, Consultant

NRC STAFF PRESENT:

WEIDONG WANG, Designated Federal Official

EILEEN McKENNA

MOHAMED SHAMS

GEORGE TARTAL

BRET TEGELER

HANRY WAGAGE

ALSO PRESENT:

TOD BAKER, Westinghouse

KENT BONADIO, Westinghouse

BRAD CARPENTER, Westinghouse

TOM CLEMENTS, Friends of the Earth*

KEITH COOGLAR, Westinghouse

MIKE CORLETTI, Westinghouse

ED CUMMINS, Westinghouse

BOB JAKUB, Westinghouse

DON LINDGREN, Westinghouse

MIKE MELTON, Westinghouse

RICK OFSTUN, Westinghouse

RICHARD ORR, Westinghouse*

STAN RITTERBUSCH, Westinghouse

SUSAN G. STERRETT, Carnegie-Mellon University*

LEO TUNON-SANJUR, Westinghouse*

ROLF ZIESING, Westinghouse

*Present via telephone

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

(1:00 p.m.)

CHAIRMAN RAY: The meeting will now come to order. This is a meeting of the AP1000 Reactor Subcommittee as standing subcommittee of the Advisory Committee on Reactor Safeguards.

I'm Harold Ray, Chairman of the Subcommittee. ACRS members in attendance or expected shortly are Mike Ryan, Said Abdel-Khalik, Charles Brown, Sam Armijo, Sanjoy Banerjee, William Shack, Dennis Bley and Joy Rempe.

ACRS consultants Mario Bonaca, Tom Kress and Graham Wallis are also present with us, or will be present with us. I think they are.

Anyway, ACRS consultant Bozidar Stojadinovic is participating with us through a telephone connection. He's in Europe.

CONSULTANT STOJADINOVIC: Yes, I am.

CHAIRMAN RAY: Thank you, Bozid.

Weidong Wang is the Designated Federal Official for this meeting. This meeting is part of the ongoing review of a proposed amendment to the AP1000 pressurized water reactor design control document.

In the past, we have had 12 AP1000

Subcommittee meetings, enjoyed them all, on the AP1000 DCD. And these were in 2009 and '10. And we produced several letter reports from those. I expect we will do so one more time as a result of this meeting.

This AP1000 Subcommittee meeting will review the Safety Evaluation Reports on the new updates in Revision 19 of the AP1000 DCD. I'll have a little more to say about that in a minute.

We'll hear presentations from the DCD applicant Westinghouse and the NRC staff. We've received written comments and request for time to make oral statements from a member of the public regarding today's meeting, and time has been allocated for that purpose.

As shown in the agenda, some presentations may be closed in order to discuss information that is proprietary to the applicants and its contractors pursuant to 5 U.S.C. 552(b)(c)(3) and (4).

Attendance at this portion of the meeting dealing with such information will be limited to Westinghouse representatives, NRC staff and its consultants, and those individuals and organizations who have entered into an appropriate Confidentiality Agreement with them.

Consequently, we will need to confirm that

we have only eligible observers and participants in the room and closure of the public phone line for the closed portion.

The closed portion is set aside for 3:15 and after. We'll see whether it's appropriate to go to a public comments portion in order not to go on and off the phone line as we get closer to that point if there's a need for a closed session.

The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full committee. And we expect that at this time, we expect that will occur at the full committee meeting in September.

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. A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice.

Therefore, we request that participants in the meeting use the microphones located throughout the meeting room when addressing the Subcommittee. Participants should first identify themselves and speak with sufficient clarity and volume so that they

may be readily heard.

Now, as I indicated in these prepared remarks, we are focused here on what is identified to us all as Revision 19 of the AP1000 DCD, and the final Safety Evaluation Report from the staff that is based upon that revision.

The topics that we're looking at of course are also addressed there. A large portion of what we'll be discussing has to do with the shield building. And as we all know, the shield building is a new scope to this in its present form, to this amendment.

And we'll also be looking at some updates of analyses, not changes, but updates of analyses that are part of the completion of the - and finalization of the amendment.

Insofar as those analyses involve things that we have not looked at because they have not been a part of the amendment to this point in time, then they become topics that are being addressed here at this last current meeting as part of the amendment by virtue of the fact that they will be updated in the analyses even though they don't reflect any changes in the design.

So, we'll get to that in due course. But

I wanted to make that point because particularly in the case -- and I'm speaking here of the containment analysis. There are many, many elements that go into that. All of them, of course, were addressed previously and are part of the certified design.

Now, there are some changes being made. And those changes will be - the changes in the analysis, that is, not in the design that the analysis is for, the containment itself or anything associated with it, but the changes in the analyses will then be on the table for discussion.

Given all of that scope, I am concerned about the time that we have available for this meeting and trying to make sure that we get through everything that we need to do and are not in a position of having material that we're unable to address.

So, we're going to have to be more than usual disciplined. And I may intervene at times not to preclude discussion of things that need to be discussed, but to expedite discussion of things that presumably are understood and well known so that we can focus on those that need to have discussion here this afternoon.

We'll go as long as necessary within reasonable bounds. That's why we're meeting here this

afternoon so that we can have a little flexibility on how much time we take, and our goal surely is to get through all of the discussion material necessary.

After the meeting is concluded, there may yet be some things that require some further review by us or input by the applicants or staff. This will come up then on the full committee agenda in September for the full committee meeting. And anything that's left for discussion will of necessity then be targeted for that full committee discussion.

Obviously, we want to minimize that and just have the full committee meeting be the basis of a final letter that we would write based on Amendment 19.

So, those are the general remarks that I wish to make at this point in time. We'll go ahead and proceed with the meeting, and I'll ask Eileen if there's anything that she wants to say.

MS. McKENNA: Yes. It's Eileen McKenna from the NRC staff, AP1000 project. It's a pleasure to see you all again.

In the interest of moving on, I think I will turn the helm over to Westinghouse to start off with the discussion of the changes that have occurred in the design control document from Revision 18, which

is where we were at the time we last met with the Committee, to what we're now calling in dealing with in Revision 19.

We'll have a general overview of the changes, and then we'll talk in more specific detail about those areas that are a little more technical in nature versus catching up on things that we identified during our confirmatory item review.

CHAIRMAN RAY: Okay, thank you, Eileen.

The staff did, among other things, there was an audit conducted at Cranberry that's provided the basis for some of the clarifications and other changes in the licensing basis that we'll be looking at in Amendment 19.

So, there are many - I don't want to call them cats and dogs, but there are many, many topics here. And we'll try and be, as I say, disciplined in how we focus on them. And, again, try and limit the time that's spent on things that are not requiring any discussion or interchange between us.

Rolf, it's yours.

MR. ZIESING: Okay. Thank you, Mr. Ray, and members of the ACRS. Westinghouse welcomes the opportunity to be here today and present a summary of Revision 19.

As we typically do, we've got a full team here to support. Not knowing exactly where your interests may be, we've got people here that hopefully can provide the answers today to any questions you have.

I just want to introduce a few of those key people. Again, myself, Rolf Ziesing, Director of U.S. Licensing. With me on the front table is Mike Corletti, Director in Engineering. And Don Lindgren is my lead licensing engineer for the structures topics.

Also in attendance, Ed Cummins, Vice President, New Plant Technology. Kent Bonadio, Manager of Containment and Radiological Analysis. And we have many other engineers, technical engineers and licensing engineers here. So, we hope that will facilitate the dialog.

The structure of our presentation today is I'm going to lead a discussion that provides an overview and I will touch on the technical topics that I know you want to spend more time talking on.

I'd ask if you want to delve into it at that point, but I'd just let you know that we do plan to then sequence more detailed technical discussion with the leads here. So, we will get to substantive

technical discussions, but I thought it was important to lead off with an overview and put the Rev 19 into the context how we see it.

Okay. So, Mike, if you could drive.

MR. CORLETTI: Yes.

MR. ZIESING: Thanks. These are the topics we're going to cover. I just mentioned that. It's consistent with the agenda you've issued.

We can go to the next slide - oh, I wanted to ask can we do a phone check to make sure - we were expecting some folks at Cranberry on the line in the event -

CHAIRMAN RAY: Yes, certainly. We heard from our consultant. The question is are the folks from Cranberry on the line also? It's possible that it was - well, it shouldn't be on mute if we're going to have any input from - well, we'll go check.

MR. ZIESING: There's not going to be a need for them immediately. And hopefully no need, but just a thing that we have down here, but we'll proceed. But if we could just make sure that we've got the line open -

MR. CORLETTI: Richard said he's on.

MR. ZIESING: Okay.

MR. CORLETTI: Richard, are you on the

line?

MR. ORR: Yes, I am. Richard Orr.

MR. ZIESING: Okay. Thank you.

MR. CORLETTI: And, Lee, are you on the line?

MR. TUNON-SANJUR: Yes, I am. Lee Tunon-Sanjur.

MR. ZIESING: Okay. Great.

MR. CORLETTI: Thank you.

MR. ZIESING: You can hit the next slide for me, Mike. And for those following, I'm on Page 3 now - Slide 3.

So, just a very brief background. DCD Revision 18 was the subject of the NRC, ACRS and public review. It contained follow-up of the technical design changes that followed Rev 17.

In the course of finalizing the licensing basis as part of the NRC process, my understanding is that confirmatory items be established to validate that when Rev 18 is submitted, that in fact the licensing basis is consistent with the prior agreements and discussions.

So, really, the history of Rev 19 is it was an expected consequence of the process and that we knew that there was the need to provide closure to

some existing items that got raised.

For example, one item was ACRS identification of the water film stabilization run-out time that was identified.

So, Rev 19 was expected. And it is a - what we refer to as a conforming change. There's no new design information in Rev 19. The design is the same as what was in Revision 18.

What Rev 19 has in it is clarifications. It's got strength and regulatory controls. We're going to get into the details of that. And basically just making sure that the licensing basis is as clear as possible leaving no ambiguity and consistent with FSER. That's the primary driver of Revision 19.

Before we issued Revision 19, what's not in these slides, and, Mr. Ray, you referred to this a little bit about the audits and whatnot that occurred, from the time that Rev 18 was issued to Rev 19 being issued as part of reaching resolution on these remaining confirmatory items, there was significant engagement oversight by staff, as well as our customers, the COL applicants via the Design Center Working Group.

So, each one of these things we're talking about has been subject of public meetings, audits and

inspections. For the three specific topics, there were three special public meetings to ensure that those items were discussed in a public forum.

So, a lot of additional effort that I'm not going to go into any further and maybe the staff may elaborate on that later to validate the contents for Revision 19 before it was issued.

Okay. Next slide. Slide 4. So, this is a thumbnail sketch of the scope of revisions in 19 and I'm going to touch on a little more detail.

But the types of changes to elaborate what we're talking about, I mention the additional regulatory control. And that was achieved through designation of existing DCD text. And in some cases, we had a text for clarification, but we designated it as what's referred to as Tier 2*.

And what that basically does is it puts a, I'll say, a regulatory lock on the licensing basis such that if there's contemplation in the future of changing any of that, the licensing basis language, that that would obligate a formal interaction with the staff in accordance with established regulatory processes for change control. And we're going to get into some examples of the Tier 2* changes.

In addition, there were clarifications and

consistency improvements, in particular with Chapter 16, the tech specs and Tier 1. It was - since we are looking at making clarification changes and whatnot to Revision 19, it really was the right time to clean up some editorial-type issues in those sections of the DCD given the fact that Tier 1 is like Tier 2.

And that if you contemplate any change in the future once the rule is issued to Tier 1, it becomes much more difficult to deal with changes. And so where there were editorial and clarification types of changes, we included those in Revision 19.

And then specific changes around the resolution of the three specific focus areas that we're going to talk about, the shield building load combination, the PCS tank, analysis methodology in the containment vessel, internal calculated peak pressure, but just to emphasize that there is no design changes in Revision 19.

Next, please. Okay. Slide 5. This gets now into examples of what we're talking about. It's not a complete summary, but I think it is a good representative summary of the kinds of changes that we're talking about to give you a sense of that. So, the next several slides will be examples of the Tier 2* changes that were implemented.

This is an example dealing with containment penetrations to basically recognize existing licensing basis language and identify it with Tier 2* control such that in this case, we're talking about information that relates to minimum thickness of the hatch cover, inside diameter of the sleeves, diameter of the insert plate. Essentially, large penetrations on a containment vessel.

There was a desire by the staff and we supported that request, that the details associated with large penetrations have the additional regulatory control associated with the design of those large penetrations.

Next slide. Slide 6. Here's another example of Tier 2*. And, again, this one has to do with containment penetrations where specifically an inset plate - details with insert plate associated with penetration was identified as Tier 2*.

Next slide. This is an example where there was a request for additional design details associated with the shield building design. And the details that were requested were considered by Westinghouse to be proprietary.

And to support the DCD being a nonproprietary document, what we agreed to was to

create a special technical report. And you see the reference there, GLR-602, but it does provide all the details that was requested.

And so that report was issued and exists, and now it's referenced as an incorporated by reference document. And the reference to that document is designated as Tier 2*.

So, that obligates us that in the future if we change any details as described in that tech report, that those changes be evaluated in accordance with the requirements that go with Tier 2*.

Okay. Next slide. This one has to do with how we control containment debris. Obviously, that was the subject of several ACRS meetings. And it was the subject of your letter that you issued December 13th asking for regulatory control on debris limits.

How it was implemented was again by identifying the associated licensing basis language in the DCD as Tier 2* controls.

MEMBER BANERJEE: Was there some discussion, Harold, about using this as tech spec or something?

CHAIRMAN RAY: Yes. Personally, I thought it made it more visible to the people who operate the

plant to put it in tech specs.

Staff felt that this was a better way to handle it from their standpoint, and I'm willing to accept any -

MEMBER BANERJEE: Thank you.

CONSULTANT WALLIS: What does "might be" mean?

CHAIRMAN RAY: What does the what?

CONSULTANT WALLIS: Might be. What does "might be" mean?

MR. ZIESING: Might be fiber.

CONSULTANT WALLIS: Why don't you just say "is"? "Might be" doesn't mean very much. "Might be" is very iffy.

CHAIRMAN RAY: How about could be?

CONSULTANT WALLIS: But it is.

CHAIRMAN RAY: Well, the total that is allowed to be fiber, it could be - that's what they're trying to say.

MR. ZIESING: The amount that's fiber -

CONSULTANT WALLIS: But you could be more direct, I think. "Might be" just doesn't sound right to me. I mean, I might be wrong on many things I say, but -

(Laughter.)

MR. ZIESING: Imagine the challenge in finalizing licensing language with some of the interested parties. It is a challenge. Appreciate the comment.

Next page. We're on Slide 9. These are other examples of changes. We're now past the Tier 2* examples.

The types of changes in the Tier 1 portion of the DCD are listed here. Changing component identifying numbers for consistency with other changes that occurred in the Tier 2 section of the DCD, editorial corrections, renumbering of ITAAC for consistency and other conforming changes to be consistent with changes agreed to in Section 2.

So, Tier 1 contains all the information that is in Tier 2. And so, we need to make changes in Tier 1 for that internal consistency with the licensing basis.

And then on the bottom, DCD Chapter 1, that's the front matter. We had to of course update list of documents and update some references to some reg guides.

Okay. Next slide. This is a slide that summarizes the changes to the tech spec sections. Really, with the exception of the last item, these are

largely editorial clarification. Acronyms, maybe clean up upper case and lower case, reformatting, etcetera.

But the last one there, the calculated peak containment internal pressure, we're going to get to the details of that. That is a consequence of correcting the time for the water pump stabilization and we'll get to the details of that.

But the reason there's a change in the tech spec section, is that there's a tech spec requirement for the containment vessel pressure test and the pressure test pressure is identified as the peak pressure.

And so, we had to update the tech spec to be consistent with the updated peak pressure calculation.

Okay. Slide 11. We added two additional, what's referred to as critical sections. And in the shield building design, there's a number of what's referred to as critical sections identified.

We added two more that you see here. The design doesn't change. And, in fact, this is strengthening the regulatory basis and that it obligates more detailed analysis and is subject to NRC audit for all the calculations associated with these

prescribed sections of the shield building.

So, it's really intended to make for a more comprehensive licensing basis determination.

Next slide. This and the next couple slides is really just a high-level slide by of the focus topics that we're going to get to in more detail.

The first focus topic is the shield building load combination topic. This revision reflected in Rev 19 was a consequence of responding to an NRC request during the confirmatory review to provide additional justification regarding our, essentially, historic treatment of normal, i.e., ambient thermal loads, plus seismic load combination evaluations. And we're going to get into the details of that.

So, we have responded to the request, did a lot of additional work analysis to complete the load calculation, combination calculations as requested that work, validated the acceptability of the existing design. The design didn't change, but the work that we did was reflected in Rev 19 to document the additional analysis and strengthening the licensing basis for the design.

Okay. Slide 13 is a high-level summary of

the shield building PCS tank topic. What prompted this change, it was self-identified by Westinghouse during the confirmatory review process that Revision 19 - or, I'm sorry, Revision 18 did not reflect an agreement that was reached during the months of shield building review that led up to Rev 18 where we had made a commitment to implement a basis for determining how the loads in the tank would be calculated, the loads from the water forces.

And we had, historically, two methods of calculation. One is referred to as the equivalent static analysis method, and the other one was the hydrodynamic loading method.

It was mutually agreed that we would reflect in the licensing basis the equivalent static analysis, and we had previously done work on that. So, we updated the DCD to reflect what was agreed to and we have some detailed discussion to represent on that.

Okay. Slide 14. And this is the containment vessel calculated internal peak pressure item. This was a consequence of identification during, I believe, the full committee to ACRS where it was identified there was a challenge that we didn't have the correct water film steady state coverage time.

That was a valid issue. We acknowledged that.

At the time, there was some discussion that we didn't expect that the correction of the steady state coverage time would affect the internal pressure.

Upon further detail review of the inputs to the modeling and whatnot, it was determined that there would be a minor affect on the pressure. And so, we went about updating that pressure to coincide with the updated steady state coverage time.

In the course of doing that, we had on the books more of the minor corrections that would have been made at some point in the future. And it was determined through discussion with the staff, that now is the right time to do that.

So, the revised pressure of 58.3 reflects a number of minor changes to input changes in the mass and energy model and the containment response model, and we're going to go through more detail of those things.

CONSULTANT WALLIS: Now, we're going to get to that later, aren't we?

MR. ZIESING: Yes, sir.

CONSULTANT WALLIS: Because the first bullet really doesn't reveal until you get to the

third bullet, that you made about a dozen changes in the inputs as well.

So, we're going to think about those later, right?

MR. ZIESING: We will, yes, sir.

CONSULTANT WALLIS: Okay. Thank you.

MR. ZIESING: We have several slides on that. We've got half a room full of people here that will help answer the question.

(Laughter.)

MR. ZIESING: Okay. And I mentioned the conforming change to the tech spec that goes along with that.

Okay. The next slide. So, this is really to wrap up the summary. Okay, that's kind of the - not kind of. That is the scope of changes in Revision 19.

I didn't cover every single change, but the technical changes, those were the only technical topics. And then it was many additional regulatory licensing basis language changes, the Tier 2* type of changes and editorial corrections.

I did not cover all of those, but I think I made a representative sampling of the kinds of changes.

Rev 19, in summary, was an expected revision to capture the resolution of the staff confirmatory items, as well as action items that were identified in the ACRS letter.

That the design of Rev 19 is the same design that was in Rev 18. Mr. Ray, you identified, though, that some of the analyses and whatnot were updated. And so there's - we acknowledge that certainly the analyses were updated, but the design has not changed.

CHAIRMAN RAY: That's understood now, but I just wanted to make sure it was understood that the analysis is subject to review and we will do that. It's hard to change one part of an analysis without providing it - creating a question about another part.

MR. ZIESING: Right.

CHAIRMAN RAY: So, we'll discuss that at the appropriate time as has been noted.

Let me take a second here to say how we'll proceed with respect to one element, though, that I want to make sure we get clarity and as much discussion as is useful here.

We have a member of the public who has asked for time, and will be afforded time later on to speak, but that individual has also provided written

comment to the staff, and separately and subsequently written comment input to ACRS staff.

I believe the input that was made to the NRC staff was the subject of discussion at a public meeting already. But in any case, the input that came to us was expected from that which was given to the NRC staff previously. Includes both the issue of the significance, if any, of radiant heating or cooling of the shield building, which was discussed previously, but also a similar effect potentially on what's known as the large-scale test rig, which was outdoors and, therefore, subject to radiant heating as well.

So, we will to some extent in this detailed part of the discussion, both the structural part, that is the shield building, and the containment pressure part, ask you, as well as the staff, a question or two. We'll allow the public member to speak to their concerns themselves.

But since that comes later, I don't want to get into a situation of which there is discussion going on back and forth. I just wanted you the opportunity to address something at the appropriate time. Then, we'll hear from the member of the public. And anything that's left to do after that, we'll have to take up then, okay?

And there's two issues that have been presented to us. Both of them involve whether or not radiant heating is significant to either the structural analysis of the shield building, or the test that was done that is related to the containment pressure behavior, okay?

All right. So, with that having been said, let's proceed.

MR. LINDGREN: Okay. One administrative matter. It says "Proprietary Class 3" on both your slides and this presentation. That's in fact a nonproprietary class for Westinghouse. So, these slides are all nonproprietary.

And the part that will be put in the public document room has been corrected to say "Nonproprietary Class 3."

CHAIRMAN RAY: Thank you.

(Off-record comments.)

MR. ZIESING: Joining us at the table is Tod Baker and Keith Cooglar from our Special Engineering Department. And on the phone, we do have Richard Orr and Lee Tunon-Sanjur.

Richard is a consultant for Westinghouse. A Westinghouse retiree. And Lee is the Manager, Structural Manager.

MR. LINDGREN: Yes, we're here to talk about the shield building load combination and this combination of normal thermal and seismic. We did focus on and the staff's questions focused on the effect on the shield building.

The shield building design was performed using an established practice for considering structural behavior under normal thermal loading. These structural design calculations in some cases, had not explicitly included a calculated normal thermal load contribution in combination with the SSE when thermal effects were considered to be small or self-relieving.

The language in the ACI Code is you should consider the thermal loads. So, there's not universal agreement on what that means.

CHAIRMAN RAY: Well, in that regard in terms of there not being uniformity about what it means, one might also then raise the question of what's the source of this thermal load.

And could you delve into that recognizing that we have -

MR. LINDGREN: Certainly.

CHAIRMAN RAY: -- an interest in radiant heating or cooling as -

MR. LINDGREN: Sure. The thermal loads that we considered were extreme weather conditions. Either very cold days, minus 40 with a wind chilling off the shield building. And on the other hand, 115-degree temperatures heating it up.

There are relatively small portions of the shield building that have both ambient temperature on the outside of the wall, and some condition space on the inside, or just subject to heating from the equipment or piping that is in that room.

So, that is the thermal load that is due to the gradient through the wall, because the temperature outside is not the temperature -

CHAIRMAN RAY: Well, wouldn't radiant heating add to that gradient?

MR. LINDGREN: Possibly.

CHAIRMAN RAY: And do you have anybody here, Don, that can discuss why that shouldn't be considered?

MR. CORLETTI: So, we can speak to the radiant heating effects. Do you want to take the first shot?

MR. BAKER: Well, we looked at a variation in temperature over a two-day period --

MR. CORLETTI: 12 hours.

MR. BAKER: 24 hours of --

MR. COOGLAR: 110 degrees.

MR. BAKER: -- 110-degree gradient. And we did that to look at the local effects. That temperature variation between the - is the steel-faced plate and the concrete to look at what effect that had. And we felt as though that 110-degree variation would account for variations in whatever temperature we applied.

In other words, that was a relative gradient. So, 110-degree variation over a 24-hour period.

CONSULTANT WALLIS: So, these temperatures that you're assuming in the shield building are uniform otherwise?

MR. BAKER: Not necessarily completely uniform. There are -

CONSULTANT WALLIS: When someone says "110 degrees," is that uniform over the -

MR. BAKER: Oh, I see what you mean. Yes, yes, over the whole -

CONSULTANT WALLIS: So, you don't consider transients? I mean, if there's a hailstorm on a sunny day, on a bright, hot day, you could get chilled regions of the -

MR. BAKER: No.

CONSULTANT WALLIS: You don't consider that sort of thing?

MR. CORLETTI: That was the intent of the 110-degree study. We basically -

CONSULTANT WALLIS: But those are transients with temperature differences. Doesn't that change the stresses in the wall?

MR. BAKER: Right. That was the idea behind looking at any - an overall change of 110 degrees over a 24-hour period.

CONSULTANT WALLIS: That's 24. I'm thinking about a quick transient where you have a gradient in the wall which is fairly short.

Does that change the stress?

MR. BAKER: Yes, but the - as we have a three-foot-thick wall, steel-faced plates on both sides, the concrete has a tendency to have significant thermal lag. So, it has a tendency to maintain its temperature.

It takes a fairly significant period of time for it to -

CONSULTANT WALLIS: I wasn't thinking of the concrete. I was thinking of the steel.

MR. BAKER: Right, and - well, we chose

this 24-hour period to change that.

CONSULTANT WALLIS: I'm just asking are there affects on the short term if you have gradients in the wall or regions which are much different in temperature from other regions because of, say, a hailstorm coming from one side or something like that?

I don't know. I'm just asking if you considered that.

MR. BAKER: Yes, I mean, I believe those are fairly localized effects.

CHAIRMAN RAY: Well, I think the issue here is what thermal stresses are combined then with seismic stresses, isn't it?

MR. LINDGREN: Yes, sir.

CHAIRMAN RAY: All right. So, we're looking for conditions which I would characterize at least as not extremely remote that is a coincident hailstorm and earthquake, but rather a condition that is appropriate for combining with a seismic event.

MR. LINDGREN: Yes, sir.

CHAIRMAN RAY: Okay, but I still don't understand the radiant heating answer very well.

Whatever the ambient condition is, is it not true that the steel, the external steel, would be subject to some elevated temperature if it were

exposed to the side that was creating this 110-degree day?

MR. BAKER: Well, there are a lot of effects that go into determining what that temperature is. The actual angle of the rays on that, the face of the building, would have a significant effect.

So, for instance, early in the morning and late in the afternoon would be the times of the day when that sun was most directly heating our surface, which is also curved, which also has a tendency to affect -

CHAIRMAN RAY: Is it fair to say, then, that you just didn't -- this didn't rise to the level of significance that would have -

MR. BAKER: That's right.

CHAIRMAN RAY: -- caused you to include it?

MR. BAKER: That's right.

MR. CORLETTI: I think that is what we're trying to say. The explicit analysis that we did as part of the shield building report, and this was asked by the staff, they asked us to look at thermal cycling effects.

And so, we looked at pretty extreme delta Ts over a fairly short period. I actually believe,

Tod, it was a 110-degree swing over a 12-hour period.

MR. BAKER: 12 hours in a day. I'm sorry.

MR. CORLETTI: Over a 12-hour period. That temperature effect, when you look at that transient temperature effect, showed very small additional stresses due to that temperature effect.

And we feel that that bounds any effect that you may have from a solar -

CONSULTANT WALLIS: But you just feel that. You didn't calculate anything?

MR. CORLETTI: It bounds the -

CONSULTANT WALLIS: You should calculate the effect, not just talk about it.

CHAIRMAN RAY: Bozid, do you have anything you'd like to direct to Westinghouse here?

MEMBER BANERJEE: Is that still on?

CHAIRMAN RAY: Well, Weidong, is the line open?

MR. WANG: I believe so.

(Off-record comments.)

CONSULTANT STOJADINOVIC: Hello?

CHAIRMAN RAY: Bozid, do you have any question you want to direct to Westinghouse on this point that we've been discussing?

CONSULTANT STOJADINOVIC: Well, what I

wrote in my report is that I suspected that the analysis of the thermal was really dependent on the input and given that one of the extremes as I think we've been talking about is fairly localized. And so, I would not expect that the additional benefit would be much different as what has been computed.

So, no, I don't have any questions other than would there be any reason to analyzing the behavior part of the plate itself that is heated by, let's say, 40, 50 degrees and then to see how it forms with respect to tons.

I have never see any problem with similar solutions in steel or steel-plated, but just in case, I was wondering if you had any comments on that.

MR. BAKER: Yes, as part of our evaluation of that 110-degree swing over 12 hours, we looked at the stresses in the studs and tie bars and components that make up -

CONSULTANT WALLIS: What's the cause of the stress? It isn't just the temperature. I mean, if everything heats up uniformly, everything just expands, right?

Isn't it temperature difference that causes these stresses?

MR. BAKER: Right, it's a temperature

gradient that -

CONSULTANT WALLIS: Right. So, you need to look at all causes of temperature gradient.

MR. BAKER: Right.

CONSULTANT WALLIS: Which could be within an hour, instead of 12 hours. It could be because the sun heated up part of the building, and not another part.

The heat should be quantified in some way.

MR. BAKER: Yes, and we did quantify that. The application of the temperature over the first hour would be a significant gradient because the steel has either warmed up or cooled off quickly while the concrete has a tendency to stay at its temperature.

CONSULTANT WALLIS: So, if it were 110 degrees, and then there were a hailstorm and it would chill to 40 degrees, this would be a very rapid transient and would create a stress, right?

CONSULTANT STOJADINOVIC: Yes.

CONSULTANT WALLIS: That difference in temperature is more significant to me just thinking about it, than a slow warming up during the day. But I don't know, because I haven't analyzed it. And I just wonder if you have, that's all.

MR. BAKER: Well, I believe we've captured

that in our assessment, because we started with the concrete at a - some temperature and changed the temperature of the steel. And now how rapidly -

CONSULTANT KRESS: I believe Harold Ray's comment was on the point of this. You're combining seismic loads with these thermal loads.

And to assume you're having a hailstorm or something, I mean -

CONSULTANT WALLIS: Rain is more frequent. Let's go with rain.

CONSULTANT KRESS: Yes, I think they're diurnal. Temperature gradients really are more appropriate for combining with seismic loads.

CHAIRMAN RAY: Thank you, Tom. Let me ask Bill to weigh in here.

MEMBER SHACK: Well, I mean, my argument before when I looked at your analysis, your largest gradients were in the winter. And they were axial gradients up and down the wall, because you've got essentially the chilled building and the cold one there.

And so in that case, the thermal warming is going to, in fact, mitigate your problem. It's not gong to affect the axial gradient.

So, the dominant -- yes, if you were

looking only at through-wall gradients, that would increase it. But their overall largest problem is really in the winter when they have essentially a warm building, and an ice cold cylinder sitting above it. And in that case, the thermal warming helps.

Now, the radiative cooling -

CHAIRMAN RAY: Helps in the seismic -

MEMBER SHACK: It helps in the thermal loads. I mean, again, as Tom said, if you're looking at this at a risk sense, your SSE occurring on the hottest day or coldest day of the year, of course, is a small thing.

But this is a design basis thing. So, it's SSE plus thermal loads. But, again, as to whether that would be affected by the thermal heating, I don't think it would, because the dominant thermal load seems to be the winter load with essentially the warm building and the cold cylinder.

CHAIRMAN RAY: And you're saying the radiant heating would relieve the cold -

MEMBER SHACK: The radiant heating would essentially be uniform or helpful in that case, because, again, you're mitigating it.

Now, radiative cooling would hurt that, but that just seems to me a much smaller effect.

Although, I haven't computed the number.

So to me, I was comfortable with the analysis that was done, because of the way it was done.

CHAIRMAN RAY: All right, Bozid. Go ahead.

CONSULTANT STOJADINOVIC: Yes, I agree with this. I think winter is more severe than summer. And I think very much there is some symmetry in the behavior that was shown by your analysis.

The only one additional question that I could possibly pose on the radiant part is whether the model Westinghouse used is capable of taking into account some kind of definition metric, say, maybe a 90-degree kind of sort of quarter of the building being heated up slightly - not slightly, but some gradient. And then the other part of the building stay at its low temperature.

And I think the model is capable of doing that and I -- from my experiences the stresses would still be smaller, but --

MEMBER BROWN: Could I make one practical observation?

CHAIRMAN RAY: If it's brief, because we're really on a fast track here.

MEMBER BROWN: Briefly. My only point

being is I've got collectors on my roof. I wanted to paint them. It was an 80-degree day. I couldn't put my hand on the roof. It was a good 40 degrees hotter, and I had to put multiple layers of stuff down.

So, if somebody tells me that the radiant heating is insignificant, it is very significant. It was very hot and I - otherwise, I couldn't have done the job.

Now, that's just a practical observation. And if you look at it, what you can do to one side of the building as opposed to the other side of the building, which is in the shade, that could become a fairly significant number.

That's just a practical observation. I'm not a thermal -

CHAIRMAN RAY: Charlie, we're specifying 30 to 40 degrees here due to radiant heating. That's already established.

MEMBER BROWN: I didn't hear that.

CHAIRMAN RAY: Okay, but it's in the written -

MEMBER BROWN: Oh, that was in the written stuff -

CHAIRMAN RAY: In any event -

MEMBER BROWN: -- that I haven't seen.

That's correct.

CHAIRMAN RAY: All right. The issue only is relevant to coincident seismic loading, which is how the issue arose in the first place.

It had to do with the combination of thermal, which they call normal thermal -

MEMBER SHACK: And even then, I mean, if you consider the 70 degrees that you get from the warmth and the minus 40 that you get in Duluth on the coldest day of the year, that really gives you the largest - it's hard to get this place warm enough if you start with 70 and start to heat up in the summer.

So, it's really that winter load that does it. And in that case, the thermal heating is -

CHAIRMAN RAY: You're saying you don't believe that 110-degree ambient day with radiant heating on top of that would be worse than the case you have looked at.

MEMBER SHACK: Right, with the 70 degrees from the building. You just - you don't heat it up that much.

CHAIRMAN RAY: Okay. I think we've spent enough time on this.

CONSULTANT WALLIS: But where is the quantitative analysis we're talking about?

CHAIRMAN RAY: They've already, Graham, indicated, I think, enough in terms of how they handled it.

CONSULTANT WALLIS: Okay.

CHAIRMAN RAY: Unless Bozid wants to say something else, we'll move on.

CONSULTANT STOJADINOVIC: No.

MR. LINDGREN: Okay. To validate the existing shield building design, Westinghouse updated the calculations to explicitly combine normal thermal plus seismic.

The updated design calculations followed the ACI Code - ACI-349 Code, as well as the recommendations of ACI-349.1R-07, which is Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures.

The revised calculations demonstrate that no change in the structural design is required. That means none of the - nothing was made thicker and there was no additional rebar.

The DCD was changed in its text in Rev 19 to clarify this licensing basis and support completion of the FSER.

One of the things we don't have in our slides that somebody asked, the thermal effects, the

temperatures and the gradients were calculated from finite element model to - that was cold where it's cold and warm where it's warm, provoked the extreme hot weather and the extreme cold weather.

CHAIRMAN RAY: Say that one more time.

MR. LINDGREN: We used the finite element model to determine the temperatures and the temperature gradients.

CHAIRMAN RAY: Okay. But not considering radiant heating.

MR. LINDGREN: We did not include radiant heating in that model.

CHAIRMAN RAY: That's fine.

MR. LINDGREN: Okay. The additional analyses show generally small localized changes to the demand when normal thermal loads are numerically combined.

CONSULTANT WALLIS: What do you mean by the word "demand"? A demand for what?

MR. LINDGREN: The load. The stress.

CONSULTANT WALLIS: The stress. You mean the stress.

MR. LINDGREN: Member forces.

CONSULTANT WALLIS: So, "demand" is a word for meaning stress?

MR. LINDGREN: Forces.

CONSULTANT WALLIS: Forces, okay.

MEMBER SHACK: Now, I did - there was something that puzzled me. And that when I looked at Appendix L, you recapitulated - you added your new load cases, which are the thermal plus seismic, but you also recapitulated the first 17 loads as a section of the table.

Then I went back to the original table back in Table 3.2-7, 17 loads, and they're both essentially design capacity for outer plane sheer, the enveloping loads are different for the 17 load cases in the two different chapters.

And why is that since the design didn't change?

MR. CORLETTI: Yes, we can explain. I think we did - and I'll ask Keith to help, but we did a more refined analysis for the thermal back in Appendix L.

What we did is a pretty simplified analysis in the original 17 load cases, simplified bounding analysis. When we did the load combination of seismic plus thermal in Appendix L, we did a refined -

MR. COOGLAR: That's right. In the body of

the report in Chapter 3 of the report, there was step temperature gradients. And then for the Appendix L, we did a heat transfer analysis that allowed for smoother transitions in temperatures that would occur at localized regions.

MEMBER SHACK: But those 17 load cases in Chapter 3 didn't have the thermal loads, right? The thermal loads are all in the 18 through 40 load cases.

MR. COOGLAR: No, that's not -

MEMBER SHACK: That's not true?

MR. COOGLAR: Well, that is true, but load cases 14 through 17 did have thermal loads, but they did not combine SSE plus thermal directly.

MEMBER SHACK: Okay. But those wouldn't have been the limiting loads then, right?

MR. COOGLAR: Well, not necessarily.

MEMBER SHACK: The SSE loads would have been limiting if we were only considering thermal.

MR. COOGLAR: Not necessarily.

MEMBER SHACK: No?

MR. COOGLAR: Not necessarily because of the conservative analysis that was done to determine the thermal loads.

MEMBER SHACK: Okay.

MR. BAKER: In the body of the report with

the step change, there were cases where -

MR. COOGLAR: Yes, there were cases where the thermal only loads would be governing because of the step thermal transition.

MEMBER SHACK: Okay, because they certainly were larger.

MR. COOGLAR: Yes. All right?

MR. LINDGREN: One point to further confuse things, the DCD and the ACI-349 refer to these as "normal loads." In Appendix L, we refer to them as "ambient." So, those two words mean the same thing.

The reinforcement design for the steel/concrete composite portion and the conventional reinforced concrete portion of the shield building is not changed.

The strength of the shield building for beyond design basis that is review level earthquake, is not compromised by the consideration of this load combination, and the ductile behavior of the structure is maintained.

What this shows - well, all of this shows up in documentation as Appendix L of the shield building report. It was added to describe the analysis of the normal thermal plus the seismic load combination.

And then in DCD Revision 19, we included the revision to Section 3.8 and Appendix 3H to address the normal thermal plus seismic load combination.

CONSULTANT WALLIS: You keep saying "normal thermal." That's -

MR. LINDGREN: It's meaning not accident.

CONSULTANT WALLIS: So, you aren't talking about normal weather.

MR. LINDGREN: No, we're talking non-accident, basically.

CONSULTANT WALLIS: Okay.

MR. LINDGREN: It is extreme environment -

CONSULTANT WALLIS: So, you're trying to exclude hailstorms or something. Normal, okay.

MR. LINDGREN: And, yes, generally the highest loads come from the - on the cold, extreme cold days.

So, that's what we have. Any more questions?

CHAIRMAN RAY: Okay. Anything else on this subject before we turn to - we're going to go now into the tank, right?

MR. LINDGREN: PCS tank.

MR. BAKER: PCS tank, that's right.

MR. LINDGREN: Okay.

CHAIRMAN RAY: I think here is where again I'm trying to look ahead so we don't miss anything. Bozid has looked at this with some care and has made some recommendations with regard to capturing in the licensing basis, some of the detail that you're showing.

I think we're going to want to talk about how it's decided what - if it's there or what's involved or required to get there, or whether that's a good idea or a bad idea.

But in any event, that's one of the things that we're anticipating discussing here.

MR. LINDGREN: Okay. As we were looking at the DCD and analyses we had done as part of the issue we just discussed, we identified that DCD Rev 18 was not updated to conform with commitment we had made in the shield building action item. Action Item 21, I believe it was.

This action item specified the application of hydrodynamic loads in the design of the PCS tank. It specified that we would use an equivalent static analysis method.

We have updated those - we have now updated those calculations, and these results are included in the DCD Rev 19.

What we did for Rev 15, which is the basis of the current certification and used only a hard rock input spectrum, was that the equivalent static analysis applying maximum acceleration from a time history analysis, the hydrodynamic loads are applied as a pressure -

CONSULTANT WALLIS: The pressure distribution.

MR. LINDGREN: Yes.

CONSULTANT WALLIS: Because this depth analysis is for the steel. The hydrodynamic is dynamic. Slushing.

MR. LINDGREN: Yes.

CONSULTANT WALLIS: So, it's a pressure distribution, but the steel responds as if it were static.

MR. LINDGREN: Okay.

CONSULTANT WALLIS: Thank you.

MR. LINDGREN: The PCS exterior wall is a critical section with the results of the analysis and the reinforcement requirements summarized in the DCD. So, that's where we were with Rev 15.

In Rev 16, the staff reviewers encouraged us to adopt a response spectrum analysis for the whole building, Nuclear Island Building complex, using what

is referred to as an NI05 model for the entire Nuclear Island design. And we included the PCS tank in this model and in this analysis.

The equivalent static analysis was applied using detailed modeling applying maximum acceleration from time history analysis for selected portions of the shield building roof design. And in this case, we applied it to the air inlet and tension rings.

The design of those portions of the shield building were really not conducive to the modeling scale in an NI05 model. So, there was further refinement.

Okay. The action item from the NRC shield building review, and these are included in the shield building report, the resolution of that required Westinghouse to apply an equivalent static analysis to the PCS tank applying maximum acceleration from a time history analysis.

A quadrant model, a finite element model of the shield building roof including the PCS tank, the tension ring and the air inlets, is used in this equivalent static analysis.

The design is performed using a methodology similar to what was certified in DCD Rev 15, and similar to the method that was used to the air

inlet structure and the tension ring.

Once again, hydrodynamic loads are applied as a pressure and validated against the time history response spectrum analysis.

And that is - the PCS tank is - this is a summary of what we've got in Rev 19. PCS tank is analyzed with the use of equivalent static analysis. In conformance with what we committed to in the action item, PCS tank design includes load combinations that numerically combine thermal plus seismic loads.

The ACI-349 criteria are all satisfied for the PCS tank design. The PCS tank is basically a reinforced concrete structure.

The PCS tank design is described in the DCD and changes we made in 3.7, 3.8, Appendices 3G and 3H.

The design of the reinforcement for the PCS critical sections is not changed in Revision 19, except that as we told you previously we added a couple of additional critical sections and they happened to be portions of the PCS tank that were it.

So, that's - I believe that's all we have. We included some tables and figures for you so you don't have to hunt through the DCD to find them.

And we have really nothing to talk about

unless you have a question related to those.

CHAIRMAN RAY: Well, this would be then all the discussion that you plan to have with us concerning the shield building structure, both the thermal loads and the PCS tank?

MR. LINDGREN: Yes.

CHAIRMAN RAY: Because there is something further, these Tier 2* details that Rolf mentioned were being added here are of some - are added in this revision, let's say.

We'll stipulate that they're not a change in the design. But, nevertheless, they're here.

MR. LINDGREN: They are licensing issues, not design issues.

CHAIRMAN RAY: And they arise at least as I read stuff, in part, in response to staff requests associated with audits performed and so on.

So, we naturally have given some attention to reviewing those. And, Bozid, do you want to go through the respective comments and recommendations that you have made to us?

CONSULTANT STOJADINOVIC: Yes, I - to summarize everything in a few sentences, some of the details, especially the RC to SC connections, are very detailed, are basically production ready. Some of the

other details are not really there yet. And one of those is the connection between the inclined roof and cylinder on the shield building. That needs a little bit more work. And the other one is the connection between the floor and the shield building.

CHAIRMAN RAY: Well, basically, let me ask you, you have your report there, don't you? I have it here, but -

CONSULTANT STOJADINOVIC: Yes, I have it.

CHAIRMAN RAY: -- I'd like to give Westinghouse more specifics as to what your conclusions were having read this.

Again, this is at least as I understand what's being suggested, is clarifications and additions the way Bozid presented it to us as the -- that should be added to the next revision of 602, but I think our interest here goes to all these things that need to be in the licensing basis and are not yet.

So, go ahead, Bozid, and discuss some in a little more detail.

CONSULTANT STOJADINOVIC: Well, what our - well, one of the details that I like that I think should be in the licensing basis is good connection would be the RC wall and the SC wall. And that is a

very well-detailed and ready-to-go drawing.

And what I would like to see is other connections that have similar physicality details on the same level.

One thing that I would very much like to see is the connection between the detail of the weld between the plate that forms the SC wall, that is if the plates enter a stage weld. And I'd like to see how that will be done together with the specification of developers and engineers' categories carry weight.

MR. ZIESING: Could I offer -

CHAIRMAN RAY: Yes.

MR. ZIESING: You know, this is a real challenge in terms of striking a balance between defining detail for licensing basis and recognizing Part 52 and the need to construct a plant under the licensing basis, and to ensure that the plant's constructed in accordance with the license in sufficient detail so that all parties understand what the design basis is.

Okay. When it comes to certain details like welds and whatnot, I mean, recognize that we conform to ASME code and details like that have to follow code compliance and they do exist. And our position would be that specifying that level of detail

on the licensing basis then really creates big challenges from a practical standpoint when we get to production and recognizing that there's always nuances in as-builts in compliance to licensing basis.

And the implications are what - how you define things now, how you define details now defines the paths in which you have to resolve things that come up.

And so -- but that's -- and that's at the heart of --

CHAIRMAN RAY: Right. Well, I --

MR. ZIESING: -- this discussion. So, it's part of --

CHAIRMAN RAY: I think we do see the problem that you're describing, or at least I do having built a plant or two.

On the other hand, the question is, is it really true that code requirements are sufficient to specify an acceptable as-built product?

I mean, we don't have any --

MR. CORLETTI: Especially since we don't have a code for this structure.

CHAIRMAN RAY: Well, that's why Rolf seemed to suggest that there's a code that applies here. But we went through all that before and concluded that if

we're going to build these things a great deal, there ought to be a code, but there isn't that's sufficient.

And I know the staff has asked you to add some details in particular places, and you've done that. That's not to say that you shouldn't do any more of it.

But nevertheless, it is a problem unless there are criteria specified that are sufficient to ensure adequacy of the as-built product as they say.

MEMBER SHACK: In some cases, you could go for a performance requirement. You have one now on the tie bar weld to the plate that it has to meet a certain yield. It has to develop a yield in the tie bar.

Why not a similar requirement for the plate-to-plate weld or the mechanical connector to the plate weld, which would, again, you wouldn't ask for the weld detail, just exactly how you were going to do that. That's sort of up to you and that could change.

But what we're really interested in a structural performance sense, is whether the weld is strong enough. And so rather than detail, add some performance requirements.

CHAIRMAN RAY: I don't know of any set of requirements that - I'm just looking here again at one

1 particular area as the steel seat and connection of
2 the roof beam seat and to the tension ring.
3 Beats me how you - I know you yourself
4 have criteria for the design that you're sure will be
5 - will result in an adequate final design. Our
6 problem is just in getting some transparency and
7 visibility to that.
8 We understand things get built for a lot
9 of reasons differently than people might think at this
10 point in time. They're going to get built. You've
11 got many, many, many changes that occur in the details
12 and you don't want to have to have a license amendment
13 every time you do that. I do understand that.
14 MR. ZIESING: I was reacting to the notion
15 that the DCD figures are production figures. I mean,
16 it's not the intent that the DCD provide production
17 ready drawings and that's not the mindset that -
18 CHAIRMAN RAY: But you referred to Part 52.
19 MR. ZIESING: Yes.
20 CHAIRMAN RAY: And Part 52, I think,
21 presumes that there are criteria that can be
22 referenced and used in the design that are sufficient
23 to ensure an adequate final product.
24 The problem we're facing with this
25 building is that we're not satisfied that that's the

case.

CONSULTANT STOJADINOVIC: Yes, and that is why I would like to see some of the details of the welds. And that's the argument. That's the argument.

MR. CUMMINS: This is Ed Cummins.

We're mixing a little bit, I think, the - we were talking about the tension rings. The tension ring is not an SC structure. It's an AISC structure, and there is a code. And the PCS tank is not an SC structure. It's an ACI-349 code.

So, it sort of depends on what picture we're actually looking at. And if it is a picture of an SC structure, then we don't have a code and the picture becomes -

CONSULTANT STOJADINOVIC: Yes I mean, you don't have a picture of the welds, of the plates, even of the SC structure. You don't have that at all.

And going back to your comments, I hope there's a connection between the plates, the floor plates and the SC structure is not the production one because there is no steel crossing a plane, a vertical plane there. So, hopefully it will revise that.

MR. CUMMINS: In the -

CHAIRMAN RAY: Excuse me. Ed made a point that I don't want to forget, which is that he's

arguing that there's adequate code provisions that apply to things other than the walls of the SC portions of the shield building.

Bozid, do you accept that that's true and that, for example, this point about the intersection at the outside wall that you discuss wanting to see some more detail on?

Are you -

CONSULTANT STOJADINOVIC: Yes.

CHAIRMAN RAY: -- in agreement that there's a code that adequately specifies and makes sure we have an adequate product at the end of the day?

CONSULTANT STOJADINOVIC: Well, there are two issues. One is about the SC walls. For the SC wall, I think we have to specify the detail because today there is no probe.

The other one is that the details will lower the design of the floor plate connection to the SC walls and the connection of the roof to the SC wall of the generator on the shield building are ACI-349 connection.

However, the connection of the floor plate, the detail that I see there is not good. I mean, just take a look at it and -

CHAIRMAN RAY: Well, okay, but -

CONSULTANT STOJADINOVIC: I really urge you to take a look at it within the current code.

CHAIRMAN RAY: I understand. But the review that we're doing now, I guess I'm trying to separate whether they've shown us how they're going to meet the code from whether they've shown us how they're going to have a satisfactory design in the absence of -

CONSULTANT STOJADINOVIC: Okay. So, I get it now. So, the connection between the floor plate and the SC wall will be covered by 349, hopefully it will be done correctly for connection between the roof, the inclined roof and the SC building will be done to 349 somehow, but let's do the SC wall then in more detail.

CHAIRMAN RAY: Well, I just need to separate those two things because -

CONSULTANT STOJADINOVIC: Yes, I see now. No problem. I understand you.

CHAIRMAN RAY: Yes, because we can't attempt to put in the licensing basis the way in which requirements are going to be met, except when the requirements themselves aren't sufficient. Then, we have a reasonable reference to look to.

CONSULTANT STOJADINOVIC: Understood. Understood.

CHAIRMAN RAY: Or if there's some element of it in which we can't imagine how the code is going to be met, then it's reasonable to ask for that too.

But at this point in time if we can just keep those separate, we won't drop either one of them and continue with the discussion that way.

Is there anything more that you could say to us about your recommendations?

CONSULTANT STOJADINOVIC: Well, everything else, I mean, everything else -- basically the essence of my comment is that I understood the answer and hopefully it will be followed through.

CHAIRMAN RAY: Okay.

CONSULTANT STOJADINOVIC: Thank you.

CHAIRMAN RAY: All right. Well, again, if you have any doubt about the ability to meet the code, for example, if we - any of us see in any area here something that assumes compliance with requirements that we can't envision how they can be met, well, we certainly want to identify that, but that's different than we don't know how you're going to establish the requirements, and we need to know about that.

CONSULTANT STOJADINOVIC: Understood. No

problem. I think that will - yes, no problem.

CHAIRMAN RAY: All right. Anything else, Bill, or anyone else has on this subject?

MEMBER ARMIJO: Well, getting back to the SC structure and Bill's point about performance requirements on the welds, whether it's tie bar welds or plate-to-plate welds, I'm just assuming those exist.

And if you meet those and you have plenty of margin, I don't know if we need - there's a number of ways you can make a weld. We don't need to lock you in as long as you have solid performance requirements that gives you margin.

Is that it? I don't recall reading that part of the DCD that specified -

CHAIRMAN RAY: Well, you could either qualify your design with testing, I would think, or you can comply with a code requirement. I don't know that there's another option.

MEMBER SHACK: Well, as I point out, they do have a performance requirement on one of the non-conventional welds, which is the tie bar to the face plate. And what I was suggesting is that they could add performance requirements for some of the other welds in the steel composite structure.

I mean, I fully agree that normally we don't specify these details because they're covered by codes. And wherever the codes are applicable, I'm typically happy. But in the steel composite structure, it's a little different.

MR. LINDGREN: We, in fact, in GLR-602, we do have the requirements. For instance, we require that the welds that anchor the liner plate to the connection are complete joint penetration welds as defined by AWS.

So we do, in fact, have more information in GLR-602 on those welds.

CONSULTANT STOJADINOVIC: Yes, I agree. I agree, but it's much more of the shield building.

CHAIRMAN RAY: Is that limited -

MEMBER SHACK: When you look at that, that just sort of tells you the geometry of the weld. It still doesn't tell you how it works. I mean, I agree. A complete joint penetration weld is a complete joint penetration weld. But if it doesn't develop the strength -

CONSULTANT STOJADINOVIC: Well, coming to that there is a few - well, there is about 10 or 15 different kinds of complete joint penetration welds, too.

MEMBER SHACK: As I say, I like the way you did the tie bar to the face plate.

CHAIRMAN RAY: Yes.

MEMBER SHACK: You just essentially put in the performance requirement on the strength that has to be developed in the tie bar. And it would seem to me that would be a reasonable thing to add to the - to some of the other - because as I say, the unconventional welds, the connector to the plate.

CHAIRMAN RAY: You wanted to say something?

MR. CORLETTI: I do believe the way the structural design has gone in under Part 52, and maybe I'm just restating the obvious, we've gone with the approach of using critical sections where we do a detailed design. We identify the loads and we take each of those - I don't know how many - if there's 12 to 15 critical sections, we show how we do detailed design.

That really - those - how we do those detailed design of those critical sections, the staff reviews that. They write their SER. We apply those methodologies to the rest of the Class 1 structures.

MEMBER SHACK: You're saying so the performance of the weld is somehow implied in your

analysis of the critical section?

CHAIRMAN RAY: Yes.

MR. CORLETTI: And that really is how we approach - use those - the approach of the critical sections and apply that to the rest of the structure.

MEMBER SHACK: That's an argument.

MR. CORLETTI: And I believe that's the way Part 52 is set up with the use of critical sections in design. And the staff could use those in detail.

CHAIRMAN RAY: Listen. Here's what I think we should do. I'll address myself to Ed. Can you capture what was just said in some manner --

MR. CUMMINS: Yes, I think I can.

CHAIRMAN RAY: -- that we can mull over? And the sooner, the better.

I'm not asking at this point for change. But at the end of the day when I say a change, of course I'm speaking of a change in the licensing basis, but we need something that we can discuss among ourselves and determine if there is a need for us to ask for that.

But this is a problem that we've been wrestling with and we don't have time to create an action item and have you come back and talk about it again.

So, give me something that provides obviously to NRO and to us, that would address what I hope you understand to be our concern. And that is these critical sections appear to be a surrogate for code requirements, I guess.

MEMBER SHACK: Yes. To a certain extent, yes. Although, they have asked for critical sections even in places that are covered by the code up in the -

MR. CORLETTI: But I think it demonstrates how we do detailed design of both - it's not just non-code. The code applies to all work that we do.

MEMBER SHACK: Right, right.

MR. ZIESING: I recognize that the composite structure we have the issue of there's not a clean code. But for many of the other structures and for welding and things like that, I mean, there's codes that apply and they're invoked and our work complies with that.

CHAIRMAN RAY: Well, but you would agree, I hope, that it's a challenge for us to work our way through that in this case. Because to merely say there are codes that apply, there's still the question of how they're going to be applied and so on since they aren't specific to in the case of the SC

structure.

MR. CORLETTI: Right, right. And that is the point of the critical sections is we show how we've applied - how we do the details on it, how do we apply the code in design space.

CHAIRMAN RAY: Well, that may be a sufficient answer. I just don't want to let it pass without asking you to give us -

MEMBER SHACK: The staff's understanding of this too since they're -

CHAIRMAN RAY: Yes, that's why I say -- it obviously comes to us through the staff with whatever comments they have, but give us something that at least says what you said orally that we can think about, and we'll let you know if there's anything more we want to hear about at the full committee meeting.

MEMBER SHACK: We'll do that. Thanks.

CHAIRMAN RAY: Okay. Now, we're going to move on if - well, go ahead.

MR. LINDGREN: It's the staff's turn now to talk about these two subjects, at least according to the agenda we were given.

CHAIRMAN RAY: Yes. Do you have anything more that you want to -

MR. LINDGREN: We are in fact done.

CHAIRMAN RAY: All right. We're going to hear from the staff now, I guess, Eileen.

MS. McKENNA: Yes, we didn't actually have a formal presentation, because we were trying to conserve the time. I think it might be more useful if we call upon the reviewers and the branch chief and myself to come up. And I know you had some questions about the audits, and I think that might be a more productive use rather than to march through the same material that Westinghouse has covered.

CHAIRMAN RAY: Okay. Given, then, that we're scheduled for a break and since we may go late, I don't want to not have a break, we're going to take a break now until 20 minutes to 3:00. And then we'll start with the staff.

(Whereupon, the above-entitled matter went off the record at 2:25 p.m. and resumed at 2:39 p.m.)

CHAIRMAN RAY: Okay, we'll resume. We want to keep the line available for requesting comments so we don't have to run out and unmute it every time. On the other hand, we would ask those who are listening in and who don't have something they want to say, to put their instruments on mute until they do, because there's an awful lot of background noise here that's coming in over the phone line.

Okay. With that being said, Eileen, it's up to you.

MS. McKENNA: Okay, thank you. I'm Eileen McKenna from NRO staff. With me is Mohamed Shams who's the Branch Chief of the Structural Engineering Branch. And on my right is Bret Tegeler who's one of the main reviewers on the AP1000 structural evaluation topics.

I thought we'd jump right in on that. I think in terms of overview, I can come back to that later if you want to talk about that. I think Rolf kind of covered fairly well the topics I was going to cover in terms of a general overview of what went on and certainly we can respond to any questions you may have, but I thought it might be more useful to just launch in on questions you may have about what the staff review included in the area of load combination and the tank issue.

I think in both of these areas, we saw these as implementing what we thought were the commitments in Rev 18. So, our focus was really to make sure that those commitments were carried through and the analysis results showed what they needed to show. And that's what the staff review really included.

I know you mentioned earlier the audits, and I would leave it to my colleagues to discuss what review in their audit activities included to make sure we answer whatever questions you have in that area.

CHAIRMAN RAY: Well, in that regard, Eileen, let's begin with we've already had some dialog on a topic that is very hard to be defective about in terms of where to draw a line.

Basically, the discussion, though, that we've had is around the issue of how much detail is needed in order to address or ensure the adequacy of the final product in the absence of any performance, as Bill referred to, criteria, ITAAC, code requirements or whatnot.

Let me just ask you flatly, is the staff satisfied that all of the required information is now in the licensing basis? And here, I'm just talking about structural. The structural design, not off into I&C or something else.

But that there is no detail that is lacking as you reflect on this, or is there some other way that you've gone about deciding which details need to be included, because we've got a lot of details that have been added at staff request like Tier 2*, for example.

Obviously, you feel like that's enough, you've got what you felt you needed, but how did you come to that conclusion?

MR. SHAMS: Do you want me to take that question?

MS. McKENNA: If you want to start, yes.

MR. SHAMS: Yes. As Eileen mentioned, Mohamed Shams. I'm the Branch Chief of Structural Engineering.

As the staff went about our review, we had a few things in mind. Basically, our guidance in SRP guided us through the reviews, as well as what Part 52 asks us to do and what to look for.

So, as was mentioned in the discussion before, there is what we call the critical sections. And those are the specific items that Part 52 requires us to identify. And those critical sections become Tier 2* items. In other words, the applicant cannot change them without a licensing amendment.

So as we do our review, we identify those critical items. If we have something like the shield building having a new configuration design that's not necessarily addressed by - readily available by codes, then we identify more critical sections in a building like that. And we have those identified in GLR-602,

as Westinghouse mentioned.

That report has in it details, weld details, more or less diagrams of these pictures. Most details that would be found, for instance, for a reinforced concrete-type structure that the applicant will commit to using ACI-349. That's a tested and a true method that we know how to apply and that we've seen it before.

So, that's sort of the approach that we would use. And we've done that. We have several - I don't want to quote the number. I want to say 14 or 16 critical sections that are identified. We thought that those are the most important, and they need the appropriate level of details, and we believe we have those level of details in place.

CHAIRMAN RAY: Well, what about these plate weld joints that are now being identified as a recommended addition to 602?

First of all, are you familiar with the recommendation? I had hoped that -

MR. SHAMS: Kind of being in that corner back then, I was having a hard time really -

CHAIRMAN RAY: Well, I thought we communicated them to the staff a few days ago. I sent you the list. Weidong.

MR. WANG: Oh, that's the list -

CHAIRMAN RAY: What?

PARTICIPANT: No, we did not receive that.

CHAIRMAN RAY: You didn't? All right. Well, there's a list of about seven or eight items that I had hoped to communicate to you so you could comment on them here.

MEMBER SHACK: Now, let's see how fast you think on your feet.

(Laughter.)

CHAIRMAN RAY: You have them there, Bill? I don't have them.

MEMBER SHACK: I think I can bring them up.

CHAIRMAN RAY: Yes.

MEMBER SHACK: But it's not going to do them any good since -

CHAIRMAN RAY: No, I know that, but those are - you're the one who has them most readily available. And you were talking about the plate welds, for example.

Can you elaborate? It seems to me like we are - we don't have our consultant any longer.

MR. CUMMINS: That's all right. This is Ed Cummins.

I don't have the words exactly right, but

I have the thought exactly right. Westinghouse has already in the DCD, committed that for the SC structures we will meet the ACI-349 code for concrete, and the AISC-690 code for steel.

And that if so if you happen to be talking about welding two plates together, we commit that we will weld it together consistently to AISC-690 code.

And we'll write those sentences again, but the general commitment is existing in the DCD that the source of our detailing - it's more than detailing, but source of the detailing must meet the codes.

CHAIRMAN RAY: Okay. So, you're -- even though I didn't ask you -- you're telling me you feel like there are code references cited and committed to that are sufficient.

MR. CUMMINS: Yes, I believe both Westinghouse would know what to do, and the inspector would know, and we then do it, also.

CHAIRMAN RAY: All right. Okay. Well, fine. That's at least what the position is, and I apologize for not getting the specific recommendations to you so you could at least look at -

MR. SHAMS: I think I have it in my -

CHAIRMAN RAY: Oh, you do have it?

MR. SHAMS: They're not going to do me any

good at this point.

(Laughter.)

CHAIRMAN RAY: All right. Well, it's a long day. It's only quarter to 3:00. We've got until the rest of the day.

Yes, go ahead.

MR. TEGELER: I just wanted to follow in that we did - although the scope of the DCD review is the review of critical sections, there have been several inspections where - at Westinghouse where we have reviewed more detailed calculations for areas that are outside of the critical section areas to ensure that these connections are designed in accordance with either, in the case of shield building, N-690 or AISC-349 - or ACI-349.

So, we have been making sure that the DCD commitments have been implemented into the design in other areas.

CHAIRMAN RAY: Well, yes, there was one passage I remember where there was a debate about methodology and you ask them to use the square root, the sum of the squares method, that conflict with the method that they used.

MR. TEGELER: Right.

CHAIRMAN RAY: And that turned out to

create a higher load that the actual details were adequate to meet it. And the question that crossed my mind was, how the heck did those details get captured?

That's what it looks like today. Who knows what it will look like ten years from now when the nth plant is built. And that's the question as an example as one of the examples that I came up with. Our consultant came up with other cases.

Yes, you wanted to comment?

MR. SHAMS: Sure, yes. The Tier 2* aspect would actually control that. That would freeze the design of that connection.

CHAIRMAN RAY: I haven't seen anywhere, though, that that detail that was referenced in dispositioning this methodology was Tier 2*.

You'll remember the passage I'm talking about.

MR. TEGELER: Yes, this related to the PCS 100-40-40 versus SRSS.

MR. SHAMS: Yes, I remember. Okay. I read the passage and -

CHAIRMAN RAY: It was part of the audit.

MR. SHAMS: Yes.

CHAIRMAN RAY: No problem, but I'm just certain you wanted to ask them to do a different

methodology. They did.

If the thing had been right on the margin, presumably they would have had to make a change, but it wasn't. It had enough margin in it that it would accommodate the methodology you ask for, and so that was it. That was good enough.

MR. WANG: Excuse me. I wanted just to say that that whole list had been passed to the staff, but that principal question I think you asked, I did not have that coming in.

CHAIRMAN RAY: Okay. That was a separate question. I understand, Weidong, separating out one of my comments from the ones from our consultant that you have.

In any event, we've probably spent as much time as is productive to spend here, but the point is that it's an issue that we are trying to get some comfort with. We observe that you guys ask for details and get them. And we want to believe that they're all the details that are needed and there isn't something else that is needed, is the issue.

And in this particular case, it wasn't a critical section, to my knowledge. It was just a check of methodology that was it.

MEMBER SHACK: I missed the first part of

Ed's response. And I guess that was that there was a general commitment in the DCD to do all structural welds according to code.

MR. CUMMINS: Yes, it's really a description of how we do SC methodology. And what we say is for structural steel, we'll use AISC-690. And for concrete, we'll use ACI-349 for any SC structure details.

And I think where we were talking before about the test of actual strength, that was because those tie bars aren't covered.

The tie bars are kind of a unique thing that are not covered in AISC. And, therefore, we have to do something special for those.

CHAIRMAN RAY: I think it's just static. It's not anybody making noise. It's static on the line. Okay.

MS. McKENNA: I think as a general matter, I know you asked the question about how we decide certain things.

CHAIRMAN RAY: Yes.

MS. McKENNA: I think as Mohamed started, we kind of look at the SRP and what conclusions we're trying to draw and see what information is in the DCD and whether that provide a sufficient licensing basis

as commitments to be carried forward by a COL operator - builder and operator.

We look at other information perhaps that might have supported maybe we asked for a sensitivity study or something that we want to reflect in our SER. We want that to be on the record so we can refer to it.

And then there's other information like Bret referred to, where we may go look at details of the calculations and cover that in an audit to confirm, basically, that the statements that were made in the other documents are indeed true.

And we kind of use the different tools to support the kind of decisions and conclusions that we're reaching. And the other layer on top of that is this question about which particular pieces of information do we think are the most important with respect to controlling the design. And we don't want them to be changed without the opportunity for the staff to approve them.

And that's when we put the Tier 2* on some information, but clearly we don't want to put every single word and every single number of Tier 2* and just drown ourselves in things that we have to process a lot of license amendments, but it really doesn't

matter where we serve that treatment, if you will, from where we think it would matter.

And that's part of the decisions that the staff went through, which were those details that we thought rose to that level that we wanted that degree of regulatory control.

CHAIRMAN RAY: Yes, and I think that's the only question, Eileen. There's no other question, really, as have we done what we need to do given the circumstance that we find ourselves in.

I mean, I appreciate Ed's point that - but it doesn't really speak necessarily to the issue that I raised with you as an example.

I'm just trying to get some clarity around how this is done. I take away from your statement, Eileen, that it's a judgment that the staff makes.

Well, we're supposed to make a judgment too.

MS. McKENNA: Sure.

CHAIRMAN RAY: So, we're trying to figure that out, and that's all that's going on here.

Okay. All right. Let's proceed ahead then. You guys -

MR. TEGELER: I'd like to point out the area that that question was relating to was -

(Loud noise.)

CHAIRMAN RAY: Pay no attention.

MR. TEGELER: -- was in an area of the structure where we know more about and that it is a reinforced concrete structure. So, we have a little more comfort with respect to the margin, beyond design basis performance, etcetera.

CHAIRMAN RAY: Right.

MR. TEGELER: So, I just wanted to add that.

CHAIRMAN RAY: That's a fair answer, I think.

Now, we're in the mode of asking questions here about the structural work. I don't - it sounded to me a while ago like we had lost Bozid. So, I don't guess we can ask him any more questions. And -

MS. McKENNA: Did you want to know anything more about the audits? I know Bret alluded to some of the things that were covered.

CHAIRMAN RAY: I read it. It seemed pretty thorough. But if you - if there's something you want to say -

MS. McKENNA: We're trying to meet your needs.

MEMBER ARMIJO: I have a general question.

In the SC to RC connections, there are a number of pretty complicated designs, both vertical connections, horizontal connections, corners.

And overall, how did the staff come to the - and I know they are designed to be really strong so that if there's going to be any deformation, it's going to be somewhere else.

But how did the staff come to the - become satisfied that these connections wouldn't require some sort of testing or that the analysis was good enough, had a margin that you are sure the analysis was okay and didn't require testing?

MR. TEGELER: I'll take that.

What was done for the review of those connections, and there were several representative connections that were designed in - that are described in the shield building report that were analyzed in great detail. And this is described in the Level 3 analysis that Westinghouse performed.

And when I say great detail, these were where studs and tie bars, plates were modeled explicitly down to about the elements where about the characteristic length is on the order of two to three inches. Very high level of detail.

Those detailed analyses showed that for

the SSE loads, that you're not yielding any of those components. You might be causing some cracking, limited cracking in the concrete. But the steel elements within those regions remain below the yellow.

And that even for beyond design basis or for the review level earthquake, as an example, you get very slight yielding, but still very small strains compared to a failure threshold.

So, those analyses served as the - I'll say the primary basis as -

MEMBER ARMIJO: I guess my - the one place where I had most concern is corners where there's no symmetry, or at least I can't - and exactly, you know, are the methods good enough to analyze those corners and -

MR. TEGELER: Yes, they were very - sorry.

MEMBER ARMIJO: How did you become satisfied with that?

MR. TEGELER: There are very detailed substructure models. So, from the very large, global, Nuclear Island building elements, if you will, that contain these corners were essentially extracted from the finite element models, boundary conditions for the forces -

MEMBER ARMIJO: So that you can have huge

stress risers at these corners or -

MR. TEGELER: If there were, they would definitely be captured in that model down to the - with the refinement that Westinghouse used, you would capture strain gradients through thickness and - so, they were of sufficient refinement that you would capture that type of - let's say an out-of-plane sheer failure model as an example.

And I should also mention that these analyses, the material models with respect to cracking and contacts between the various elements, studs and tie bars to concrete, those are benchmarked, if you will, to the test.

So, that's why we have confidence that the analysis were benchmarked to representative experiments.

MEMBER ARMIJO: Okay. Thank you.

CHAIRMAN RAY: Let's go to the issue of radiant heating. I know you've dealt with that at least as a result of getting a letter from a member of the public which is at least, I believe, applied only to the shield building.

The same concern then was passed along to us along with a concern similarly that the effects of radiant heating of the large-scale test would have

affected the purpose and function of that test.

Let's just stick with the shield building right now, because I know you guys don't want to talk about the containment code.

So, tell me what was your response, if you would, and how you would look at that concern.

MR. SHAMS: Sure. With respect to radiant heat, I believe we first heard the concern during a public meeting as the commenter pointed out that she made that comment back then.

At that time, we looked at it to sort of - I mean, we were aware of what Westinghouse did, but the concern sort of raised the issue even further in our minds.

So, bottom line is what Westinghouse did is they took a simplifying assumption in terms of looking at the conduction of heat, air - or the transfer heat in terms of conduction and conviction.

That simplifying assumption is essentially in line with the standard practice for how we deal with civil structures.

The thermal stresses, the gradients that we're dealing with in terms of 70, 80, a hundred degrees, they constitute on the structure that we're dealing with roughly about, at the most, at the

critical areas, are constrained the most with about 10 to 15 percent of the overall stress that the structure was seeing.

So, taking that simplifying assumption and even looking at what radiant heat would contribute in addition to what's already considered in the analysis, would be another 10 to 20 percent of thermal, which would be 10 to 20 percent of the overall.

So, what we looked at is the margin is there. The analysis consistent with the standard. If we are to refine the analysis more, which is what Westinghouse has done already, refined it in terms of taking the conviction aspects into consideration and if we are to refine it even further, at the end of the day that's not necessarily going to impact the design, that's not necessarily going to erode the margin sufficiently for us to be concerned.

So, we feel that that level of analysis, again, considering what we would need to do or Westinghouse would need to do to address the radiant heat aspect of it, it was just not commensurate with the level of stresses that we're dealing with.

And Dr. Shack mentioned earlier that the controlling aspect is the - or the controlling - the loading condition is the winter condition. So, the

radiant heat becomes even less of a factor in that aspect.

So, that's sort of how the staff looked at it and made a decision on that.

MEMBER SHACK: I mean, is it generally understood, I mean, since these are all kind of postulated loads, I mean, you know, you have SSE plus the thermal load, is it general practice to only use the ambient air to the thermal loads? Is that -

MR. SHAMS: It is. It is the standard. Again, it's looked at from the perspective of you're adding a thermal load that's still somewhat extreme. That's your extreme thermal condition.

You're adding it to a seismic condition that's another extreme. So, at a certain point it becomes how extreme is extreme, and how do you add these extremes together?

So, yes, it's just the ambient - the air temperature is looked at, considered, and that's the practice.

MEMBER SHACK: I mean, is that an NRC thing? Is that a code thing?

MR. SHAMS: No, that's standard practice. That's ACI-type codes. That's -

MEMBER SHACK: Okay.

MR. SHAMS: -- what structure are being designed to out there.

MR. TEGELER: Yes, the ACI won't specify the temperature, only that you consider it. And then it's Westinghouse, their design base of course lays out the temperature -

CHAIRMAN RAY: Well, one consideration seems to me is that I take it one can assume convection of any elevated temperature of the exterior steel plate into the concrete.

So that unlike the case that Charlie gave of perhaps something that didn't have any heat sink on the other side, that this steel plate that's exposed to radiant heating would have a fairly substantial heat sink on the back side.

And, therefore, that would limit the - that urgence, I'll call it, of the steel plate from ambient. But all of that is just a gut-feel consideration, but I'm just wondering if that's what you're thinking here.

I mean, you can get an elevated temperature on a car hood or something like that that's fairly extreme, but it's not backed by three feet of concrete.

MR. SHAMS: That's part of what we looked

at, too, is how fast that temperature that actually feels real hot to the touch dissipates as you go through a steel plate, and then you have three feet of concrete behind it.

That was really that kind of thought process. It's really extreme, how extreme is it, and what benefit do we get from the level of refinement that would really get us the extra 10 or 20 or 30 degrees, and how is that going to affect the overall design in the end?

CHAIRMAN RAY: Well, can you tell us at least that based on the - at least based on the input that you received at the public meeting, that you've considered this?

MR. SHAMS: Yes.

CHAIRMAN RAY: That's the conclusion you arrive at?

MR. SHAMS: Yes.

CHAIRMAN RAY: Okay.

MEMBER SHACK: I have a question about the review level earthquake. And again as my memory serves me, that puts the strain, the two percent strain in some places a little bit before the 0.5 g, and what's the acceptance criteria?

I mean, that's really sort of related to

the structural margin calculation where they have to hit the 1.67.

What's your acceptance criteria for the review level earthquake?

MR. TEGELER: Well, you can have - the review level primarily is you still have to remain functional. You can have yielding in your structure, but you have to prohibit collapse. And you have to maintain function of SSC -

MEMBER SHACK: Oh, okay.

CHAIRMAN RAY: Structure, systems and components.

MR. TEGELER: Yes, thank you.

(Laughter.)

MR. TEGELER: Yes, so the criteria is exactly that. And for review level earthquake in terms of - so, you can relax some of the constraints you have for design. You can start to use instead of design values for materials, you can take best estimate values. You can start taking credit for higher damping in the structure.

So, you can start to - you can - so, the basis becomes different. But, again, it was looked at explicitly in the case of the shield building. And as you point out that there was some local yielding for

the review level, but again I think -

MEMBER SHACK: Well, I mean, it's more than yielding when you hit two percent strain.

MR. TEGELER: Yes, but remember these are like five percent strain capacity kind of - some of these elements and -

MEMBER SHACK: Yes, but -

MR. TEGELER: And also very localized yielding.

MEMBER SHACK: I think those were in modules, weren't they? So, the two percent is really a real kind of failure criteria for the module.

MR. TEGELER: Where you - for the module in tie bars where you started to see strains getting on the order of one and a half, two percent, it was actually, I think, much higher than the review level.

I don't have the value in front of me.

MEMBER SHACK: Okay. So, the two percent was in the reinforced structure. I can't remember the analyses that -

MR. TEGELER: For the review level, I think there were -- the case for the review level where we're talking about these higher strains, I believe they were up in the tension ring area and perhaps some studs. I think a cluster of studs. I'd have to go

back into the report to find out where.

MEMBER SHACK: But the criteria really is, is functionality.

MR. TEGELER: That's right.

MEMBER SHACK: That's what you're looking for.

MR. TEGELER: Yes.

CHAIRMAN RAY: Okay. Anything else in the structural area? We've got a couple of areas that we still need to give some time to here.

We're done with this?

(No response.)

CHAIRMAN RAY: Okay.

MS. McKENNA: Okay. Then we'll switch over and have Westinghouse come back and talk about the -

CHAIRMAN RAY: We're going to talk about containment pressure first. So, we want to start with the discussion of the containment pressure analysis update with the applicant, and then we'll talk about the flywheel testing.

(Off-record comments.)

CHAIRMAN RAY: Well, I don't know that you want to have that up there right now. I don't think you have anything to show us on the containment - there we go. Oh, my apologies.

(Off-record comments.)

CHAIRMAN RAY: Okay, everybody. Let's switch gears here now. We'll talk about the containment peak pressure analysis.

MR. CARPENTER: Okay. Good afternoon. My name is Brad Carpenter. I work in the AP1000 Licensing Department for Westinghouse.

Up here with me are the engineering leads for the containment pressure analysis. To my left is Rick Ofstun. To my right is Bob Jakub. And to my far right is manager of the Containment Radiological Analysis Group, Kent Bonadio.

Next slide. Okay. So, just to give an overview of what was done and why it was done in terms of the Rev 19 or the containment pressure analysis completed in support of Rev 19, first I guess a little background.

The peak pressure from a LOCA reported in Rev 18 of the DCD, is 57.8 psig. And what precipitated this analysis was an ACRS review comment that was given at the full committee meeting last December. And that concerned the scale and calculation from the one-eighth sector testing, PCS flow testing.

And that would impact the time to steady

state film coverage of the PCS flow over the containment vessel. And ultimately, it would impact the peak containment pressure.

So, the sub-bullet there shows that this - when the containment response model was updated to make this correction to the time to steady state film coverage from 337 seconds to 400 seconds, the containment peak pressure increased to 58.1 psig.

At that point, we reported that result to the NRC staff and, additionally, other items that we had captured in our corrective action program that also would have an impact on the peak containment pressure, and what the decision made at that time was.

The direction we received from the staff, was to go ahead and make all these corrections for the analysis in support of Rev 19, and make a correction to anything that would impact the peak containment pressure that was reported in the technical specifications as a parameter for the containment leak rate test.

And so the last bullet shows there that once this was done and we did make all the corrections to both the LOCA mass and energy and the WGOTHIC containment response model, peak pressure from LOCA went up to 58.3 psig.

So, the difference between what was reported in Rev 18 and Rev 19 was a half psi.

MEMBER BANERJEE: But you also brought in structures, heat sharing and so on.

MR. CARPENTER: That's correct, yes. We'll get to that, yes.

MEMBER BANERJEE: There were nine of these changes. I think you listed nine.

MR. OFSTUN: Yes, there's an additional - I think it was eight or nine thermoconductors that we took credit for in -

MEMBER BANERJEE: You needed them.

MR. OFSTUN: Yes.

CONSULTANT KRESS: Did these numbers include containment leak rate?

MR. OFSTUN: No, we don't model leakage outside containment.

CONSULTANT WALLIS: These seven input changes to the M&E model, are they all positive, or is there offsetting some of -

MR. CARPENTER: There was one offsetting.

MR. JAKUB: A couple were offsetting.

CONSULTANT WALLIS: Remember how big the nitrogen, in fact, was by itself? It's part of that, isn't it?

MR. JAKUB: We didn't run any separate effects test, but -

MR. OFSTUN: That was in the containment response model.

CONSULTANT WALLIS: Do you remember the volume of the containment?

MR. OFSTUN: It's about two million cubic feet.

CONSULTANT WALLIS: Two million. So, adding 2,00 cubic feet of nitrogen doesn't make much difference.

MR. OFSTUN: I think it increased our pressure by a couple of tenths of psi.

CONSULTANT WALLIS: Something like that.

MR. OFSTUN: Yes.

CONSULTANT WALLIS: Couple of tenths of psi.

MR. OFSTUN: Yes.

CONSULTANT WALLIS: So, it's part of that.

MR. OFSTUN: Yes.

MEMBER BANERJEE: Which was the offsetting? Like the epoxy coating would have increased, right?

MR. OFSTUN: Slightly.

MEMBER BANERJEE: Slightly. What was the offsetting? What would have produced the -- is there

anything -

MR. OFSTUN: Well, in the containment response model, the additional thermoconductors -

MEMBER BANERJEE: Of course those would, yes.

MR. OFSTUN: In the mass and energy release model, core power level that we had used was 15 megawatts too high. And I don't know, Bob. You have some other?

MR. JAKUB: The core power was 15 megawatts higher than it should have been. And the steam generator tube heat transfer area was about 9,000 square feet larger per generator than it should have been for the generator that's now in the design.

MEMBER BANERJEE: All right. So, let's go through it.

MR. CARPENTER: Okay.

MEMBER BANERJEE: Possibly I missed it.

MR. CARPENTER: So as I've said, the majority of these items were items that we have previously captured in our corrective action program and were found to have an impact on the peak containment pressure.

The impact of the individual items was determined from essentially these studies to be small.

But as I stated, the NRC had requested that we make these changes at this time for the Rev 19. So, that is what we did.

There were seven input changes to the LOCA mass and energy model. The combined impact of those seven items was eight-tenths of a psi.

There were five input changes to the WGOTHIC containment response model, and the combined impact of those five was three-tenths of a psi.

And then we did credit additional heat sinks that did exist currently in the WGOTHIC containment response model. And the impact for that was a negative nine-tenths of psi.

So, I didn't list each of the changes to the model in this slide. But what I did was put some examples of the type of input changes that we made in this evaluation.

So, looking at the LOCA mass and energy release model, it was discovered that some metal mass from the reactor vessel internals was not included. So, when adding that metal mass in, it would impact the - that energy release, and then ultimately the containment peak pressure.

Steam generator secondary side pressure input transition from being at the steam generator

outlet to being at the tube bundle. So, the increase in pressure there would affect the M&E results, and then ultimately the peak containment pressure.

Examples of inputs to the changes to the containment response model, coating material specific heat, both epoxy and inorganic zinc, was changed in the model to reflect the updated testing information. So, that would be a slight increase when lowering specific heat values.

The affect of accumulator nitrogen gas was modeled in the most updated analysis. This was not in the license methodology evaluation model, but it was found to affect heat pressure. So, that was addressed at this time.

CONSULTANT WALLIS: I have some questions about that. This is reported in your June 14th report --

MR. CARPENTER: Okay.

CONSULTANT WALLIS: -- which we haven't seen before. Now, you calculated an adiabatic expansion and an isothermal one. And adiabatic is probably more realistic, but it isn't completely adiabatic. So, these are extreme values.

The adiabatic expansion gave the gas expanding to 279 degrees R, which is minus 181 degrees

Fahrenheit. And you used that to calculate the volume discharged.

And then you multiply the volume by density, which was evaluated at 120 degrees Fahrenheit. So, I think that's an error that should be corrected.

And the mass discharge then goes from 42 to 88.

MR. CARPENTER: Okay.

CONSULTANT WALLIS: Still not that big, but it's an error in the calculation on Page 34.

MR. CARPENTER: Right.

CONSULTANT WALLIS: Then you used an isothermal extreme of 120 degrees Fahrenheit and said it was conservative.

Now, on Page 37 you talk about the accumulator compartments as a heat sink. Say it's a dead end below the CMT. And it says heat and mass transfer to the thermoconductors that are located within these dead end compartments is only allowed during the blowdown phase.

Which tells me that you're allowing steam and perhaps water to go into these compartments.

MR. CARPENTER: During blowdown, yes.

CONSULTANT WALLIS: And contact the

accumulators.

MR. OFSTUN: Yes.

CONSULTANT WALLIS: And then it's 1500 seconds before the peak pressure. So, there's plenty of time for that steam and water to heat up the accumulator.

MR. OFSTUN: The condensor, yes.

CONSULTANT WALLIS: So, 120 degrees Fahrenheit is not conservative for the temperature of the accumulators, it seems to me, because they can be heated up by the steam.

So, I did a calculation there with that, and I came up with something like 715 pounds instead of 625 pounds. Again, we're probably talking about maybe a 0.1 psi or something. I don't know, but it isn't - strictly it isn't conservative to assume 120, it seems to me.

Do you agree with that? Because it could be heating from the blowdown -

MR. OFSTUN: Well, it will heat from the blowdown and throughout the rest of the time.

CONSULTANT WALLIS: That's for a long time. There's 1500 seconds for this to happen. So, it will heat up, yes.

MR. OFSTUN: Right, and then it will heat

the shallowing. And then it will have to come back through the shallowing and into -

CONSULTANT WALLIS: That's right.

MR. OFSTUN: -- into the gas.

CONSULTANT WALLIS: But it probably isn't that big an affect.

Okay. Now, we've got this stuff coming out at minus 181 degrees Fahrenheit if it's adiabatic. If it's 80 percent adiabatic, it's minus 120 degrees Fahrenheit. So, this is probably pretty darn cold, right?

And I wonder what you think happens when you have hundreds of pounds of nitrogen at minus a hundred degrees Fahrenheit or more going down this pipe, and it chills the pipe.

And in another part of the report it says there's the lowest surface metal temperature at minus 18 degrees Fahrenheit.

So, what do you think happens to this pipe when the surface is chilled by or down to minus a hundred degrees Fahrenheit?

Nothing?

MR. OFSTUN: No, no. I can't answer that.

CONSULTANT WALLIS: Well, I talked to Bill Shack. And he said if it's stainless, probably it's

all right.

But if there were thermal stresses and if you lost the DBI line, you wouldn't like that because then the water will be lost, it would just come in through it.

So, it seems to me you might wish to make some analysis of thermal stresses in the DBI line.

MR. OFSTUN: And that would be outside of our containment analysis area.

(Laughter.)

CONSULTANT WALLIS: But it's not unimportant.

MR. OFSTUN: It's not unimportant. That's correct. And I'm not aware if that has been done already.

CONSULTANT WALLIS: You'll be making snow and all kinds of things. But what happens is, remember, the DBI line to the tank is closed. It isn't open yet, right?

So, they're just blowing out the water into the - with the accumulator's gas, just blowing the water into the reactor in a little length of pipe.

And then it goes into the plenum in the reactor. There's quite a big opening there. So, it comes out pretty rapidly once the water's blown out.

The gas blows through pretty rapidly. So, it's a high heat transfer coefficient.

Okay. So, you can look into that, maybe? Or somebody might.

MR. ZIESING: Just to comment on the status of our piping design finalization, that is one of two open DAC and we're still in the process of doing the piping.

CONSULTANT WALLIS: I haven't seen anything in any of this discussion about possible thermal stresses in the pipe.

MR. ZIESING: So, the impact of thermal transients on piping is still a work in progress.

CONSULTANT WALLIS: Work in progress. So, we look forward to that then, maybe.

(Laughter.)

MR. CUMMINS: We have to show the staff this piping DAC, that's for sure.

CONSULTANT WALLIS: And you're going to consider this very cold nitrogen as -

MR. CUMMINS: Yes. I'm not sure before, but now we certainly are -

(Laughter.)

CONSULTANT WALLIS: But otherwise it seems to me although you may have made some assumptions

which are not quite right, otherwise the effect is so small and shouldn't bother the containment pressure. It's a 0.1, 0.2 psi or something effect.

You might want to tidy up the document.

CONSULTANT KRESS: On that particular slide before we change it, on the reactor vessel internals, what temperature did you assume it was started from?

You're blowing the -- I guess for the blowdown -

MR. JAKUB: For the nitrogen, or -

CONSULTANT KRESS: No - well, the nitrogen comes to light. I'm thinking about you're including water when you've got the break and it's going by the internals.

MR. JAKUB: Yes.

CONSULTANT KRESS: I was wondering how that would affect things if it's the same temperature as the water at the start. I was wondering how you include it in your calculation.

MR. JAKUB: In the reactor vessel model, we have all of the control volumes set to the initial conditions based on t hot, t cold, with instrument uncertainties included.

So, there are temperatures for the internals of the vessel that range anywhere from 570

degrees to 630 degrees, approximately.

CONSULTANT KRESS: Generally hotter than the water itself.

MR. JAKUB: Yes.

CONSULTANT KRESS: So, it's effect would be to add to the pressure. Is that what you're saying? Because you're adding an energy that you didn't add before.

MR. JAKUB: Yes.

CONSULTANT KRESS: Okay. That's what I was trying to find out.

MR. JAKUB: Yes.

MEMBER BANERJEE: This is sort of a best estimate calculation. Is that it, or -

MR. JAKUB: No.

MEMBER BANERJEE: Or is it driven to all the parameters which -

MR. JAKUB: We have input set in the conservative direction.

MEMBER BANERJEE: Always, so you know what is -

MR. JAKUB: Yes, this isn't a best estimate calculation.

MEMBER BANERJEE: I sort of - if you didn't have the metal mass there, right, that's very

conservative. Once you put the metal mass and all these other heat-sharing structures in there, then isn't that becoming more for best estimate-type calculation?

MR. JAKUB: Well, in this particular case, there was approximately 60,000 pounds of metal that wasn't in the original model. We added 60,000 pounds of metal at approximately 610 degrees to the initial condition of the RCS.

So, the internal energy was increased by that much to make it even more conservative than it was previously.

MEMBER BANERJEE: But then you get a 0.9 psi reduction to heat sharing, right?

MR. JAKUB: That's in the containment model.

MEMBER BANERJEE: That's what I mean. In the containment.

MR. JAKUB: Right.

MEMBER BANERJEE: That's what I -

MR. JAKUB: The other metal was inside the vessel, yes.

MEMBER BANERJEE: Yes, I'm talking about the containment pressure calculations. Is that the sort of best estimate calculation, or is it always

conservative?

MR. OFSTUN: That's a bounding calculation as well.

CONSULTANT WALLIS: Very conservative, isn't it? Because you ignore a large amount, according to what I read.

MR. OFSTUN: Yes.

CONSULTANT WALLIS: You ignore about 90 percent of the metal or something like -

MR. OFSTUN: We ignore a lot of the metal in the gratings and platforms.

MEMBER BANERJEE: Where do you include the metal? Just below a certain level or -

MR. OFSTUN: We included metal thermoconductors in the CMT compartment, which is just below the operating deck.

CONSULTANT WALLIS: Including the accumulator?

MR. OFSTUN: The accumulator, I'm not sure if that - I think that may be in -- the accumulator compartment, that may be included in there as a heat sink.

And then there's some additional metal heat sinks above the operating deck.

MEMBER BANERJEE: So, what was the logic by

which you included or ignored these metal mass -

MR. OFSTUN: Well, originally we did not include those platforms and gratings because back when we did the original containment analysis in 2001, 2002, those were not finalized or certified for construction-type drawings.

So, they said do not use these as heat sinks until they become more - the design becomes more finalized.

Now that the design has been more finalized, we -

MEMBER BANERJEE: Can we go back a couple of slides to the - yes. So, that's a significant effect.

MR. OFSTUN: Yes.

MEMBER BANERJEE: Yes, minus 1 psi or 0.9 or whatever.

MR. OFSTUN: Yes.

MEMBER BANERJEE: So, how did you decide which metal masses to include and which not to here?

In other words, I'm trying to understand is this a conservative calculation, or is it sort of closer to a best estimate, in my mind at least?

MR. OFSTUN: Well, we selected ones that we could calculate relatively easily. And there's a very

large one in the CMT compartment. The platform in the CMT compartment wasn't included originally.

There were some heat sinks that were embedded in compartments that we had the numbers for. And it hadn't changed much, and so we used those as well. And then there were a few that were above the operating deck.

MEMBER BANERJEE: So, whatever was easiest to take, you took them.

MR. OFSTUN: Yes, we just -

MR. ZIESING: We were, I mean, the practical aspect of what was going on at the time is we were trying to result in - trying to target a revised pressure that was similar to what had existed there before.

Recognizing where we were in the review process, we didn't want to do anymore necessarily than we could have. We could have credited more heat sinks, but at some point you change so much and then the question is how much more review you need to do and that type of thing.

So, really trying to balance a few things in terms of just enough to get us back to where we were before to be consistent with the prior Safety Evaluation on Rev 15 where the NRC looked at this

modeling and looked at the margin and that type of thing.

So, it was really just trying to balance the practicality of -

MEMBER BANERJEE: But roughly how much material did you put in? I mean, was it like 30 percent of the metal? 40 percent of the mass as heat sinks? Hundred percent?

MR. ZIESING: Your question is of the metal mass that does exist in the design, how much did we formally take credit for?

MEMBER BANERJEE: Yes, let's say how much you could have taken credit for, and how much did you take credit for?

CONSULTANT WALLIS: I think that's in he report.

MR. CARPENTER: Yes, so the statement that we have in the transmittal letter for the report to the staff is that we increase the amount of metal in containment that we're crediting as a heat sink by 15 percent. And that does not include the shell.

MEMBER BANERJEE: Now, going back to this, I don't want to pursue it too much. But when you made these input changes and so on, let's assume that your previous calculation was also conservative

calculations. Make all these changes and you get a plus 0.8 and plus 0.3 psi, which means those inputs were not driven to their most conservative values.

How are they driven to their most conservative values now? That wasn't a best estimate either, right? It was a conservative calculation.

You made some changes and you were another 0.8, and then you were another 0.3.

MR. BONADIO: Those changes were not adjusted solely on the conservative side. They were actually differences in what we found in the model based on updated drawings or more recent information such as the zinc coatings. That's an aspect that was actually changed because of the GSI-191 improvements.

So, these changes weren't necessarily to more -- the worst answer, for instance. Some changes were as found information to correct them and update them for, for instance, the metal mass we were talking about.

So, when we found the metal mass was - didn't have sufficient metal mass in a problem, we updated that to include that. So, we've done extended conditions on the items we found to ensure that we had all the conditions covered and there was not metal mass, for instance, that should have been in the

model.

MEMBER BANERJEE: So, if I read your answer and give it back to you, those seven and five input changes were related to improvements, let's say, or at least an improved model based on the design would change certain input parameters rather than trying to drive things to be more conservative.

Is that how I should understand that, that you actually -- it reflected some physical change?

MR. BONADIO: It's an accurate reflection of the model, but still applied on the conservative assumptions for the analysis.

CONSULTANT WALLIS: Sanjoy, on Page 35 of this report it says only ten percent of the metal mass above the operating deck is credited; is that right? On Page 35.

MEMBER BANERJEE: It's because it was only ten percent is accessible, or ten percent -

MR. BONADIO: Was needed.

CONSULTANT WALLIS: Only ten percent is credited.

MEMBER BANERJEE: Yes, but there is metal mass in metal mass. It may not be accessible, right? I don't know.

CONSULTANT KRESS: When you add additional

metal mass in, does it have its own specific surface area and heat transfer coefficient, or is there some average value you use?

MR. OFSTUN: It has its own specific surface area and heat transfer coefficient, yes.

CONSULTANT KRESS: And that comes out of GOTHIC?

MR. OFSTUN: The surface area is input to GOTHIC.

CONSULTANT KRESS: Input, and the H?

MR. OFSTUN: And the H is also, you select Uchida correlation for the internal heat sink.

MEMBER BANERJEE: So, it must depend on what flows out to it or all sorts of things. It's a complicated problem because it may be some sort of lump parameter.

MR. OFSTUN: Lump parameter, yes.

MEMBER BANERJEE: Yes, characterization of this. But you select the ten percent because you are fairly sure that that ten percent, you could defend that position, right?

MR. OFSTUN: Yes.

MEMBER BANERJEE: Yes.

MR. OFSTUN: I think we selected more like Rolf was saying, we just didn't have the time

available to put all of the additional internal heat sinks into the model and check them all and make sure they were -

MEMBER ARMIJO: Do you handle rough estimate of how much additional benefit you would get if you included all the mass that's in there?

Is that your 0.9 psi, or is it -

MR. OFSTUN: I don't have that number right now.

MEMBER ARMIJO: If you knew it, you wouldn't tell me.

(Laughter.)

MR. CUMMINS: This is Ed Cummins.

You can't - they're not all the same. So, you just can't - you can't just say I got 90 percent more. You have to do each one, because it has a surface area and a coating and whatever.

MR. OFSTUN: And verified against the drawings.

MR. CUMMINS: Yes, there's a reluctance by designers to include these things because the design changes and you don't want to count something that suddenly is missing.

And so, we tend to be conservative in this area.

MR. CARPENTER: Okay. So, as we were just talking about, the existing heat sinks in the containment model were credited in order to offset the impact that the input changes to the mass and energy and containment response models had on the peak containment pressure, and to maintain roughly the same amount of margin that was reported in Revision 18 of the DCD.

CONSULTANT WALLIS: This is more for the double-ended guillotine cold leg break.

MR. CARPENTER: Correct.

CONSULTANT WALLIS: Just to remind ourselves about that because in cold leg break, things happen on quite a different time scale. The numbers are quite different.

And these numbers would be different too. Wouldn't get 0.9 necessarily -

MR. CARPENTER: That's right.

CONSULTANT WALLIS: -- in all the other breaks.

MR. ZIESING: Yes, the punchline on this slide though is that where we did credit the heat sink material, that that's been identified as Tier 2*, okay, to put the regulatory hold on that given the fact that now it's relied on in the analysis.

So, that's the key take-away on this slide.

MEMBER BANERJEE: Is Uchida - remind me. Is it a condensation heat transfer coefficient, or what is Uchida, exactly?

MR. OFSTUN: Yes, Uchida is a condensation -

MEMBER BANERJEE: Well, if that is the case, then there has to be some orientation as well of the surface, right, if you go back to your previous slide?

It's not just the surface area. Next slide. Condensation on a horizontal surface facing upwards would be different.

MR. OFSTUN: They are different if - in Uchida, I don't think there is a difference between horizontal or vertical for that correlation. There are for the - if you use the other correlations that we use for the climbs, for the shell, we have a difference between horizontal -

MEMBER BANERJEE: Suppose you had a horizontal surface facing upwards. Clearly, the heat transfer would be different from the horizontal surface or perhaps a vertical surface.

MR. OFSTUN: Yes. In fact, the horizontal

facing upwards surface will be covered with a film of water, and we shut the condensation off on those surfaces.

MEMBER BANERJEE: So, you don't credit those surfaces?

MR. OFSTUN: We don't credit those -

MEMBER BANERJEE: So, when you arrive at that surface area, it must have an orientation there.

MR. OFSTUN: Yes, we'll have to know if it's a floor and we shut it - we don't model the condensation on the floors.

MEMBER BANERJEE: Right. So, it would only have to be a vertical or somehow inclined or -

MR. OFSTUN: Tilted, yes.

MEMBER BANERJEE: So it can drain?

MR. OFSTUN: Yes.

MEMBER BANERJEE: And that goes into the surface area.

MR. OFSTUN: Yes.

CONSULTANT WALLIS: And then you do transient conduction in the steel as well?

MR. OFSTUN: Yes, there's a transient conduction.

CONSULTANT WALLIS: That depends on the shape.

MR. OFSTUN: All the heat sinks are modeled as slabs.

CONSULTANT WALLIS: Oh.

MR. OFSTUN: The internal heat sinks.

MEMBER BANERJEE: Including gratings?

MR. OFSTUN: Yes, including gratings. Thin slabs.

MEMBER BANERJEE: Thin slabs, okay.

CONSULTANT WALLIS: I guess, to focus on this, the 0.9 psi is what you need to bring it back to where you were before.

MR. OFSTUN: Yes, pretty much.

CONSULTANT WALLIS: And all these assumptions make the difference - could make a difference.

MEMBER BANERJEE: Yes, but what sort of bothers me is if you're very conservative, this is fine, but there are very large uncertainties in these sorts of calculations.

So, if you took everything which was vertical or whatever and kept 0.9, the devil here is in the details.

CONSULTANT WALLIS: So, how well mixed does it stay when it's condensing on all these surfaces?

MEMBER BANERJEE: Yes. I guess that's why

you don't start by crediting it. And then you -- if you have to, you take the most conservative defensible part of it which would withstand all scrutiny.

Let's assume you did that.

MR. CARPENTER: So, this is a comparison plot of the containment pressure response as a function of time like the analysis results from the Rev 18 containment pressure analysis, and Rev 19.

So, the red line is what was done for Rev 19. And the green dotted is what was done for Rev 18. And as you can see, the plots are very similar. Peak pressure for Rev 19 being 58.3 psi. And for Rev 18, 57.8 psi.

CONSULTANT WALLIS: One other thing that struck me was there's a very long discussion in your report about how well mixed the containment is and whether or not there's mixing in some of the dead ends and all. That's another point.

I didn't follow it all, but you did justify your assumptions with reference to experiments.

MR. OFSTUN: We were summarizing the information that was in our WGOTHIC application report for the NRC.

CONSULTANT WALLIS: But it was quite a long

discussion even though it was a summary.

MR. OFSTUN: Well, the other report is about 300 pages.

MR. CARPENTER: Okay. So in conclusion, model input changes were made to both the LOCA mass and energy and the WGOTHIC containment response model to address identified items that affected the peak containment pressure reported in the technical specifications in DCD.

No physical design changes were made as a result of or preceding this analysis in terms - or regarding this analysis.

Peak containment pressure remains under design pressure 59 psi. As I stated, the reported peak pressure in Rev 19 is 58.3 psi.

And the NRC has reviewed the modeling changes, requested additional information and found the changes and responses to their questions to be acceptable.

CHAIRMAN RAY: Any other questions?

(No response.)

CHAIRMAN RAY: If they are done, then I think it's your turn, Eileen.

MS. McKENNA: Okay. This is Eileen McKenna again.

As you know, we provided the Committee with the staff Safety Evaluation on this topic. It was actually in two parts. The first part dealt with the film coverage issue, because that was the piece of information we reviewed first.

And then later we got into the discussion of these additional modeling changes that were being discussed. And so, we wrote a separate evaluation on that second part of the story.

The technical staff who prepared that evaluation are here. They're prepared to answer questions. Or if you'd like a presentation, we can do that, but I know your agenda is tight. So, we're trying to meet whatever needs you would have as to what's the most effective use of your time.

CHAIRMAN RAY: Okay. I think we are doing fine. We will ask you to come up, but it does remind me I ask about the radiant heating effects on the shield building, but I neglected to bring it up in this context here.

I recall I said that it's a question that has been brought to us not only in the context of induced stresses on the shield building, but in the context of potential effect on the large-scale test that was conducted under circumstances in which

radiant heating might have had some affect on the results.

Have you had any chance to think about that or provide any comment? You're not obligated to do so at this point.

MR. CARPENTER: Okay. So, our response would be that the heat and mass transfer data taken from the testing is lower bounded when applied to the evaluation model. And the test data was taken from several different facilities, test facilities and on different scales. So, not all the test data was exposed to sunlight and outdoors.

CHAIRMAN RAY: Well, let's be a little more granular here. Let's just talk about the large-scale test. I recognize there are other sources of information that you have.

But it's not really clear looking at the picture or reading the words, exactly what parameters were being monitored as that large-scale test facility was being used to - obviously, it's being used to look at the distribution of the film of water and so on, not clip what temperatures and pressures and so on might well have been monitored.

One might think that the affect of radiant heating would be to reduce the effectiveness that

would otherwise be determined in terms of the water film's reduction or - well, reduction in the containment pressure.

What's your take on it?

MR. OFSTUN: Well, I haven't really thought it all through. But I guess if the solar radiation was heating up the vessel, the temperature of the vessel on the outside might be a little warmer than it would have been if it was done - if this test was done in the dark. Maybe the evaporation rate might have been a little higher than what was measured -- or would have been measured a little higher than what was actually measured in the sunlight, but you have to really look at the - all the impacts.

If I warm up the vessel to my delta T, my temperature difference through the vessel is different and I get a different heat flux and I get - there's all kinds of things that factor in there.

CHAIRMAN RAY: What were you measuring in the test?

MR. OFSTUN: We measured the temperature across the shell. So, they had thermocouples on the inside and the outside of the vessel. They measured the air temperature in -

CONSULTANT WALLIS: So, they'd know if the

sun was heating it up then as they're measuring that.

MR. OFSTUN: Yes, they could. And the sun would be on one side or the other. And when we took data from it, we took data from the whole circumferential and averaged it out.

So, things got averaged out to -

CONSULTANT WALLIS: It doesn't really matter how it's heated if you're measuring temperature, does it?

MR. OFSTUN: It was heated from the inside. So, you know the steam flow rate. You knew the temperatures inside, the pressures inside. You knew the air flow rate in the annulus. You knew the water flow rate that was put onto the vessel, and they measured the amount of water that was running off of the vessel. And they measured the condensate flow that was coming out of the bottom of the vessel.

CONSULTANT KRESS: Did you have an annulus that blocked the solar heat?

MR. OFSTUN: They had a Plexiglas -

CONSULTANT KRESS: Yes, Plexiglas.

MR. OFSTUN: And so it was clear, but some solar radiation would have been reflected off of -

MEMBER BANERJEE: That was on the smaller-scale test, right? Not on the -

MR. OFSTUN: Yes. Well, the large-scale test is the one that I was familiar with because I saw that one in operation. I didn't see the others.

The test facility was located in the trees and under the trees. So, part of the time it was in the shade in the summertime, in the spring and early fall. And I don't know if they did tests in the winter or not.

They did?

MR. CORLETTI: It was cold.

MR. OFSTUN: Okay. So, they did test in the winter too. In that case, then the trees wouldn't help much for -

MR. CUMMINS: So, this is Ed Cummins. We're really putting a lot of steam on the inside of this. The heat balance of this is sun versus steam. It was huge amounts of steam to get the pressure off. And we had an undersized boiler. We were running it as hard as we could to get high temperatures. So, lots of energy from steam.

MEMBER ARMIJO: All right. Recognizing that, the effect of the sunlight would be in what direction, do you think, if you were trying to determine the effectiveness of the water film and removing heat from the vessel?

MR. CUMMINS: Well, I think that Ray said it correctly. It tends to show that you had more cooling overall, I think, because in the end the temperature would be higher on the outside. But I don't - I think the effect is so small that probably not any impact whatsoever.

CONSULTANT WALLIS: The effect of the sun during the test that I calculated was very, very small.

MR. CUMMINS: Very small.

CONSULTANT WALLIS: But the effect of heating up the wall before the test, if the sun shines for hours before the test, that's what you might -

MR. CUMMINS: But I think that we - as soon as you put water on it, that's over. All right. I mean, as soon as you start the water flow, that - we were trying to measure heat transfer from steam to weld, to weld, to water and this was sort of steady state.

So, that would have been - the sun effect would have been gone before we got test results.

CONSULTANT WALLIS: So, what you're measuring is after some time; is that right?

MR. CUMMINS: Yes.

MR. OFSTUN: They start the test. They put

the water - they've established a water coverage, and then they put the steam in after that.

CONSULTANT WALLIS: Okay.

MR. CUMMINS: Yes, the ACRS made a big point of that because they said you didn't really have all the right scaling for transients.

CONSULTANT WALLIS: I think that's probably the answer. If you establish the water coverage before you do the test, then you've wiped out the past history of the sun.

MR. CUMMINS: Right.

CONSULTANT KRESS: You were running these tests to validate GOTHIC under those situations?

MR. CUMMINS: We were trying to get the heat transfer coefficients for condensation and for heat transfer from the weld to the water.

CONSULTANT KRESS: You actually got those out of the test and implemented them?

MR. CUMMINS: Yes.

CONSULTANT KRESS: Okay.

MEMBER ABDEL-KHALIK: Could you go back to Slide Number 10, please.

MR. CUMMINS: Well, in the end we were trying to predict the GOTHIC test too. I mean, so we did -

MEMBER ABDEL-KHALIK: I know this is relatively small and it may be just an artifact of the drawing, but could you explain why the green line could ever be higher than the red line?

(Off-record comments.)

MR. OFSTUN: The only quick explanation I can come up with is that when we do what's called an evaporation limited PCS flow rate, we don't model the entire - the PCS flow rate might be 450 gallons per minute. And it is for the first four hours or something. And we only model - we take credit for something close to that during the peak, because it can evaporate that much water.

But after the peak, the evaporation rate is lower. And so, we only put on the amount of water that would evaporate. And so, you have to do some iterative calculations to come up with that flow rate.

And I guess you may have the iteration may result in a slightly different flow rate for the two tests. And in the one case, the pressure would be a little higher than the other.

CONSULTANT WALLIS: I have a question while this is up. When the pressure goes down after the peak, does water go back into the accumulator? There's no check valve or anything there, is there?

MR. CUMMINS: Accumulators don't have check valves.

CONSULTANT WALLIS: The accumulators. So, flow can't go back into the accumulator?

MR. CUMMINS: No, because it's normally on the reactor cooling system with two check valves that's always on as a makeup source. So, you can't go backwards.

CONSULTANT WALLIS: It can't go back into the accumulator.

MR. CUMMINS: No.

CONSULTANT WALLIS: Okay, thank you.

MEMBER ABDEL-KHALIK: I'm not sure we got a reasonable answer to the question that was posed earlier, because you have made several changes to the model. And the balance between the changes resulted in a net increase in peak containment pressure albeit small.

The question is, what would cause the balance of the effect of these various changes to go from positive to negative?

MR. OFSTUN: Well, we made changes to the mass and energy release calculation model which impacted primarily, I guess, the core power change reduced the long-term decay heat.

So, we had a lower long-term decay heat rate in the new model than in the old one. And so when you look out past 10,000 seconds or so, you're going to see that impact a little more decay heat.

The higher initial values were for initial conditions primarily, right? The steam generator pressures and initial condition, which gives you a higher secondary energy content that you have to pull out and throw into containment.

And once it's in the containment, it will condense the steam that's generated or at least will condense the internal structures and on the shell.

The internal structures will heat up and they will become saturated. And then they'll have to give up their heat later as you continue to cool a containment through the external shell.

So, the primary difference, I think, is in that external shell and in that - how it responds to that evaporative limited PCS flow rate that we put on.

CONSULTANT WALLIS: I have an explanation. It's the transient in the metal which you're taking credit for as the heat sink.

In the beginning, you go down because you get your plus 1.2 psi or something. And then you get your minus 0.9 later on because it takes time for that

to go into the heat sinks. It takes more than a hundred seconds, probably, after a thousand seconds. And you suck more heat into the - it's the transient in the heat sinks. Isn't that what it is?

You don't get that 0.9 until later.

MR. OFSTUN: Yes, 0.9 shows up at about 2,000 seconds.

CONSULTANT WALLIS: That's right. You haven't got it by the beginning.

MR. OFSTUN: Well, we do have a slightly higher peak pressure or, you know, for the blowdown portion at 20 seconds due to the -

CONSULTANT WALLIS: You pull it down. The red is the new calculation.

MR. OFSTUN: The red is the new curve.

CONSULTANT WALLIS: So, you buy that 0.9 later on.

MR. OFSTUN: Do you remember what the difference at peak pressure and blowdown was? It was - was it higher than 0.9 or - you don't remember.

CONSULTANT WALLIS: You keep getting more - well -

CHAIRMAN RAY: Yes, I agree with you, Graham. It seems to make sense to me, but maybe that's because I don't understand.

(Laughter.)

CHAIRMAN WALLIS: Is that the way you make decisions?

CHAIRMAN RAY: No, only when I have to.

Okay. I want to complete this, which means I want to see if there's any questions to the staff on containment pressure.

I realize we still have the flywheel to go, but it's such a different discussion that - actually, let me take your suggestion. Perhaps it's not necessary. Let's hold and see if you need to come up.

Does anybody, any member or any of our consultants have any questions they'd like to address to the staff on this issue of containment analysis?

CHAIRMAN WALLIS: Well, I wondered how the staff would respond to Professor Banerjee's questions about how difficult it is to calculate the heat sink contribution because of the geometry - difficult geometries and orientations and all that.

CHAIRMAN RAY: Okay. Well, introduce yourself, please, and just speak from the side then.

MR. WAGAGE: My name is Hanry Wagage. I'm from the staff. I think the question asked was that how we feel about the new heat structures introduced.

CONSULTANT WALLIS: The new heat sinks in the containment and the difficulty with evaluating their contribution.

MR. WAGAGE: These new heat structures are capsules and they have been not created before. This is closer to other heat structures. In creating these heat structures, it's a small part of other -- they did not create them, and we are not finding any issues with that because the heat structures were similar to others. And we thought that --

CHAIRMAN RAY: Okay. Hanry, you've got a presentation here.

MR. WAGAGE: Yes.

CHAIRMAN RAY: I think it would be good if you had a chance to give it.

MR. WAGAGE: Okay, thank you.

CHAIRMAN RAY: Why don't you go ahead and we'll just leaf through it? We don't need to use the projector here.

So, just take us through this presentation. I'd like you to have a chance to do that.

MR. WAGAGE: Yes, my name is Hanry Wagage. I would like to first go through the background of this issue. ACRS raised the concern on time to steady

state water film coverage of the containment vessel at AP1000 Subcommittee meeting December 1st, 2010.

When addressing this concern, the applicant identified additional errors or updates in the containment evaluation model.

Applicant's changes impacted staff's conclusions made in NUREG-1793 section 6.2.1 and Chapter 21. Because of that, then staff reviewed these changes immediately.

Regulatory criteria or guidance applicable to these issues are GDC 38 and GDC 50. And 10 CFR 52.47(c)(2) and 10 CFR 50.43(e). SRP tables applicable to these issues are Section 6.2.1.1.A and 6.2.1.3 and SRP Chapter 16 for the new specifications.

There were several changes made. I'd like to address three of the changes. The first one is the time for PCS to begin steady state film coverage. Staff reviewed the calculation of delay for steady state film coverage and audited the GOTHIC calculation evaluating the effect of this change.

Staff reviewed the containment evaluation model and AP1000 DCD. And staff found that containment evaluation model and DCD changes acceptable.

The second change I would like to discuss

is LOCA mass and energy releases. Staff reviewed the mass and energy releases modeling changes, and we audited SATAN calculation which generated mass and energy releases into the containment.

Staff reviewed AP1000 DCD changes on mass and energy input. And we found that changes to mass and energy input model and the mass and energy input date in AP1000 DCD acceptable.

The last and third thing I would like to touch is the credit for some existing thermoconductors for platforms and gratings. We audited GOTHIC calculation and reviewed the changes to containment evaluation model and DCD. We found the containment evaluation model and DCD changes acceptable, including Tier 2* table with information on new heat structures credited.

Based on its review, the staff concludes that the AP1000 design changes are acceptable and the design is compliant with GDC 38, GDC 50, 10 CFR 52.47(c)(2) and 10 CFR 50.43(e).

The staff found that AP1000 DCD changes are acceptable.

CHAIRMAN RAY: Thank you, Hanry.

You have heard us talk with applicant about a concern that's been brought to our attention

that the large-scale test facility results may have been affected by radiant heating.

Have you had a chance to think about that and do you have any comment on it?

MR. WAGAGE: This is a very new issue. We, I read it today. And with respect to the reviews we did, for example, the film coverage, I think my understanding is that for the film coverage there is radiation heating. Then film coverage will be less. It might take a longer time because of additional heat coming from the sun's radiation. And then it might take longer to establish a steady state film, meaning that what we have right now is more conservative.

CHAIRMAN RAY: Any comments for staff members on this subject?

(No response.)

CHAIRMAN RAY: Thank you. Okay. Again, as I said, I want to finish this discussion and not come back to it later. So, I'm going to bring up an opportunity for a member of the public to address the particular issue that we just were speaking to staff about.

We will have another opportunity for public to address this or any other subject at the very end. But since we're not done with the meeting

yet, I just want to attempt to take any and all public comments.

The letter - we have a letter addressed to us by Dr. Sterrett, if I'm pronouncing that correctly. If not, I apologize. Dated August 12th. I have alluded to it a number of times.

Is Dr. Sterrett here with us?

MR. WANG: Pretty soon she will be on the phone. Over the phone.

DR. STERRETT: Hello. Hello.

CHAIRMAN RAY: Yes, Susan.

DR. STERRETT: I'm on the telephone.

CHAIRMAN RAY: That's fine.

DR. STERRETT: Can you hear me?

CHAIRMAN RAY: We can. You had some slides also. And it looks like we have these in front of us now on the screen.

DR. STERRETT: Okay.

CHAIRMAN RAY: So, please proceed. You heard our discussion, I believe.

DR. STERRETT: Yes. I'm at the airport. If you give me ten seconds, I'm going to find a quiet corner.

CHAIRMAN RAY: Well, you're going to do better than we are usually when we do that, because

sometimes quiet corners become noisy. But I'll give you ten seconds, certainly.

DR. STERRETT: Okay. Let's see. And I was thinking of wrapping it maybe in sound absorption by putting it on a scarf.

CHAIRMAN RAY: Have you heard my attempts to represent at least what I understand in your letter, to various people here this morning or today?

DR. STERRETT: Yes, and they're very admirable.

CHAIRMAN RAY: Okay. Well, then you go ahead with whatever else you want to say.

DR. STERRETT: Okay. Thank you. If for some reason it's too loud, I have somebody at Carnegie-Mellon in a quiet office that can take over.

Okay. Can you hear me? Is it adequate?

CHAIRMAN RAY: Yes, we can hear you adequately. That's a good way to put it.

DR. STERRETT: Okay. All right. The title slide, just the title, okay, thank you for letting me come to speak today. For the record, I'm Dr. Susan Sterrett of Carnegie-Mellon University.

Prior to my academic career, I worked in the nuclear power industry, including work in structural mechanics and in fluid systems design.

Although I did some work on Westinghouse plastic plant systems, I never worked specifically on the AP1000. The information I'm referring to here is from materials made available to the public on the NRC's website.

I'm just going to do a brief summary here because the letters are too long to read. Okay. first slide. In the midst of the severe heat wave our nation has been experiencing this summer, there have been news reports of road and bridge surface temperatures exceeding 140 degrees Fahrenheit.

An airport that had to close because their concrete runways buckled, of concrete roads, ramps and bridges that have buckled and the water pipes across the U.S. that have burst open from thermal loads, these remind us of the powerful effects of the sun, because they're effects that are not due to air temperatures alone, but to the effects of sunlight heating up surfaces, that is, of solar thermal radiation.

There is a heat influx, a continuous heat influx due to the sun that's not captured by considering air temperatures alone. Correct engineering design and analysis must recognize that. And of course as has been pointed out, the problem is

that the AP1000 analysis, it seems, has been forgotten at many points.

So, I want to talk about this error today, this false assumption and how it affected Rev 19 calculations. I believe the error must be corrected, and I want to try to explain why.

Okay. So, on the slide that says "Forgetting About the Sun Issue 1" with no pictures, just words, the calculations of thermal loads on the shield building in Rev 19 documentation submitted to the NRC revealed that a false assumption has been employed, since the maximum temperature used was never higher than the maximum ambient air temperature no lower than the minimum ambient air temperature.

But as we know, the building at the exterior surface can get hotter than ambient due to solar radiation, much hotter, and that it can get much cooler than the ambient air due to radiation for the night sky.

I think it's important to understand the significance of this error, and I worry that the NRC staff does not understand that many calculations are affected by this false assumption, not just concrete temperatures.

The basic significance is the role of heat

input from the sun. It's a flux, a heat rate continuous into the reactor building, not merely an initial temperature condition, okay. So, the comments earlier, I think, can appreciate that.

I've listed some affected calculations on this slide. Notice that peak containment pressure is one of them. Heat transfer to and from the reactor building is an important factor in the safety analysis of this passive plant.

Throughout all of the AP1000 supporting technical documents I've looked at recently, I haven't seen once the radiative heat fluxes from the sun or to the night sky depicted. And they're important for conclusions of the safety evaluation of the effectiveness of the passive containment cooling system and removing decay heat in an accident situation. That's why it must be corrected.

Okay, second - the next slide which is Forgetting About the Sun Issue #1 with a picture of the shield building. So, here's the applicant's sketch of the AP1000 on a sunny day. There's a nuclear fission reactor inside the shield building. And there's also a nuclear fusion reactor 92 million miles away, and both of these are sources of heat input.

The error I'm pointing out is a simple matter of basic Physics. The sun shining on the reactor building will add heat to it by the mechanisms of thermal radiation, and by the same mechanism working in the opposite direction when it recedes to the the night sky. And these thermal transfers are in addition to heat transfer due to convection and conduction. It's that simple, but it's not reflected in the AP1000 calculations.

It seems to be missing from an analysis sketch of setting up heat balances that are used to arrive equations at various points in the safety analysis, or upon the treatment of all cores, including rates made from experimental test results.

It leads one to ask is it just the understanding of the effect of the solar radiation on the shield building that's affected? And of course the answer is no, and that leads us to Issue 2 which you already mentioned.

Let's look at the next slide which is Forgetting About the Sun Issue #2 with just words on the slide. No pictures. According to the Applicant's submittal of the Rev 19 changes, the peak containment pressure which is extremely important to public safety, was calculated using WGOTHIC computer code.

Keeping containment pressure sufficiently load to protect the public, relies upon evaporative cooling of the steel containment which is wetted by coils in the passive containment cooling system and inside the concrete shield building.

As explained in Rev 19 submittal, WGOTHIC was validated using the physical model test in which the dome was wetted, but the experimental test was run outdoors in the sun. And I couldn't find any discussions of the significance of this.

Okay. Next page with pictures. Issue #2 with pictures. This helps make it clear. The test setup used to validate the WGOTHIC, which is the applicant's version of GOTHIC, WGOTHIC computer code, which is a methodology of calculation of evaporative losses and of peak containment pressure is pictured on the left. The situation for which WGOTHIC was used for calculations is on the right. One's in the sun. The other is not.

Now, evaporation in the test model, I believe, is unquestionable that it would be aided by the sun. Remember, it's a continuous heat input. It's not just heating up beforehand.

Since WGOTHIC was validated using this model, the tendency may be for WGOTHIC to overestimate

evaporative losses and thereby to underestimate peak containment pressure. And the question is what, if anything, is going to account for this.

Now, what about the small-scale test facility? In the letter that I've given the ACRS, there's a photograph of that. And it looks like that was outside too. In fact, it's so small I don't feel it could be inside the building.

So, there are all sorts of agreements between large-scale tests and small-scale tests doesn't help us very much in answering that question.

And I would guess - well, I don't know, but I would imagine these same questions apply to the analysis by the NRC staff using any of the NRC staff codes, computer codes.

Okay. So, final slide as to why and what the importance is. These two issues are important. One is important to the structural integrity of the shield building which protects the water tank for the passive containment cooling system.

And both of the issues are important for protecting the heat removal capabilities of a passive containment cooling system to remove decay heat after an accident.

Now, I think that more hangs keeping the

containment cool in this passive plant design than some other PWRs. And I'll remind you that there's no core capture on the AP1000.

I'll remind you that the concrete shield building does not function, does not function as an airtight secondary containment on the AP1000 backing up the steel containment in an accident situation, but containment integrity on this plant plays a much more important role in ensuring public safety.

Public safety depends heavily on the passive containment cooling system being able to remove decay heat. And I've just explained why the analysis and interpretation of test results from which claims of its ability to do so as predicated, are incorrect.

So, I'm coming to you because you have the opportunity to do something about what, well, we certainly don't know whether it has serious consequences or not until we look more closely at it.

Here's why it's important to do that now. The only check and balance class at this point in the 10 CFR 52 process are the ITAAC.

Now, what would the ITAAC tell you? Well, the ITAAC actually used this error, this false assumption, in coming up with the criteria by which

the system is going to be deemed acceptable. That is, the ITAACs, I believe, what they used to say whether the PCS has sufficient decay heat removal capability or heat removal capability is in terms of flow rates and that the flow rate is based on the same false assumptions.

So, the ITAAC PCS heat removal capabilities is not in terms of demonstrating actual heat removal capability in the realistic environmental context.

That means that the ITAACs will not provide a check on this error that I've been talking about until it must necessarily indicate whether or not this initially meant that the safety systems won't be able to remove a sufficient amount of decay heat using a passive containment cooling system.

Neither the structural capabilities through the ITAACs are designed to let you know that this kind of error, the error of forgetting about the sun, whether or not it has period safety consequences.

I think we don't want to find out that this serious condition does, in fact, have serious consequences during a serious accident. I don't, at least. And so, that is why I urge this committee to use whatever means it has to try and get this error

corrected now.

This really might be the last opportunity for anyone to do so. Thank you.

CHAIRMAN RAY: Thank you, Dr. Sterrett. We will take your presentation, I think, closely followed what we understood from your letters and we appreciate it.

DR. STERRETT: Yes.

CHAIRMAN RAY: We only act as a committee after the committee deliberates. So, we won't engage in any feedback to you, but I'll ask the member -

DR. STERRETT: I understand.

CHAIRMAN RAY: I'll ask the members if they have any questions about what you said that they would like to ask you to respond to.

(No response.)

CHAIRMAN RAY: No one does. I think you've been quite clear. We appreciate it, and thank you very much.

DR. STERRETT: Thank you.

CHAIRMAN RAY: If there's nothing more, we'll then proceed with the agenda. And thank you for calling in from the airport. You did very well.

DR. STERRETT: Thank you.

CHAIRMAN RAY: Okay. All right. With

that, we're ready, I think, if I'm keeping track at all, to discuss flywheel.

Is that correct, Rolf?

MR. ZIESING: That is correct.

(Off-record comments.)

MR. ZIESING: I'm going to ask - Mike Melton is going to join me here and summarize where we are since he's my lead that's been following this.

(Off-record comments.)

MR. MELTON: So, are we ready to start, Mr. Chairman?

CHAIRMAN RAY: Any time.

MR. MELTON: Okay. So, just some background. The December 13th letter from 2010 noted that both Westinghouse and NRC had a - we are at a position on the fly where material was suitable for primary water environments.

There was concerns expressed during the meeting on the adequacy of the testing program. We agreed at that time, to conduct a test program to demonstrate the SSC resistance. Once again the staff position was it wasn't required and was a part of the FSER.

Okay. Next slide. Comments made available to the ACRS through the staff, the comments

that we heard and read in the letter, there was a concern being that the test program was documented in the May 19th letter.

We reviewed that and discussed and have decided to make a change. So, we will be doing the slow train rate testing in addition to the crack growth rate testing as part of our program.

We are in the final purchase order phase of the program. Once it gets started, it's essentially a 16-week program. The crack growth rate testing program is in progress.

Most of this work is going to take us to the end of the year and probably to the first quarter of next year. Once we finalize the purchase order and have those details settled, we'll inform the NRC staff, give them another briefing, and then we'll move on from there.

MEMBER ARMIJO: You've done all these tests before as far as equipment for doing these tests, both the crack growth and slow strain rate testing.

MR. MELTON: We have experience doing that. The slow strain rate test we have to go to an outside vendor.

MEMBER ARMIJO: It's not in your laboratory?

MR. MELTON: Not in our laboratory. We're doing the crack growth rate test in our laboratory.

MEMBER ARMIJO: Okay.

MR. MELTON: But the more aggressive testing is outside our laboratory close by.

MEMBER ARMIJO: Okay.

CHAIRMAN RAY: I appreciate the response.

MR. MELTON: It's a good decision.

CHAIRMAN RAY: Well, in any case, it certainly makes our task easier.

MEMBER SHACK: Anybody here know about the details of the testing?

MR. MELTON: I was going to speak to that. But since we hadn't quite finalized the purchase order, I didn't want to go into that except that there's a three-day very accelerated test, and then another three-week test, 20-day test.

MEMBER SHACK: Okay, that sounds about right.

MR. MELTON: But going after high levels of strain in a very short time, and then over a 20-day period, the same strain over that period of time.

MEMBER SHACK: In the crack growth rate test, do you know whether they're doing cyclic loading to transition from transgranular to intergranular? Do

they just pre-crack in air and then pop it in the autoclave and load it, or do they cycle it within the autoclave?

MR. MELTON: I believe they're pre-crack specimens in the autoclave.

CHAIRMAN RAY: Anything else?

MEMBER ARMIJO: As far as times and temperatures and water chemistry and all that sort of stuff, that's not decided yet?

MR. MELTON: Well, there is a proposal for the temperatures, as well as the water chemistry. I think we've determined that it's perfectly suitable for the primary water environment to be picked up. So, we don't have any issues with that test scope myself. And more importantly, our Ph.D. experts who are working on this.

I think - plus we're using what I would say is probably one of the state-of-the-art facilities now that - with a firm that does work for EPRI and Owner's Groups and this is the more aggressive testing as far as the slow strain rate test goes.

And I think everything we do will be in conformance with what's being done in modern times.

MEMBER ARMIJO: And your ring material, that will be prototypic as far as mechanical

properties and -

MR. MELTON: Yes.

MEMBER ARMIJO: Whatever it is that would represent the ring itself.

MR. MELTON: Right.

MEMBER ARMIJO: Okay.

MR. MELTON: We have the same material, right. I think we may be the first to do this kind of testing of the primary water environment.

MEMBER SHACK: There's a paper out there.

MR. MELTON: There's a paper out there.

(Laughter.)

MEMBER ARMIJO: Just probably as one of the instigators of this issue is, I believe this will - a solid test program like this will put the issue to bed one way or the other. If you find problems, you have time to fix them. If you don't find problems, that component is going to be out there for a long, long time without routine inspection. So, you've got to put that to bed.

CHAIRMAN RAY: Again, your response is appreciated just from the standpoint of making it easy for us to resolve.

MEMBER ARMIJO: Very good.

CHAIRMAN RAY: Is there anything more you

wanted?

MR. MELTON: No, we're ready to push on.

CHAIRMAN RAY: We're going to hear from the staff about rulemaking, but our agenda also calls for any staff comments that we haven't yet received.

Is there anything more, Eileen?

MS. McKENNA: I don't think there's really much more to add other than if you had any questions about the overall getting from 18 to 19 that we went through. I think Rolf kind of covered it from the Westinghouse side.

My notes were very similar in terms of the focus on clarifying what we wanted to be in the DCD and Tier 2* and the structural area, resolving some consistency thing, updating some references in the particular rev numbers of WCAPS to make sure we have the most recent ones referenced in the DCD, that kind of thing. And then of course the three technical topics that we've discussed in more detail.

You've - we're kind of, the changes to the SER that we're not just closing out the controlling triads with the yellow highlighting to try to help you focus on what we saw as the changes.

We had sent a similar document to Westinghouse to check for proprietary information.

There was no proprietary information, but we did change one place in the description of the tie bars so that it would not reveal proprietary information. And that's the SER that we - we put that in the whole SER. We've issued the entire SER by a letter dated August 5th. And it is publicly available in ADAMS. We're going to be putting it on our website.

So, our final FSER is complete as far as - at least as far as we're concerned. And that's really where we are.

CHAIRMAN RAY: Yellow highlighting is much appreciated though highly redundant - or repetitive, I should say. Not redundant. But the portions that were not repetitive were easily located. We appreciate that.

MEMBER ARMIJO: Harold, do we have time to raise one issue to a couple of questions on the spent fuel racks?

CHAIRMAN RAY: Yes, this would be a place. To the staff, or to the applicant?

MEMBER ARMIJO: Both.

CHAIRMAN RAY: I see. Go ahead.

MEMBER ARMIJO: Yes, in the updated SER, the seismic loading was updated and the rack designs were bonafide in some way. And then there was a

notation there that the maximum impact forces in a seismic event between the racks and the wall would increase substantially.

And I started looking to what - for a number on what "substantially" meant and how close that was to some margin. I ran out of time.

Could you kind of expand on that? What does that mean that the impact forces between the racks and the wall will increase substantially?

MR. ZIESING: I may need a minute to reflect on that.

MEMBER ARMIJO: Okay.

MR. ZIESING: I know that there was discussion about understanding the impact. To tell you that would have on the fuel integrity itself, Stan is here.

Are you comfortable enough with the background on this to field the question, or do we need to -

MR. RITTERBUSCH: I think I'd need some consultation before -

(Simultaneous speaking.)

MEMBER ARMIJO: It was in the SER. And I read that and I said, oh, what does that mean? You don't - that's a language in the SER.

And then so I went looking for some numerical thing, a change from here to here compared to what the margin is, and I couldn't.

I'm sure it's there, but I didn't find it.

CHAIRMAN RAY: Eileen, do you want to say something?

MS. McKENNA: I was going to say in terms of -- I'm trying to find one of my staffers. I think our structural people left the room. We need to get them back.

So, if you could maybe see if you could get a hold of Mohamed or - I think they might be able to answer that question. So, maybe you could hold that while we try to track down somebody.

CHAIRMAN RAY: All right. We'll stay in session until -

MEMBER ARMIJO: And along with that there was a second question that's mainly for information. And there were some - a part that the original rack design had these impact bars. Impact bars on what was called the Region 2, which was the spent fuel.

And the question is, are they still there in the updated design? Or maybe I just would - I just lost track of what the design looks like.

MR. ZIESING: I believe they are. The

design has not changed in Rev 19. So, what the question -

MEMBER ARMIJO: The impact bars are still there.

MR. ZIESING: -- centered around was, was the analysis and questions on that and -

MEMBER ARMIJO: The issue was just then the forces, the impact forces. And if it said the impact forces increased and the staff found them acceptable, I just wanted to know what we're talking about.

MS. McKENNA: Certainly the staff found them acceptable.

MEMBER ARMIJO: I know that.

MS. McKENNA: It's not an issue in the SER, but I can't specifically speak to the magnitude of what "substantially" was without the appropriate staff person to help me out.

MEMBER ARMIJO: Okay. I can wait.

MS. McKENNA: So, maybe we can come back to that.

CHAIRMAN RAY: All right. We'll wait for that.

Did you want to say something? If so, would you just identify yourself and then say -

PARTICIPANT: No, I'm done. Thanks.

CHAIRMAN RAY: Okay. So, we've got one item that we'll take at the - perhaps at the very end here.

Eileen, did you want to talk about the rulemaking? There's an agenda item here "Rulemaking Update."

MS. McKENNA: Yes, we're just discussing this. A staff member is driving, and so we're trying to figure out if he can call into the bridge number or something like that.

CHAIRMAN RAY: All right. Well, we are going to have an agenda item at the full committee meeting. And so, it's not like this is -

MS. McKENNA: We can always provide a response to wait on to distribute to clarify that.

CHAIRMAN RAY: All right. Let's handle it that way then.

MS. McKENNA: I think since it's a straightforward question, I think that -

(Off-record comments.)

CHAIRMAN RAY: Okay. Anything else, Sam? Sam, did you have anything else?

MEMBER ARMIJO: No.

CHAIRMAN RAY: Okay. So, there's one item that presumably will come in, information that will be

distributed and we'll assume for now that it will not have any follow-up.

Now, finally the rulemaking update. Did you want to talk to it?

MS. McKENNA: Yes, actually George Tartal from our Wilmington guidance branch is here. And he's got handout copies. I don't know whether we've got the electronic loaded up.

It is, okay. The electronic is loaded up. I'm just going to get you a tent card to -

CHAIRMAN RAY: Okay. Well, our transcript will benefit from some clarity around who we're hearing, at least. If it's on the presentation package, then we've got it there.

(Off-record comments.)

CHAIRMAN RAY: All right, George.

MR. TARTAL: Thank you, and good afternoon, everybody. My name is George Tartal. I'm a senior project manager in the Office of New Reactors. And the topic today here is a brief presentation on the status of the AP1000 design certification amendment final rule.

So, the three slides that I've prepared here are kind of where we've been, where we are now, and where we're going with this rule.

So, the first slide is how did we get here, the history of the proposed rule. The initial design certification was done in 2006, and we certify the design as Appendix D of 10 CFR Part 52. In that rule, we incorporated by reference Rev 15 of the DCD.

Since then, we've gotten obviously the application from Westinghouse to amend the design certification. When the staff got significantly through the review of that design certification, we started working on the proposed rule. That happened last year.

We published the proposed rule on February 24th of this year. And in that proposed rule, it would have at that point, incorporated by reference Rev 18 of the DCD. At that point in time, that was the latest that we had.

It also addressed some substantive - the substantive changes, technical changes to the design such as removal of the HFE DAC from the DCD, changes to I&C DAC and ITAAC long-term cooling, etcetera, etcetera. You all in this committee have reviewed all those changes already.

The proposed rule text changes that were included in that proposed rule, I've just listed a couple of them here that are probably of more interest

to you. Two of them - actually, I skipped over the - sorry. I skipped over the compliance with the AIA rule bullet there. So, that was an important change as well.

So, in the proposed rule text changes, two of the text changes that I list here are related to compliance with the AIA rule. One is that plant-specific departures from Tier 2 information that would address AIA requirements, do not require a license amendment.

That's basically to say that anything that is a plant-specific departure just because it may impact or it may affect the AIA requirements itself, would not require a licensed amendment, but there may be other reasons why that kind of change may require a licensed amendment. So, this is just for compliance with the AIA rule.

And then the third one down there requires Westinghouse to maintain a copy of the AIA assessment. That's also a result of the AIA rule.

In the middle here is the revision of certain items designated as Tier 2*. So, here's some of the more technical changes resulting from this amendment.

One of them is the RCP type, human factors

engineering where we changed it to expire after full power operation. And then some changes to certain ASME code and addenda.

So, that's what you would see if you were to look at the proposed rule as it was published in February.

Since then, the public comment period closed on May 10th, 2011. And as you probably heard, we received a lot of public comments on this rulemaking. As a matter of fact, it's more than 13,500 different submissions.

Now, I do say different submissions because there are some that are different. And the majority of them are actually very, very similar.

The majority of the public comments that we received were from two different form letters that came from a particular group's website. And they encouraged - apparently encouraged others to send it in as a public comment. And so, we ended up receiving 13,000 almost identical public comment submissions.

And I say almost identical because there were certain public comment submissions that looked like the form letters, but had additional comments in them or rearranged the comments or changed a few words here and there.

So, the staff had to one by one look through each of those public comment submissions and identify anything that was different from the form letter.

As we went through that, the form letter comments itself, there were nine common comments through those form letters. And then as I mentioned just a minute ago, there were numerous separate comments that we got from those.

Aside from those form letter comments, we also got 63 different comment submissions that contained over a hundred comments in there. And then we also had four petitions that were received.

CONSULTANT WALLIS: So, a hundred comments per submission, or total.

MR. TARTAL: That's total.

CONSULTANT WALLIS: Okay.

MR. TARTAL: Total, yes. And then we had additionally four petitions that were submitted to the NRC that contained 39 comments.

Now, each of these, you shouldn't view these comments as summing them up. Some of them are common across the generic or form letter comments to the comment - 63 comment submissions in each of the four petitions. Some of them are the same.

So, all in all we got seven comment submissions that were absolutely in favor of the rule. There were four that were unconditionally opposed to the rule. The vast majority of them were somewhere in between.

And in this case, some of them were - or most of them were conditionally opposed to completing the rule until we've incorporated lessons learned from the Fukushima accident.

There were also others that were opposed to the rulemaking for a number of reasons such as resolution of high-level waste storage. So, that's my overview of the public comments that we have received.

Now, where we're going with this - and, by the way, those numbers that I gave you on the comments and whatnot, we're finalizing the final rule now. So, those numbers may change a little bit when you eventually see the staff's work on the final rule.

But at this point in time, none of the public comments that we've received have resulted in a change to the final rule to the DCD or the EA, because those are the three documents that we requested public comments against in the proposed rule.

In the final rule, we are changing it to

incorporate by reference DCD Rev 19. As you've heard earlier today, it clarifies in there that - sorry. Rev 19 clarifies the licensing basis, as you heard Westinghouse say earlier, and there were no design changes in Rev 19.

There is a new Tier 2* category that's being addressed in the final rule. And I'll ask Eileen to talk on this one for a moment.

MS. McKENNA: Yes, thank you.

In the current rule, there are a number of Tier 2* provisions. Some of which have an indefinite lifetime, and the others which expire at full power operation.

There are a number of Tier 2* requirements now on structural aspects like the containment design, use of certain codes like AISC or ACI. And as we were going through the discussion like we said earlier in terms of looking at the areas where we wanted Tier 2* information, we looked to see whether the categories, if you will, remained that we had in the rule were sufficient to cover things like the Tier 2* information on the composite models.

We didn't see that they fit totally within the categories and everything we had, so we created a new category. And the way it works, the rule just

kind of gives a general statement, if you will, a topic area where there is Tier 2* information. And you go to the DCD and you look for the markings that give you very specifically on a page this word, this phrase, this whole section, this figure is Tier 2*. So, that was one new Tier 2* category that we added.

The second one was really prompted by our discussion earlier in terms of some of the information about the debris and how it's generated and the limits on that that underpinned the GSI-191 analysis where we, again, put Tier 2* controls on that. And these controls would not expire. They would continue for the life of the plant.

Whereas the ones on the construction aspect, if you will, once the buildings are built, we felt we did not need the Tier 2* control on those aspects anymore.

And the third area where there is new Tier 2*, had to do with the gratings that we talked about that are part of the containment pressure analysis. Since they played a key role, I think, in that analysis, we felt having the Tier 2* attached to them was appropriate. And, again, it would not expire for the term of the license. And those were the new areas of Tier 2*.

MEMBER ARMIJO: If somebody wanted to change the design of those gratings, they'd have to go through a rulemaking?

MS. McKENNA: The particular ones that are credited. I mean, as was indicated, it's not every grating. And it would only be at the level of what information about them was being relied upon.

If there was a certain surface area and other material-type of things that was referred to, that's the information that would - if it were to be changed, would require a review.

MR. TARTAL: Okay. So, we'll finish up on this slide here.

The ACRS has reviewed the changes to the DCD and the staff's associated safety evaluation. As a result of the ACRS' review of all of the technical information in there and consistent with our past practice on the last three design certification rulemakings, we do plan on requesting ACRS waive its review of the final rule.

That letter or that request will be coming out soon once we start into concurrence on the final rule. And that's the end of my presentation.

Are there any questions?

CHAIRMAN RAY: Well, yes. I guess we will

plan to write a letter on the review that we are just finishing today. I guess we could respond to your request you just referred to if we had it in hand by then. If not, I guess it's something we'll do separately.

Do you know when it's coming out?

MS. McKENNA: Our advertised schedule is that the rule package is due to the Commission October 5th.

CHAIRMAN RAY: All right. So, we'll have it by the September full committee meeting. I was just talking about agreeing to -

MR. TARTAL: It's probably sometime in September, but I don't have an exact date.

MS. McKENNA: Probably not by the September 8th -

MR. TARTAL: Unless we really hurry.

(Laughter.)

MR. TARTAL: Any other questions?

CHAIRMAN RAY: Thank you. All right. Now, we will once again ask whether there are any members of the public here or on the telephone line who wish to make any comments to the Subcommittee at this time.

MR. CLEMENTS: Hello.

CHAIRMAN RAY: Yes, please. Go ahead.

Identify yourself first, please.

MR. CLEMENTS: Yes, thank you so much. This is Tom Clements calling from Columbia, South Carolina. I'm with the environmental organization Friends of the Earth. I just had a couple of brief comments, and perhaps a question or two if I might if you could respond.

I appreciate the discussion that the ACRS has had today particularly about the issues related to containment pressure and the shield building heat load questions.

I want to point out to the ACRS particularly given the NRC presentation that just took place, that the public comment period closed on May the 10th. If I am correct, it was on June the 6th that Westinghouse submitted Revision 19 to the NRC. And the public essentially has not had the opportunity to comment on Revision 19, though the NRC said they would accept and consider comments to the best of their ability.

So, we don't know if anything that was submitted after May 10th was considered or not. And I don't know what those numbers that were presented, if they did take into account anything that has been submitted, but I feel the public has been slighted in

this process by not being able to ask some of the questions that the ACRS asked today and getting answers to them.

So, I think that's - well, that is a great concern by people that are monitoring the licensing of the new reactors.

The second thing concerning the presentation by the Nuclear Regulatory Commission where one of the bullet points is that ACRS has reviewed the changes to the DCD and the associated FSER, but I think we heard today that there are a lot of questions about the calculations both for containment pressure and that heat load of the shield building, but this says nothing about if the staff is going to respond and answer those questions, or if Westinghouse is going to answer.

And I feel a little bit hanging after the presentations that were made, the questions by the ACRS and the questions raised by Dr. Sterrett, if there is going to be further resolution to these very serious questions or not.

And I would hope that the ACRS does make sure that everything that has been raised by you and Dr. Sterrett get answered in a timely manner.

And my last two points, which the NRC did

point out, that it doesn't appear that lessons learned from Fukushima are being taken into account in the licensing review of the AP1000.

This is of some concern and we'll see how this plays out, but I think there's an obligation, a legal obligation by the staff to take into account the recommendations of the Fukushima task force.

And my last point also relates to the final rule slide of the Nuclear Regulatory Commission and which we just heard, that the staff plans on requesting that the ACRS waive its right to review the final rule, and I would hope that the ACRS does not do this.

This is such a serious matter that I think that it's incumbent upon you to review the final rule and that you don't agree to waive your right to do that.

So, that concludes my comments. If there are any questions, I'm certainly glad to answer them.

CHAIRMAN RAY: Okay. Well, that's quite clear. I want to be sure for the transcript that - would you please spell your entire name and your association once again for us?

MR. CLEMENTS: Yes, absolutely. Thank you. My name is Tom Clements. T-O-M. C-L-E-M-E-N-T-S.

And I am the southeastern nuclear campaign coordinator for Friends of the Earth here in Columbia, South Carolina.

CHAIRMAN RAY: Okay. And although I couldn't take down all of your comments as you made them, I'm not that fast, I can assure you they're on the transcript and will be considered.

As you've heard me say, we will - this is a subcommittee meeting. There will be a full committee meeting at which all that we have done here will be summarized and deliberated on. And we appreciate - that will include your comments as well. So, we appreciate that.

MR. CLEMENTS: Thank you very much.

CHAIRMAN RAY: Eileen, did you have - were we going to make any response on the bean - I'll call it bean count question as to whether comments were included in the numbers we received?

MS. McKENNA: I think we try to consider comments at a certain point. May 10th was the closure of the period. We try to consider comments as far into the future as we can. But at some point we need to stop so we can finish -

CHAIRMAN RAY: But the numbers that we heard, we don't know whether they include post-May

10th comments or not.

MS. McKENNA: There were a few that were post-May 10th in those numbers, but I won't say that they reflect every single piece of correspondence that we have received -

CHAIRMAN RAY: Yes, all right.

MS. McKENNA: -- since May 10th.

CHAIRMAN RAY: That's an important point is that we haven't cut off or we didn't cut off -

MS. McKENNA: It wasn't like okay, sorry, the gate came down on May 10th and -- but we can't go forever with a comment period.

CHAIRMAN RAY: No, I think that's understood, but I - the important part is that some of the post-May 10th comments at least have been looked at and dispositioned.

Okay. I hope that's some feedback for you. There's large background noise. Is there somebody else who wants to speak?

(No response.)

CHAIRMAN RAY: Okay. We'll assume it's airport noise or something and that no one else wants to speak to us.

With that then, we will close this meeting by going around the table starting first with our

consulting corps to see if there's any comments that they would like to make to the Subcommittee at this time.

Mario.

CONSULTANT BONACA: Yes, I looked at the PCS tank reevaluation, that report. Reevaluation of PCS tank, seismic analysis. And it seems okay. I have really no issues with that. The staff seems to be satisfied with their review of the analysis.

On combining normal seismic demands also seems as if Westinghouse has done a proper job. I think it's complete. And they've performed an evaluation.

One issue that still - I have questions in mind is radiating heating issue. We seem to believe that there is enough margin there to take care of that issue being missed, but I really would like to understand how it's being dealt with in the context of the documentation that we're having on this issue and also the treatment that Westinghouse has done.

I mean, was it an oversight? Therefore, the component or contribution was missed. Or was it simply a normal approach that says that that contributing factor is small enough that you can neglect it?

I had the sense that the second phase was right. And I'd like to ask the question to Westinghouse.

CHAIRMAN RAY: Okay, that's fine. If you want to respond at all, go ahead.

MR. CORLETTI: I think that is the normal approach.

CHAIRMAN RAY: Identify yourself.

MR. CORLETTI: Yes, this is Mike Corletti.

That is the normal approach that we have taken in structural design, and the effect is small. And that's why it's not -

MEMBER SHACK: We're looking into whether it's a consensus approach. We know it's your approach.

MR. CORLETTI: No, I think that is the industry practice from our - our understanding of industry practice, that is the industry practice.

CONSULTANT BONACA: And I hope the three that was covering the experiment benchmark was pushed. And how they treat it is now, that's - anyway, I really have no further comments outside of that.

CHAIRMAN RAY: Okay. Dr. Kress.

CONSULTANT KRESS: Well, the combined loads, I found them very acceptable. And that was a -

given that it was seismic and thermal, that looked to me like a very good way to do it. And from a deterministic standpoint, I see nothing wrong with it and found it acceptable.

On the radiant heat issue, I personally think it's a non-issue. I don't think it impacts the actual results of the calculations with GOTHIC. In fact, I think radiant heat would have probably made the large containment test a little more conservative than they should have been.

The question of the accumulator gases, I think that thermal expansion was sufficiently conservative. I felt like the doctor had a good point about would a cold temperature in a more realistic expansion do something else to the lines that shouldn't be that kind of thermal load.

I doubt if it will affect them, but it needs to be looked at.

CHAIRMAN RAY: And we were assured, I believe, that it would be.

CONSULTANT KRESS: Yes. The changes in the various heat sinks in GOTHIC to get the right temperature and pressure, it looked good to me. I couldn't find a problem with them.

I think that Westinghouse answered our

questions very well and staff seemed to have made a good review of them. So, I don't think there's a problem there.

I don't know if all the lessons learned in Fukushima have been considered or not, but they all seem to be basically external to the design. And I don't think that that impacts your review certification.

But all in all in summary, I think the - I hate to say this, that the ACRS is ready to put this up.

CHAIRMAN RAY: Anything else?

CONSULTANT KRESS: No.

CHAIRMAN RAY: Okay. Graham.

CONSULTANT WALLIS: I'll write the report this week. On the solar issue, I will give you some quantitative assessments. I think I agree with Dr. Kress that it won't turn out to be an issue.

On the new containment pressure analysis, I made some points today. I got some answers. And I think my points were successfully addressed by Westinghouse apart from this temperature thing which we're going to hear about.

On the heat sinks, I think Professor Banerjee made some good points. And the answers

seemed to me somewhat discursive and qualitative, and I'm not sure I want to really dig into how that was treated. I'm not quite sure how I would find out how all these orientations and shapes were handled.

So, it's sort of a bit iffy. It's left in the air for me. I'm not sure I'm going to put any work into it. So, I'll just make some comments about the discussion being qualitative. I'm not sure I can get any further with that issues because I'm not sure I have the information.

MEMBER BANERJEE: May I just interrupt, Graham, for a moment?

It is important because that's why they are going to put the Tier 2* category on the gratings.

CONSULTANT WALLIS: I don't know how the gratings were treated. So, I can't really comment technically on it, and that's what I try to do.

CHAIRMAN RAY: Anything further, Graham?

CONSULTANT WALLIS: That's it.

CHAIRMAN RAY: All right, Joy.

MEMBER REMPE: I don't have any major comments other than to perhaps sort of reiterate what Said brought up about the pressure curve. And those, again, are qualitative. I'm not quite sure why it behaved the way it did response from Westinghouse and

it might be of interest to have a little more detail on that.

CHAIRMAN RAY: You don't believe the thermal inertia -

MEMBER REMPE: Maybe, but I just - I hear three different answers in response to the question.

(Simultaneous speaking.)

CHAIRMAN RAY: Okay, Charlie.

MEMBER BROWN: Yes, I don't have anything other than I would appreciate Graham's kind of a quantitative assessment of the radiant heat thing. That still - it's just been kind of a qualitative discussion and that it would be nice to have something that says, hey, this is really small or it's really insignificant with a little bit more of a technical basis to it than intuition.

Other than that on these subjects, I have nothing else to say.

CHAIRMAN RAY: Bill.

MEMBER SHACK: I was sort of glad to get the helpful reminder that the steel composite structures actually if there's no real code for them, at least the steel is done by a code. The concrete is done by a code. And that does take care of some of the concern about details that aren't really

described. And I think that addresses them fairly well from my point of view.

Again, on the structural impact of the solar loads, I think my - I'm willing to buy my argument that it's by and large conservative. And since they're sort of postulated loads anyway, it's a sufficiently robust structure under this analysis that I'm not concerned about it.

MEMBER RYAN: No additional comments.

CHAIRMAN RAY: Sam.

MEMBER ARMIJO: I do have a little bit of a - I think the radiant heating question is - there are experts here who think it's going to turn out to be a nonevent. And it probably will be, but industry practice is okay for concrete, industry practice is okay for steel, but this is a composite. It's a different kind of - the SC is a different kind of structure and I think some straightforward calculations could put this issue to bed.

Steel is a really good conductor. This is a coated structure. It's got this huge concrete base beneath it to transfer heat to.

So, I think it will turn out to be very, very small, but would be nice to say, hey, we've looked at it, here are the numbers, and it is tiny.

That's all I have.

CHAIRMAN RAY: Okay. Dennis.

MEMBER BLEY: I really agree with Sam on this. Nothing new to add. I'm pleased, as Sam was, to see the testing on the pumps.

CHAIRMAN RAY: Sanjoy.

MEMBER BANERJEE: Well, I think by and large most of the things have been said. I do think that we need to be quantitative about this radiation thing if for no other reason that it's been pointed out. And I think we need to address it in a quantitative way.

Graham will do some calculations, but that's our own ACRS people. I feel that there should be maybe a second opinion from outside the ACRS whether it be Westinghouse or the staff or somebody should take a look at it just to make assurance.

And my intuition is in line with the others that it will be a smaller negligible affect. Nonetheless, I think it should be addressed. That's the first point.

Second, I won't comment on the structural aspects, because I have no expertise in there. But on the pressure transients, I was a little bit surprised that changing the inputs could actually give rise to

a pressure increase of something over a psi.

And then I can see putting the gratings in would reduce the pressure, but these were ostensibly conservative calculations which I made a sarcastic remark which was, was this a best estimate calculation? But that's a significant change just by changing inputs.

How did that happen? It would be interesting to understand, because these were somehow supposed to be conservative calculations. And if you hadn't taken credit for the gratings, you would have just infused the pressure.

Now, part of it was due clearly to the -

CHAIRMAN RAY: Can I interrupt you for a second -

MEMBER BANERJEE: Yes.

CHAIRMAN RAY: -- and ask a question, Sanjoy? Doesn't the argument that I don't want to take credit for things that I don't need to because that means I then have to control them, isn't that a persuasive argument to you?

MEMBER BANERJEE: That's persuasive to the gratings.

CHAIRMAN RAY: Well, it's not just the gratings, I don't think it's anything -- you don't

want to take credit for the beneficial effect just because you don't then want to have to make sure that they are precisely as you had assumed them going forward.

I'm just asking a question.

MEMBER BANERJEE: Well, I think certainly if I was doing a very conservative calculation, that's what I would try to do, but they were just changing the inputs. I'm just talking about dividing that from the heat structures.

When they change the input, some of those inputs clearly were changed in response to the observation that getting to steady state or whatever took longer. So, there was -

CHAIRMAN RAY: Right.

MEMBER BANERJEE: That's understandable. But what wasn't clearly separated in my mind, and I would have to go through this report in much more detail than I -

CHAIRMAN RAY: You -

MEMBER BANERJEE: -- maybe an hour before or 15 minutes before.

CHAIRMAN RAY: As it turned out.

MEMBER BANERJEE: As it turned out, right.

CHAIRMAN RAY: You recall the comment that

they went to the staff, and the staff says you ought to put this other stuff in at the same time.

You're really asking the question why wasn't it put in earlier. That's what you're asking.

MEMBER BANERJEE: No, I'm not even asking that question.

CHAIRMAN RAY: Well, I am.

MEMBER BANERJEE: Yes, you can ask that, which is a separate question.

CHAIRMAN RAY: I think it's the question you're really asking also, which is why were there other things at this point in time.

But anyway, go ahead.

MEMBER BANERJEE: I'm asking a separate question.

CHAIRMAN RAY: Just a minute, Ed.

MR. CUMMINS: Okay.

MEMBER BANERJEE: The first question is that these changes in inputs resulted in an increase in pressure somewhat.

Some part of that came perhaps from the delay in reaching a steady state whatever heat transfer. Some part of it came from changes in the inputs.

Now, that was explained in getting, let's

say, a more refined definition of what happened as the design evolved. Okay. But it's still a nebulous area in my mind as to how that change occurred.

And then of course I can see clearly that provided you can put in structures such as gratings into your calculations which are already there, then you can reduce of course the pressure because then that's for a large heat transfer surface area and it's got a significant amount of capability to take up energy.

So, I can see how that happened and probably they didn't want to control it earlier. So, they took it out.

Now, they feel they need it and they put it back.

CHAIRMAN RAY: Right.

MEMBER BANERJEE: And it has to come in as Tier 2* now, okay.

CHAIRMAN RAY: That's right.

MEMBER BANERJEE: Okay, or whatever, all right. But some clarification of precisely what happened, because we're awfully close to the maximum pressure here, would be helpful.

It's truly a conservative calculation.

CHAIRMAN RAY: I still think you're asking

the question that I said, which is what about the other things that cause the pressure increase?

That's what I was trying to say.

MEMBER BANERJEE: Okay, that's the question.

CHAIRMAN RAY: Yes. I recognize that, but that was in the category of and there was other things that the staff says we should put in at the same time.

I'm going to give you a chance, Ed, to talk about it if you want, but let me finish it up. The assumption I made in my mind, anyway, was that there was an accumulated number of changes that were in the direction of increasing pressure. And they were made along with the one that Said identified all at the same time. And as to why they weren't made earlier, I can't say other than that the design proceeds along its way. And at various points in time, a lot of things get caught up, but you don't do it - as you go along the mass and energy release, for example -

MEMBER BANERJEE: Epoxy coating.

CHAIRMAN RAY: Yes. That was mentioned, but not picked up in 18. And then it was picked up in 19. This isn't a perfect process.

MEMBER BANERJEE: Just wanted to be assured

that this is truly a conservative calculation.

CHAIRMAN RAY: Okay.

MEMBER BANERJEE: Because we are awfully close.

CHAIRMAN RAY: Yes.

MEMBER BANERJEE: And the next revision, you have to have some more stuff having to be brought in to reduce it.

CHAIRMAN RAY: Okay, we're done with this dialog. Ed, do you want to say something?

MR. CUMMINS: Yes. Ed Cummins.

So, I think we have said it, but maybe it wasn't clear, that we have an engineering process where if we find that an assumption in an analysis code doesn't match the design, that's a quality error and we have the caps.

We fill out a form and you go through kind of a parent cause. Depending on how serious the cap is, you process them and you analyze them to see if they're - and so certainly putting in the grating is not a cap, because that's what we consciously did to make up for all the others.

And each one you have to analyze to make sure that the effect of it is not taking over your limits. And then there are, I think, some

requirements to communicate with the NRC staff these things that you find in your safety analysis codes.

And so all this is happening in a quality process where if we were ever over, we'd have to pick up the phone quickly and call the staff and say we're in trouble.

CHAIRMAN RAY: Okay. I think we've got that message also.

CONSULTANT BONACA: I have a question.

CHAIRMAN RAY: Yes, Mario.

CONSULTANT BONACA: Were there many changes that were inputted to the code? And I certainly understand clearly there wasn't one by one evaluation of the direct effect of the change of the result if you lump them altogether, what was there in evaluation?

MR. CUMMINS: Ed Cummins. An evaluation of each one as part of its cap - as part of its cap process to make sure that it didn't cause you to be out of spec. And then there was a general one where you put them altogether which wouldn't necessarily be the sum of their individual inputs.

Sometimes there's ones that - ways that one can affect another.

CHAIRMAN RAY: Okay. My comment is to

observe that it will make it much easier on everyone if applicant will do as Sanjoy suggested and assist us with some quantitative ability to determine the significance of the radiation heating element.

And we all have expressed our opinions about it. We all, nevertheless, feel at this stage of the game that it would be probably fairly easy and straightforward if the applicant would do that.

We will do it ourselves, but we would very much encourage Westinghouse to give us their quantitative assessment. If you would do that in between now and the full committee meeting, we will take cognizance of it at the full committee meeting and, I believe, be in a position to reach a decision then with the benefit of that input.

There was one other thing, Ed, that you were going to do for us, I believe, along the same lines having to do with - we were talking about Tier 2* at the time, I think, weren't we? You were going to help us understand how these critical sections were definitive in terms of replace - it was the dialog we were having about whether or not there was a - something not covered by the code. And, therefore, the detail would need to be captured in the licensing basis.

And the response to that was, well, no, we are committed to comply with the code. And where it's not clear, how that would be done.

We identify in accordance with Part 52, a critical feature, and I guess I've recycled back to you basically what I wanted to hear you say to us. But if you would just say that again, you said it had been said before, but you're willing to do it again.

If you do it again in a way that it will be communicated to the staff to us, we will review it and hopefully come to a final conclusion.

Then staff was going to give us a statement about Sam's what do we mean by significant increase in rack loads.

MEMBER SHACK: Check the yellow on Page 152.

MEMBER ARMIJO: Yellow on Page 152. Were there numbers there?

CHAIRMAN RAY: In which case all you need to do is tell us to check the yellow on Page 152.

MEMBER ARMIJO: The numbers and you know, they give you the margin -

CHAIRMAN RAY: Do you want to do it now, Bill?

MEMBER SHACK: Well, they get - the worst

impact is at 5.69. They have an allowable grid impact of 8.92 g. The staff said, okay, where'd you get the 8.92 g from. And that's from some testing. And so, the staff agrees that in fact they've established that margin.

CHAIRMAN RAY: Okay.

MEMBER SHACK: And they have a substantial margin of 1.57 between the worst calculated impact and the allowable. So, they found that acceptable.

CHAIRMAN RAY: Well, that takes the staff off the hook for -

(Laughter.)

CHAIRMAN RAY: Rolf, did you want to say something?

MR. ZIESING: Yes. Thanks, Harold. I wanted to address your first request with regard to the request to us to do the quantitative determination of the radiant heating.

CHAIRMAN RAY: It was an observation that it would make things a whole lot easier for us to resolve.

MR. ZIESING: I just didn't want to leave here with maybe differing expectations.

CHAIRMAN RAY: Okay.

(Laughter.)

CHAIRMAN RAY: All right. I don't want to make this a negotiation, but go ahead.

MR. ZIESING: We understand the request. And I guess where I want to leave it is we need to consider that request. While it might be a simple thing to do, where we are in the process, the implication of the information, I'm assuming it's going to be acceptable, but I just don't understand where we are in space in implication of that with respect to the staff's actions of the rulemaking schedule.

So, I want to be able to really evaluate the consequences of that action before we would be in a position to -

CHAIRMAN RAY: That's fine. That's your job. I'm just telling you we're making a record here which will be added to by the full committee meeting.

That record can contain whatever questions and answers still need to be resolved, and then we'll write a letter.

MR. ZIESING: I understand.

CHAIRMAN RAY: And what's in the letter can be perhaps reduced as against what it would be otherwise. If you guys have anything to show us, we're groping around trying to find a way to confirm

our own instincts.

And if you can help us, that would be, I think, a good idea.

MR. ZIESING: I understand. Thank you.

CHAIRMAN RAY: All right. Now, anything else anybody else has for us?

I want you all to realize it's only 5:15 now. We've got time to go to the gym or whatever we want to do, and Charlie can get on the road.

With that, we will adjourn the meeting.

(Whereupon, the above-entitled matter went off record at 5:13 p.m.)

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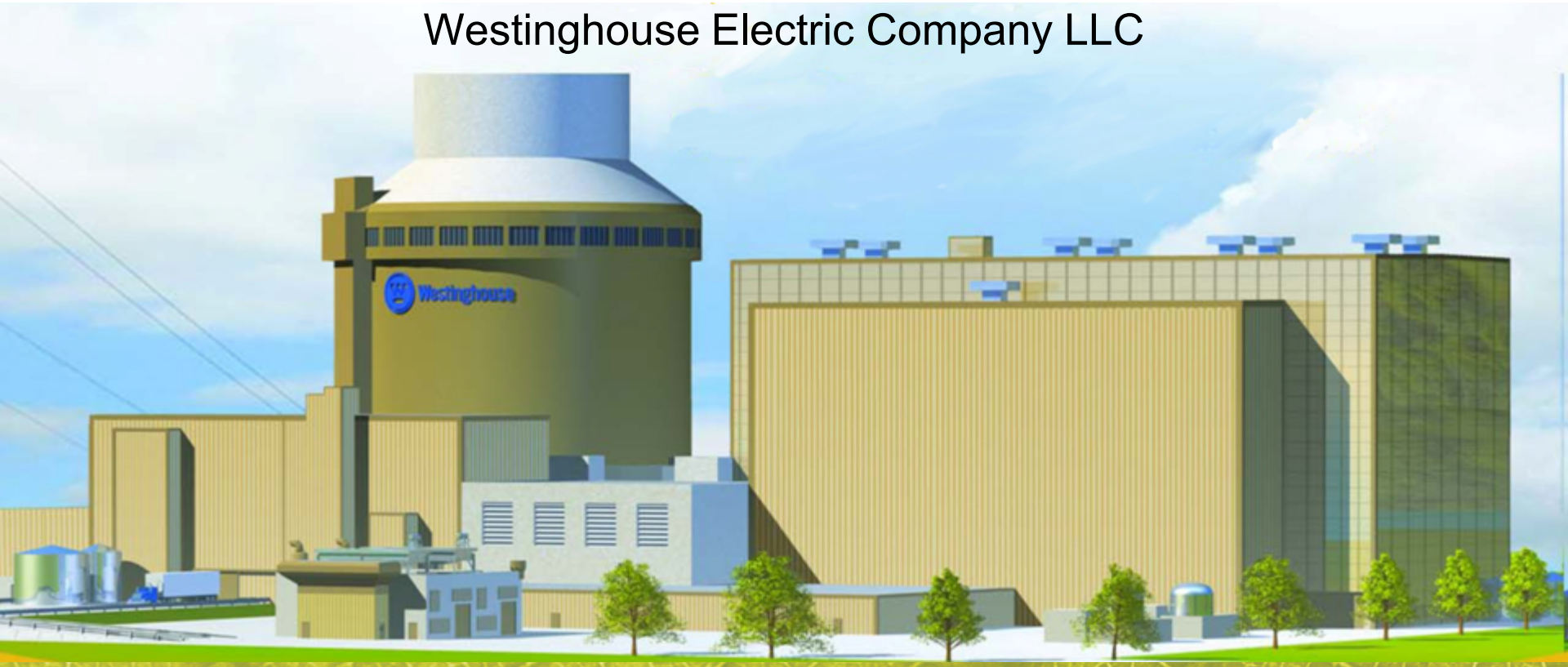
AP1000® Design Certification

DCD Revision 19 Update

Presentation to the ACRS AP1000 Subcommittee

August 16, 2011

Westinghouse Electric Company LLC



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Agenda Topics

- Design Control Document Revision 19 summary
- Shield building load combination
- PCS tank structural design
- RCP retaining ring flywheel material testing
- Containment vessel pressure analysis

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DCD Revision 19: Background

- Design Control Document (DCD) Rev18
  - Captures the AP1000 design that was subject to NRC, ACRS and public review
- Design Control Document Rev19
  - An expected consequence associated with NRC staff Advance Final Safety Evaluation (AFSE) confirmatory items and ACRS recommendations per letter dated December 13, 2010
  - The “design” is the same as DCD Rev 18
  - DCD Rev 19 incorporates revisions to strengthen regulatory control, to clarify the licensing basis, and to ensure DCD conformance to the AFSE
  - DCD Rev 19 validated – NRC letter dated August 5, 2011 issued Final Safety Evaluation

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DCD Revision 19: Scope of Revisions

- Additional regulatory control – Additional DCD text designated with Tier 2* controls:
  - Shield building details
  - Containment debris limits
- Clarifications and consistency improvements:
  - Chapter 16 Technical Specifications
  - Tier 1 editorial improvements
  - Referenced document citations
- Conforming revisions to address confirmatory review of:
  - Shield Building Load Combination
  - PCS Tank Analysis Methodology
  - Containment Vessel Calculated Peak Internal Pressure

No design changes included in DCD Revision 19

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DCD Revision 19

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Tier 2* Changes

- To resolve a confirmatory item, additional structural design information was added and designated as Tier 2* information. For example information on the large containment penetrations was added in 3.8.2.1

  "[*The information in Figure 3.8.2-2 that is considered to be Tier 2* information is the minimum thickness of the hatch cover, the inside diameter of the sleeve, the diameter of the insert plate, the minimum thickness of the insert plate, and the nominal spherical radius of the hatch cover* .]*

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DCD Revision 19

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Tier 2* Changes

- To resolve a confirmatory item, existing structural design information was added and designated as Tier 2* information. For example information on an insert plate for containment penetrations was made Tier 2*

"[*The main steam and feedwater penetrations are combined into a common 3-3/4-inch-thick insert plate.*]*"

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DCD Revision 19

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Tier 2* Changes

- To resolve a confirmatory item, reference to Shield Building connection information in APP-GW-GLR-602 was added and designated as Tier 2* information

"[*These RC-to-SC connections are shown in Figures 1, 2, 3, and 4 of APP-GW-GLR-602 (Reference 57).*]*"

APP-GW-GLR-602 is a document containing proprietary design information incorporated by reference into the DCD

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DCD Revision 19

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Tier 2* Changes – Containment Debris

- The ACRS recommended that the containment debris limit be controlled.
- Information in Section 6.3 related to debris was designated as Tier 2*. For example:

  "[*The COL cleanliness program will limit the total amount of resident debris inside the containment to ≤ 130 pounds and the amount of the total that might be fiber to ≤ 6.6 pounds .*]*"

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DCD Revision 19

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DCD Tier 1 Conforming and Consistency Revisions

- Changes to component identifying numbers
- Editorial, for example gray replacing grey
- Renumbering of crane and hoist ITAAC
- Conforming changes to list of critical sections.

DCD Chapter 1 Updates

- Updates to list of documents incorporated by reference. (Table 1.6-1)
- Update to Regulatory Guide conformance. (Appendix 1A)

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DCD Revision 19

Technical Specification Clarifications

- Acronyms are spelled out.
- Appropriate use of capital or lower case letters
- Addition of footnotes for table for post accident monitoring instrumentation
- Reformatting and renumbering of requirements
- Calculated peak containment internal pressure

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DCD Revision 19

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Shield Building Related Critical Sections

- To resolve a confirmatory item shield building information was added as critical sections.

"Shield building SC cylinder – see subsection 3H.5.7.1, Figure 3H.5-16, and Figures 5 and 6 of APP-GW-GLR-602 (Reference 57)"

"Shield building SC to RC connection – see subsection 3H.5.7.2, Figure 3H.5-16, and Figures 1, 2, 3, and 4 of APP-GW-GLR-602 (Reference 57)]"*

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DCD Revision 19

Shield Building Load Combination Topic

- This revision was a consequence of responding to NRC request to provide additional justification regarding treatment of normal thermal plus seismic load combination evaluation
- The design and analysis requirements for the Shield Building steel concrete composite wall is documented in new DCD section 3.8.4.5.5.
- Tables in Appendix 3H are updated to include the ambient thermal plus seismic load combination

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DCD Revision 19

Shield Building PCS Tank Topic

- This revision was a consequence of implementing an action item from the Shield Building review
- The use of equivalent static analysis for the PCS tank is summarized in Section 3.7
- Appendix 3G includes a more detailed description of the use of equivalent static analysis for the PCS tank
- A table (3H.5-15) and figure (3H.5-11, Sheet 6) added to Appendix 3H for additional design information on the PCS tank and adjacent shield building roof is consistent with use of equivalent static analysis for the PCS tank

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DCD Revision 19

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Containment Vessel Calculated Internal Peak Pressure

- This revision was a consequence of resolving an ACRS comment related to the water film steady state coverage over the containment vessel
- New calculated peak internal pressure is 58.3psig (compared to 57.8 psig)
- Section 6.2 was revised to address updated CV peak pressure
  - Input changes in mass and energy model
  - Input changes in containment response model
- Conforming change in Technical Specifications

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DCD Revision 19: Summary

- DCD Rev 19 was an expected revision to capture the resolution of NRC staff confirmatory items and ACRS recommendations
- The DCD Rev 19 "design" is the same as DCD Rev 18
- DCD Rev 19 incorporates revisions to strengthen regulatory control, to clarify the licensing basis, and to ensure DCD conformance to the AFSE
- DCD Rev 19 validated – NRC letter dated August 5, 2011 issued Final Safety Evaluation

No design changes included in DCD Revision 19

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Questions and Discussion

Westinghouse Non-Proprietary Class 3

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Shield Building Load Combination

Presentation to the ACRS AP1000 Subcommittee

by Westinghouse Electric Company LLC

August 16, 2011

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Normal Thermal Plus Seismic Load Combination

- The Shield Building design was performed using an established practice for considering structural behavior under normal thermal loading
  - The structural design calculations had not explicitly included a calculated normal thermal load contribution in combination with SSE when the thermal effects were considered small or self relieving
- NRC Staff requested Westinghouse to demonstrate with the direct combination of SSE + normal thermal that the design was acceptable

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Normal Thermal Plus Seismic Load Combination

- To validate the existing Shield Building design, Westinghouse updated calculations to explicitly combine normal thermal plus seismic
- The updated design calculations follow the ACI-349 code as well as the recommendations of ACI 349.1R-07, Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures
- The revised calculations demonstrate that no change in the structural design is required
- DCD text changes were included in Revision 19 to clarify the licensing basis and support completion of the FSER

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Normal Thermal Plus Seismic Load Combination

- The additional analysis shows generally small, localized changes to the demand when normal thermal loads are numerically combined
- The reinforcement design for the steel concrete composite portion and the conventional reinforced concrete portion of the shield building is not changed
- The strength of the Shield Building for beyond design basis (i.e. Review Level Earthquake) is not compromised by consideration of this load combination and ductile behavior is maintained

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Normal Thermal Plus Seismic Load Combination

Documentation Changes

- Shield Building Report Appendix L was added to describe the analysis of the normal thermal plus seismic load combination
- DCD Revision 19 included revision to Section 3.8 and Appendix 3H to address the normal thermal plus seismic load combination

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Questions

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AP1000® Shield Building Roof PCS Water Storage Tank Analysis

ACRS AP1000 Subcommittee

August 16, 2011

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PCS Tank Background

- As part of the resolution of the SSE plus normal thermal issue, WEC identified that the DCD Rev 18 was not updated to conform with a Shield Building Action Item
- The Action Item specified the application of hydrodynamic loads in the design of PCS tank
- Westinghouse has updated the calculations and the results are included in DCD Rev 19

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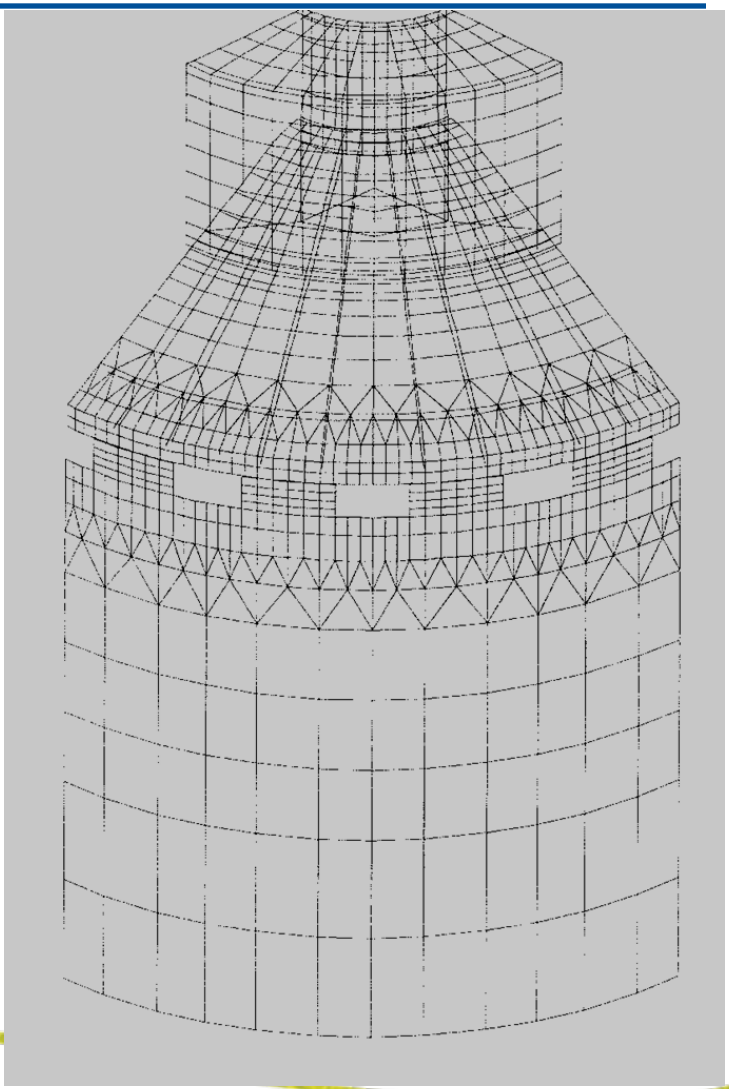
PCS Tank Design DCD Rev 15

Hard Rock Design Certification

- Equivalent static analysis applying maximum acceleration from time history analyses
- Hydrodynamic load applied as pressure
- PCS exterior wall is a critical section with results summarized in the DCD



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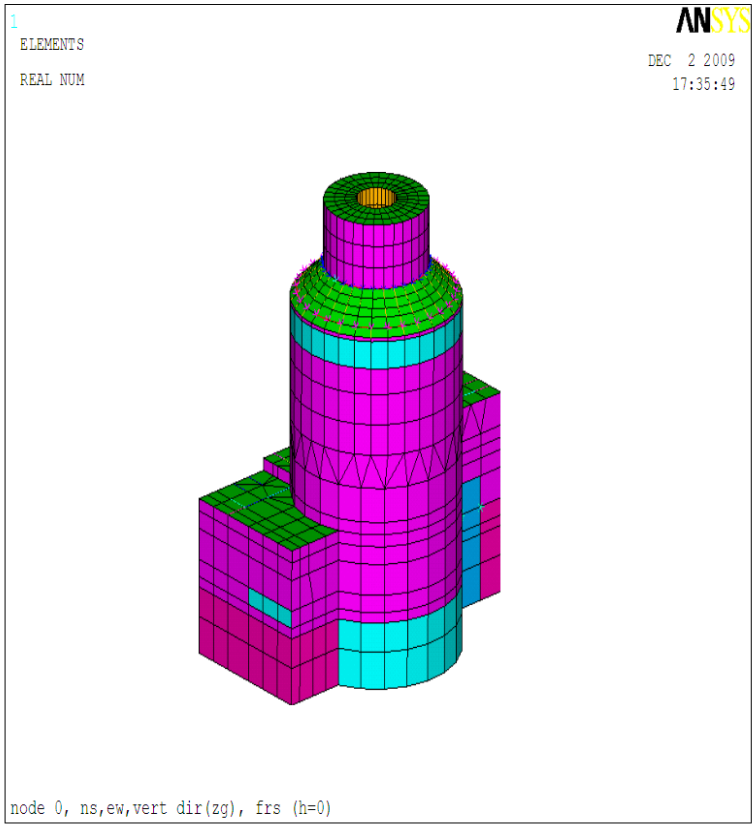
PCS Tank Design DCD Rev 16-18

Extension to Soil Sites

- Westinghouse adopted Response Spectrum analysis method using NI05 model for entire Nuclear Island Design
  - Including PCS Tank
- Equivalent static analysis was applied using detailed model applying maximum acceleration from time history analyses for selected portions of shield building roof design
  - Air Inlet & tension ring



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PCS Tank Design Analysis

Action Item from NRC Shield Building Review (included in Shield Building Report)

- Required Westinghouse to apply equivalent static analysis to the PCS tank applying maximum acceleration from time history analyses
- A quadrant FE model of SB roof including the PCS tank, tension ring, and air inlet is used for the equivalent static analysis
- Design is performed using an equivalent static methodology similar to what was certified in DCD Rev. 15 and similar to method used for the air inlet structure and the tension ring
- Hydrodynamic loads are applied as pressure and validated against a time history response spectrum analysis

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Summary of Results Presented in DCD Rev 19

- The PCS tank is analyzed with the use of equivalent static analysis
- The PCS tank design includes a load combination that numerically combines thermal plus seismic loads
- ACI 349 criteria are satisfied for the PCS tank design
- PCS tank design is described in DCD Section 3.7, 3.8. Appendices 3G and 3H
- The design of the reinforcement for the PCS tank critical sections is not changed in DCD Revision 19

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Tables and Figures

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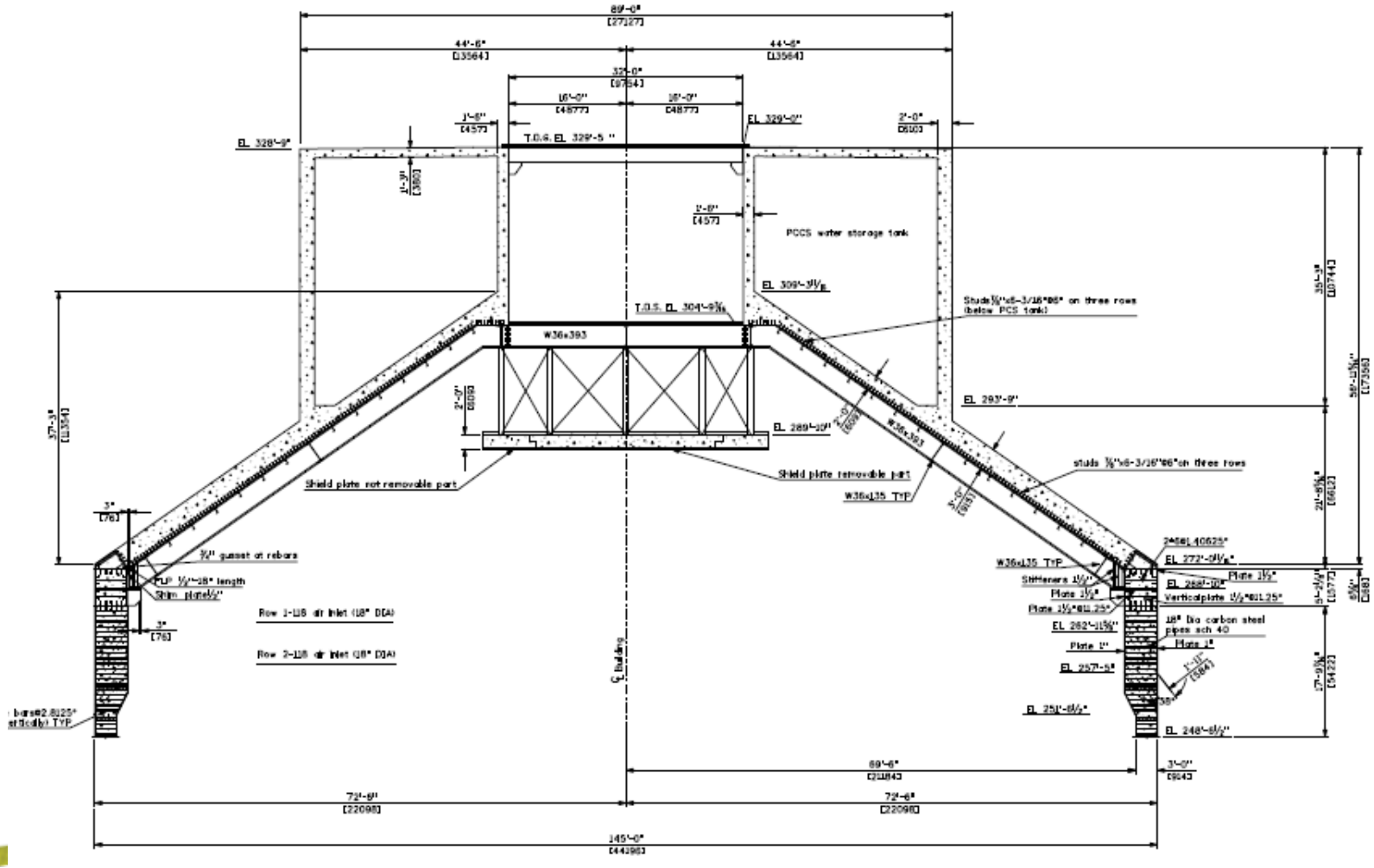
Shield Building Roof
DCD Figure 3H.5-11 Sheet 1



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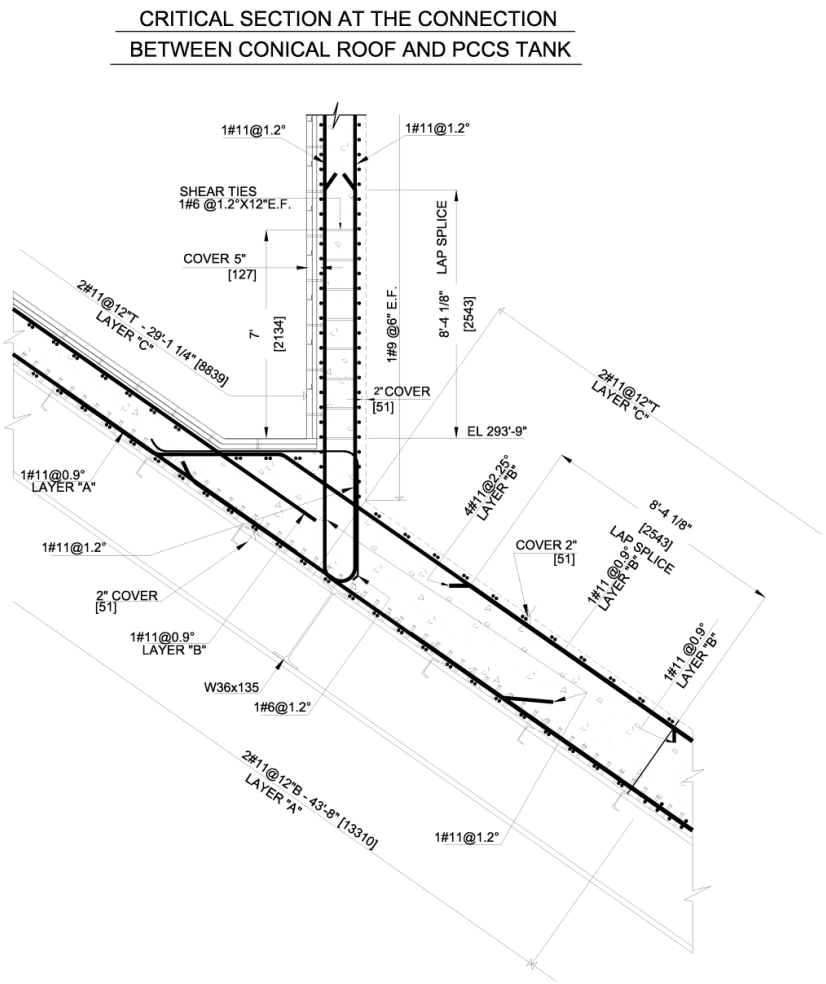
Shield Building Roof DCD Figure 3H.5-11 Sheet 5

Figure 3H.5-11 Sheet 5 shows the knuckle region and a portion of the exterior wall.
It is consistent with the reinforcement design defined in Table 3H.5-9 Sheet 3



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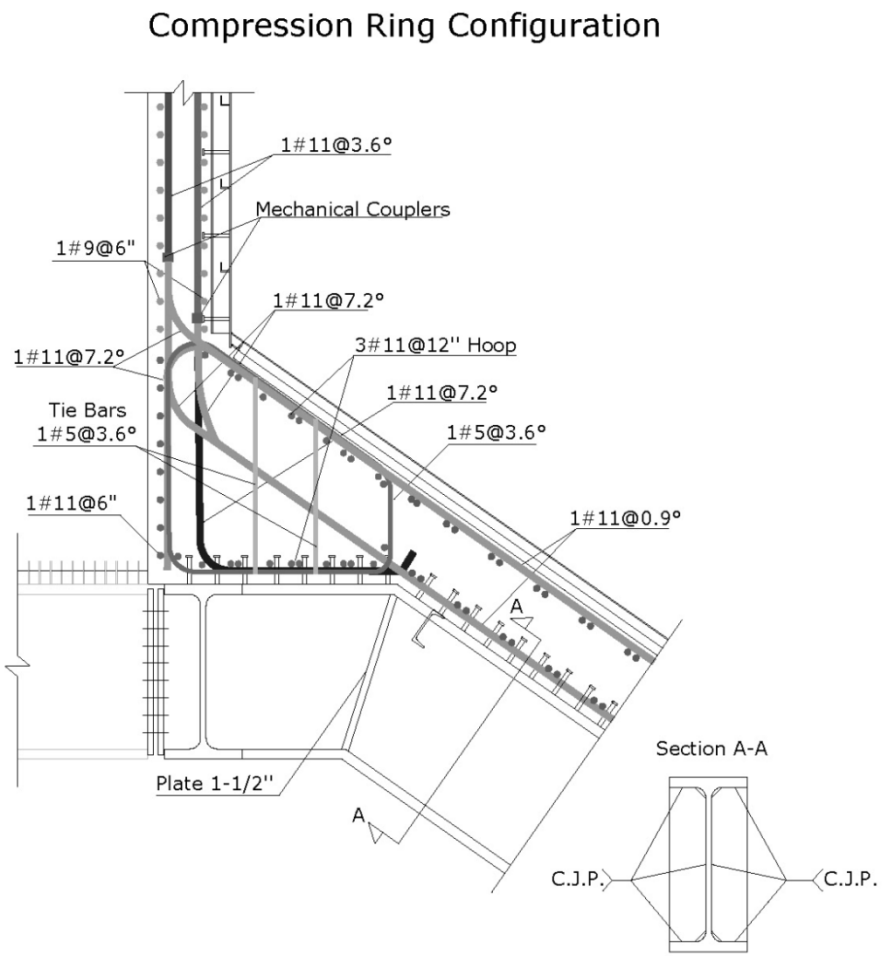
Shield Building Roof DCD Figure 3H.5-11 Sheet 6

Figure 3H.5-11 Sheet 6 was added to show reinforcement design of compression ring



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AP1000® Reactor Coolant Pump Retaining Ring Material Testing Update and Status

ACRS AP1000 Subcommittee

August 16, 2011

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Background

- ACRS letter dated December 13th 2010 noted comments regarding AP1000 RCP Flywheel retaining ring material
  - Noted both WEC and NRC Staff position that material is adequate for primary water environments
  - Expressed concerns on adequacy of current operating experience and supporting testing for stress corrosion cracking (SCC) resistance to primary water environment
  - Westinghouse agreed to conduct test program to demonstrate SCC resistance in primary water
  - Testing not required by staff for DCD final safety evaluation (FSER issued Aug 5th 2011)

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Current Status

- ACRS reviewed the Westinghouse test program and expressed a concern with bent beam test program for SCC initiation
- Concern documented in ACRS letter dated May 19th, 2011
- Westinghouse is changing the test program to include slow strain rate testing (SSRT) in addition to crack growth rate testing
  - Bent beam testing eliminated
- The updated program plan and schedule will be updated and NRC staff briefed by September 2011

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Questions and Discussion

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AP1000® Design Control Document – Containment Pressure Analysis

ACRS AP1000 Subcommittee

August 16, 2011

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Containment Peak Pressure Analysis Overview

- Peak pressure of 57.8 psig reported in DCD Revision 18
- Increased the steady state PCS water coverage time delay input value to resolve an ACRS review comment
  - Containment peak pressure calculated to be 58.1 psig
- Additional input changes to the LOCA M&E model and containment model input were made to address other items that could affect the peak containment pressure reported in the Technical Specifications.
- Peak pressure of 58.3 psig reported in DCD Revision 19

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Containment Peak Pressure Analysis Overview

- Additional input changes were made to the models for the DCD Revision 19 containment analyses
  - Majority of items previously identified and captured in the Westinghouse corrective actions program
  - Impact of individual items on peak pressure is small and were intended to be addressed in future analyses, but have been incorporated in DCD Revision 19 at NRC request
  - 7 input changes in the LOCA mass and energy model (combined impact of all 7 is +0.8 psi)
  - 5 input changes in the containment response model (combined impact of all 5 is +0.3 psi)
  - Credited additional heat sinks in the containment response model (impact is -0.9 psi)

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Containment Peak Pressure Analysis Input Update Summary

- Examples of input changes to the LOCA M&E Release Model
  - Some metal mass from the reactor vessel internals was not included in the LOCA M&E model
  - Steam generator secondary side pressure input transitioned from the SG outlet to the tube bundle
- Examples of input changes to the Containment Response Model
  - Revised coatings material specific heat input values to reflect updated test information
  - Modeled the effect of the accumulator nitrogen gas release for LOCA

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Containment Peak Pressure Analysis Input Update Summary

- Existing heat sinks in containment model were credited in order to
  - Offset model input changes impact on peak containment pressure
  - Maintain roughly same amount of margin reported in DCD Rev. 18
- Analysis performed in accordance with approved methodology
- New DCD table generated to capture key parameters (surface area, volume, material) of new heat sinks as Tier 2* information

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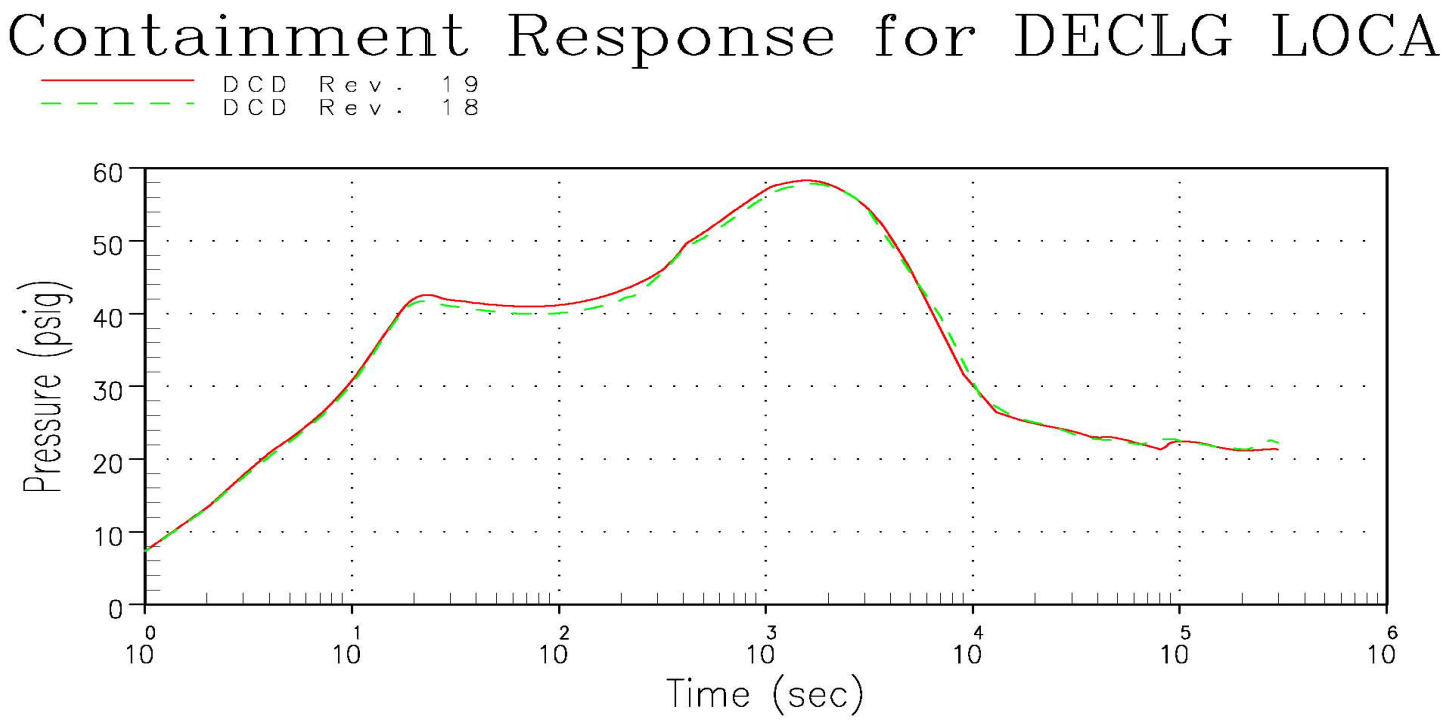
Summary of Containment Pressure Analysis Results



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Conclusions

- Model input changes were made to address items affecting the peak containment pressure reported in the Technical Specifications
- No design changes were made regarding this analysis
- Peak containment pressure remains under 59 psig
- NRC has reviewed the modeling changes, requested additional information and found the changes and responses to be acceptable

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- Questions and Discussion

United States Nuclear Regulatory Commission

Protecting People and the Environment

AP1000 AFSER SECTIONS 23.X & 23.Y

Presented by

Hanry A. Wagage, NRO/DSRA/SBCV

Background

- ACRS raised concern on time to steady state water film coverage of the containment vessel at AP1000 Subcommittee meeting on December 1, 2010
- When addressing this concern the applicant identified additional errors/updates in the containment evaluation model (CEM)
- Applicant's changes impacted NUREG-1793 Section 6.2.1 and Chapter 21
- Regulatory Criteria/Guidance
  - GDC 38 and GDC 50
  - 10 CFR 52.47(c)(2) and 10 CFR 50.43(e)
  - SRP Sections 6.2.1.1.A and 6.2.1.3 and SRP Chapter 16

Staff Evaluation

- The time for PCS to begin steady state film coverage
  - Reviewed calculation of delay for SS film coverage
  - Audited GOTHIC calculation
  - Reviewed changes to CEM and AP1000 DCD
  - Found CEM and DCD changes acceptable
- LOCA mass and energy (M&E) releases
  - Reviewed M&E releases modeling changes
  - Audited SATAN calculation
  - Reviewed AP1000 DCD changes on M&E input
  - Found changes to M&E input model and M&E input data in AP1000 DCD acceptable

Staff Evaluation (con.)

- Credit for some existing thermal conductors for platforms/gratings
  - Audited GOTHIC calculation
  - Reviewed changes to CEM and DCD
  - Found CEM and DCD changes acceptable , including Tier 2* table with information on new heat structures credited

Conclusions

- Based on its review the staff concludes that the AP1000 design changes are acceptable and the design is compliant with GDC 38, GDC 50, 10 CFR 52.47(c)(2), and 10 CFR 50.43(e)
- The staff found that AP1000 DCD changes

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

AP1000 Design Certification Amendment Final Rule

George Tartal
Sr. Project Manager
Office of New Reactors

August 16, 2011

History / Proposed Rule

- Initial design certification in 2006 as Appendix D to 10 CFR Part 52
  - Incorp by reference DCD Rev. 15
- Published proposed rule for this amendment on February 24, 2011
  - Would incorp by reference DCD Rev. 18
  - Addressed substantive technical changes to the design
  - Addressed changes for compliance with AIA rule
  - Proposed rule text changes include:
    - Plant-specific departures from Tier 2 information to address AIA requirements would not require a license amendment
    - Revision of certain items designated as Tier 2*
      - RCP type
      - HFE (changed to expire after full-power operation)
      - Certain ASME Code and Addenda
    - Requires Westinghouse to maintain a copy of the AIA assessment

Public Comments

- Public comment period closed on May 10, 2011
- NRC received more than 13,500 comment submissions
  - Majority were received through a “generic” (form) submission
    - 9 common comments and numerous separate comments
  - 63 comment submissions containing over 100 comments
  - 4 petitions containing 39 comments
- 7 comment submissions in favor of the rule
- 4 comment submissions unconditionally opposed to the rule
- Most comment submissions conditionally opposed completing the rule until Fukushima lessons learned have been incorporated
- Others opposed completing the rule for reasons such as resolution of high level waste storage

Final Rule

- None of the public comments resulted in a change to the final rule, the DCD, or the EA
- Incorp by reference DCD Rev. 19
  - Clarify licensing basis - no design changes
- New Tier 2* category
  - Composite steel modules (expires at fuel load)
  - Debris limits (does not expire)
  - Gratings (does not expire)
- ACRS has reviewed the changes to the DCD and the associated FSER
- Staff plans on requesting ACRS to waive its review of the final rule

Forgetting About the Sun:

two different issues that arise for AP1000 Rev 19 Calculations

S G Sterrett, Carnegie-Mellon University

ACRS Meeting August 16th, 2011

Rockville, MD

Forgetting About the Sun Issue #1: Forgetting about Heat of Solar Radiation on the Exterior Surface of the Concrete Shield Building

- Rev 19 analyses per Appendix H (as of June 30th, 2011):
  - falsely assumes that range of exterior surface temps of concrete shield building is same as range of the outdoor ambient air temperatures.
  - analyses and conclusions incorrect because temp of concrete shield building exterior surface can be much hotter than ambient due to solar radiation, and much cooler than ambient due to radiation to night sky.
  - variety of calcs should be affected: calculation of peak containment pressure, thermal loads, stresses & displacements of concrete shield building, concrete max temperature, PCS water tank temperature, etc.

Forgetting About the Sun Issue #1:
Forgetting about Heat of Solar Radiation on the Exterior Surface of the Concrete Shield Building

The sun heats surfaces exposed to it by radiation.

It increases surface temperatures of the things it shines on.

The AP1000 concrete shield building is no exception.

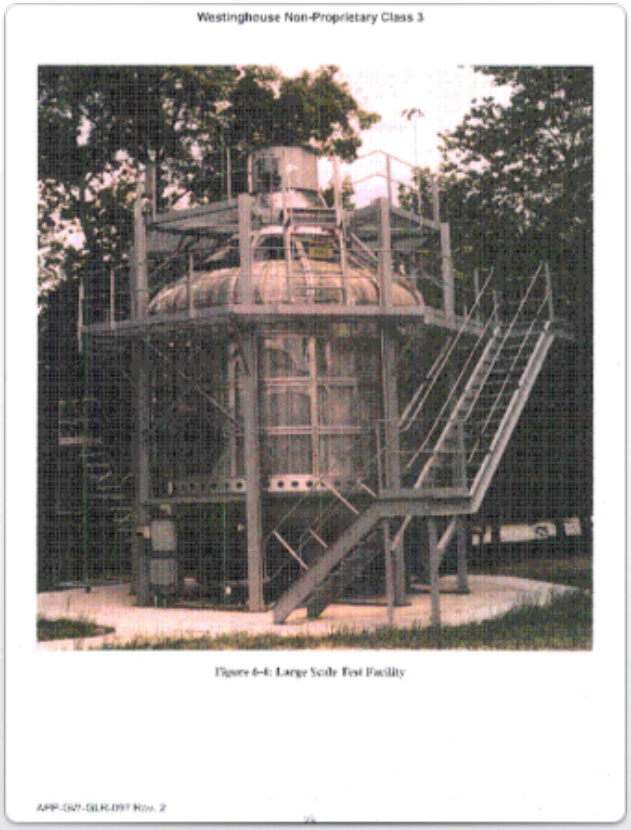
(Similarly, when sun not shining, heat is radiated back to night sky, decreasing surface temperatures.)

Forgetting About the Sun Issue # 2:
Forgetting about solar radiation on exterior surface of physical models of evaporative cooling of containment used to validate WGOTHIC computer code (?)

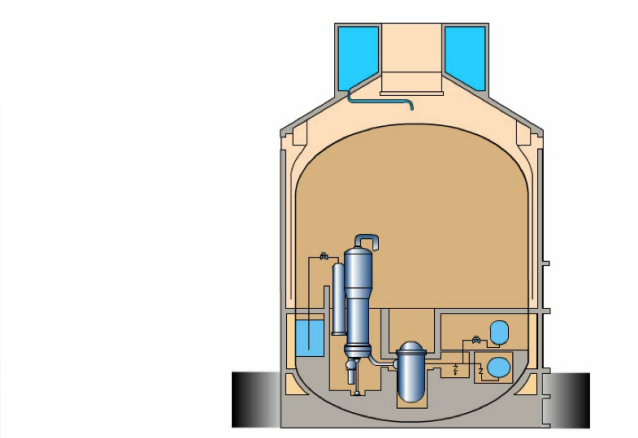
- Calculations of peak containment pressure, which depends upon evaporative cooling of the steel containment dome wetted by Passive Containment Cooling System flow, were redone for AP1000 Rev. 19.
- AP1000 Rev 19 calcs of peak containment pressure used WGOTHIC computer code; WGOTHIC was validated by comparing its calculated results to experimental ones for a physical model test in which dome was wetted.
- But test model was out in the sun (?), so solar radiation would have aided evaporation -- how did the validation of WGOTHIC account for that? If effect of the sun not accounted for, the validation of WGOTHIC for analyses of Passive Containment Cooling System effectiveness in accident mitigation is not valid. *Did they remember to account for the sun or did they not? If so, how?*

Forgetting About the Sun Issue # 2:

Forgetting about solar radiation on exterior surface of physical models of evaporative cooling of containment used to validate WGOTHIC computer code (?)



Passive Containment Cooling



The test setup used to validate WGOTHIC code (methodology of calculation of peak containment pressure) is pictured on the left; the situation to which WGOTHIC was applied is on the right.

One is in the sun; the other is not.

How was the difference accounted for in interpreting test results to validate calc methodology in WGOTHIC computer code?

Forgetting About the Sun
Issue #1:

Forgetting about Heat of Solar Radiation on the Exterior Surface of the AP1000 Concrete Shield Building

Forgetting About the Sun
Issue # 2:

Forgetting about solar radiation on exterior surface of physical models of evaporative cooling used to validate WGOTHIC computer code (?)

The opportunity to do something
about this
will soon pass you by.

Thank You.