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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

AP1000 REACTOR SUBCOMMITTEE MEETING

OPEN SESSION

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WEDNESDAY

NOVEMBER 17, 2010

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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 8:30 a.m., Harold B. Ray, Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD B. RAY, Chairman

SAID ABDEL-KHALIK, Member

J. SAM ARMIJO, Member

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

MARIO V. BONACA, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

JOHN W. STETKAR, Member

NRC STAFF PRESENT:

PEI-YING CHEN

PHYLLIS CLARK

LAURA DUDES

BILLY GLEAVES

JOHN HONCHARIK

ROBERT HSU

JOHN S. MA

EILEEN MCKENNA

PRAVIN PATEL

JOSE PIRES

BRET TEGELER

NRC STAFF PRESENT: (CONTINUED)

BRIAN THOMAS

JOHN WU

WEIDONG WANG, Designated Federal Official

PRESENT FROM WESTINGHOUSE:

MIKE CORLETTI

ED CUMMINS

WILLIAM LEPAY

DON LINDGREN

DON MOORE

RICHARD ORR

ROB SISK

DOUG TRIMBLE*

LEE TUNON-SANJUR

AMIT VARMA

RON WESSEL

ALSO PRESENT:

THOMAS S. KRESS, ACRS Consultant

BOZIDAR STOJADINOVIC*, ACRS Consultant

GRAHAM B. WALLIS, ACRS Consultant

*Present via telephone

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

C-O-N-T-E-N-T-S (CONTINUED)

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

8:31 a.m.

CHAIRMAN RAY: (Presiding) The meeting will now come to order.

This is a meeting of the AP1000 Reactor Subcommittee, a standing subcommittee of the Advisory Committee on Reactor Safeguards. I'm Harold Ray, the Chairman of the Subcommittee.

ACRS members in attendance today are Mike Ryan, Mario Bonaca, Dennis Bley, Bill Shack, John Stetkar, Joy Rempe, and Sam Armijo.

ACRS Consultant Tom Kress is also present. ACRS Consultant Bozidar Stojadinovic is on the telephone from overseas and will participate with us.

CONSULTANT STOJADINOVIC: Yes, I am on the phone.

CHAIRMAN RAY: Thank you, Bozidar.

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 10 of these AP1000 Subcommittee meetings.

This AP1000 Subcommittee meeting will continue to review the Safety Evaluation Reports on Revision 17 to the AP1000 DCD. During this three-day meeting, we will review Chapters 3, 15, 23, and action items from the past AP1000 Subcommittee meetings.

We will hear presentations from the DCD applicant, Westinghouse, and from the NRC staff. We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

As shown on the agenda, some presentations will be closed in order to discuss information that is proprietary to the applicant and its contractors, pursuant to 5 USC 552bc(3) and (4). Attendance at these portions of the meeting dealing with such information will be limited to Westinghouse representatives, the NRC staff and its consultants, and those individuals and organizations who have entered into an appropriate confidentiality agreement with them.

MEMBER RYAN: Excuse me, Harold.

Could whoever is on the phone line put your line on mute?

CHAIRMAN RAY: That is on the bridge

line.

MEMBER RYAN: The bridge line, please.

CHAIRMAN RAY: I was going to get to that in a minute.

MEMBER RYAN: Sorry.

CHAIRMAN RAY: But that's fine.

Consequently, we will need to confirm that we have only eligible observers and participants in the room for the closed portions.

Now let me digress here briefly and say that the agenda that was provided and is available here in the room would have us go back and forth between open and closed in each of the three presentations this morning. So, we would be making that transition a total of six times. I don't think that's practical for us or for those who would be involved in going in and out of the room and doing the necessary verification.

Therefore, we are going to amend the agenda as shown. This portion of the meeting, of course, is open. But when we begin the applicant presentation, it will then be a closed meeting and will remain so through the staff discussions until we get to item 6 on the agenda, at which time we will then have it open except for discussion in that

section that needs to be closed.

This is the only practical way I can see for us to go forward here, since, like I say, going back and forth and having people come in and out of the room at times that it is very difficult for us to know that we are in the open sessions not encroaching on the proprietary information, is the way we will have to do it.

So, when I am done here and anything in the other business is concluded, we will close the meeting until item 6 on the agenda.

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

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 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. The participants should first

identify themselves and speak with sufficient clarity and volume so that they may be readily heard.

And we will now proceed with the meeting.

Now I believe, as it is set up now, we basically have two telephone connections: one, the bridge line that Member Ryan spoke about a minute ago, and the other one is on another -- "frisbee" I call it -- here in the room.

So, we will close the bridge line for the closed portion of the meeting, unless there is a Westinghouse proprietary line established, but the line with the ACRS consultant on it -- and he's the only one on that line -- will remain open during that time, during the entire meeting. And from time to time, he will make input, a comment to us, ask questions, and so on, just as if he were here.

Okay. With that now having been said, Eileen, are you here this morning? And do you have anything you would like to say?

MS. McKENNA: Yes, sir. This is Eileen McKenna from the NRO staff.

I just wanted to say, as you said, we were trying to make as much material available as we could. And I will comment that the staff slides are material that can be made public, and the first few

slides of Westinghouse's presentation are also non-proprietary. So, that material can be shared in the public domain.

But I appreciate the logistical challenges, and we were trying to balance those interests.

CHAIRMAN RAY: Yes. Can we do that with the publication of the minutes that are made available to the public, include all the slides that you mentioned?

MS. McKENNA: The ones that I have mentioned as being -- you'll see in the Westinghouse pile there's a few in the front that are non-proprietary and then a larger stack that is proprietary.

CHAIRMAN RAY: Yes.

MS. McKENNA: The staff slides are all non-proprietary.

CHAIRMAN RAY: But, I mean, when we issue the transcript -- I said the minutes; I was mistaken. Anyway, what's the vehicle by which we will make them available to the public?

MS. McKENNA: I'm not sure what that might be. Maybe your staff has an idea on that, but I'm just making the comment that --

CHAIRMAN RAY: Yes.

MS. McKENNA: -- from our perspective, that is material that can be open.

CHAIRMAN RAY: All right. Well, I appreciate your saying that, and it is certainly our goal to try to make it available. I'm simply trying to find a path by which members of the public can have access to the slides. Well, we will leave it as something we need to do. But, as you say, logistically, it just doesn't seem practical for us to go back and forth that many times here.

Okay. Do you guys have anything you want to say?

MR. TUNON-SANJUR: No, thank you.

CHAIRMAN RAY: All right. Okay. With that, then, we will take a moment to -- well, let me say this: do you guys, Westinghouse, are you prepared to do your non-proprietary portion and then say, "We're at the proprietary section."?

MR. CORLETTI: It's about our first four or five slides.

CHAIRMAN RAY: All right. Well, we'll do that then.

MR. WANG: The line is already closed.

CHAIRMAN RAY: It is already closed?

Okay. Well, so be it. We'll check the room and do that step. Has that been done also?

MR. WANG: We are not through yet. We have to make sure.

CHAIRMAN RAY: Because if there's anybody here, there's certainly no objection to them remaining.

MR. WANG: We'll check it out.

(Whereupon, at 8:39 a.m., the proceedings went from open to closed session.)

(Whereupon, at 2:55 p.m., the proceedings resumed in open session.)

CHAIRMAN RAY: Back on the record now.

We're in open session finally.

(Laughter.)

We will remain there for as long as I can keep people here and we have something to talk about because we have a big hill to climb; we can't afford to waste any of the available daylight hours.

(Laughter.)

Or the early nighttime hours, either.

So, let's get underway here. The gym is open until midnight, Sanjoy.

MR. LINDGREN: My name is Don Lindgren, Westinghouse Electric. With me is Dr. William LePay, Lee Tunon-Sanjur, and Richard Orr.

We are going to be discussing Section 3-7 and 3-8 in the DCD and the SER. Towards the end of 3-8, I believe we have some additional information that may address Mr. Ray's questions about what are

we putting in the DCD to make sure we build the shield building like we say we do.

CHAIRMAN RAY: Please do.

MR. LINDGREN: I thought you would want to see that.

Okay. And I've got the wrong file here. Sorry about that.

CHAIRMAN RAY: It happens to the best of us.

MR. LINDGREN: Okay. There we go. Okay.

The first thing we are going to talk about is 3-7, which is seismic design.

Just to remind you what's in 3-7, 3-7.1 is about seismic input. That is the design, and the response, and the supporting media.

3-7.2 is titled, "Seismic System Analysis", which means structures in this Chapter.

The 3-7.3 is seismic systems analysis, which is really mechanical systems and components, particularly piping.

3-7.4 is seismic instrumentations, and we made no changes in that.

And then, finally, there is a section on combined license information items. And we did include a timing clarification on that.

The changes in 3-7 were the extension from just hard rock sites to soil sites, utilization of 3D finite element shell models, instead of --

MEMBER SHACK: Isn't the extension to two hard rock sites --

MR. LINDGREN: Yes. We included hard rock, yes. Previously, we only had hard rock sites. Now we have six soil cases all together, including hard rock.

We addressed the effect of high-frequency ground motion, use of the coherency function, and classification of adjacent buildings. Those were the changes.

And it was primarily the changes that drove the NRC questions and open items. There were 15 open items all together in the 3.7 SER. As I said, these items were primarily as a result of NRC staff questions about the changes in the DCD, and the largest number of them were due to questions about the addition of the soil changes and things that fell out of that. These open items have all been resolved.

I selected a few of the more interesting ones to discuss. I am not going to go through all of them, but just the ones that typically were the most

difficult to come to agreement on. So, we can do more if you have questions, but these were what we think were the critical ones.

There were two of them that were closely aligned. They were related to justifying the concrete cracking and the damping values we used in the analysis and justifying the .8 stiffness reduction factor for concrete cracking used in the shield building analysis.

This is resolved. We did this by doing an additional nonlinear time history analysis that supported the original analysis assumptions. That is, the .8 stiffness factor reduction.

Oh, and we have two more that were closely aligned to each other. We requested to provide a description of a proposed method of using a more detailed NI05 model to evaluate the flexible regions, and then addressed some issues related to the NI20 model for flexible regions up to 50 hertz.

As a reminder, NI stands for nuclear island; 05 is the approximate size in feet of the elements that are in the model. We have an NI05, NI10, and NI20, and we had questions coming about some of the modeling of these.

Once again, these are resolved. The NI05

model was reviewed to find the flexible regions where the out-of-plane response is considered flexible. The floor response spectra for the flexible nodes are included in the design floor response spectra document as a separate table for area-specific spectra to use in local analysis.

The next item we want to discuss was a question to justify the treatment of missing mass in mode superposition. The resolution was a determination that the mode superposition time history analysis provides a sufficient solution accuracy because the modes which respond beyond the cutoff frequency have no significant contribution to the structure amplified response spectra.

The way this was determined was we did a time history analysis of the cutoff frequency, which was compared to an identical time history analysis with significantly more modes, and the results were comparable.

The next item was a request to include the methodology for structure/soil, structure interaction analysis of buildings adjacent to the nuclear island. To resolve this, we included the methodology we used in the DCD. The seismic analysis that is performed for the adjacent seismic Category

II structures is a simulated 3D analysis, and the seismic Category II buildings are designed using envelope foundation input response spectra.

And the next one, because of the changes in the shield building dimensions, we are asked to update the sloshing analysis of the PCS tank. That is the tank on the roof of the shield building.

The actual change from the Rev. 18 design to the enhanced shield building was that the roof was basically dropped about 5 feet. Rev. 15, okay, that was in Rev. 15.

And the actual configurations of the tank stayed the same. It was just dropped down 5 feet. NRC did audit our calculations and agreed with the conclusions.

MEMBER ARMIJO: Could I ask a question on that?

MR. LINDGREN: Yes.

MEMBER ARMIJO: In the SER, you dropped that rise in the roof by 5 feet.

MR. LINDGREN: It wasn't actually the rise. The whole roof was dropped 5 feet.

MEMBER ARMIJO: Okay.

CHAIRMAN RAY: Including the ring, and so on, right?

MR. LINDGREN: Yes, it's just the whole, from the roof up, was just translated down 5 feet.

MEMBER ARMIJO: I thought it was just the slope of the roof was flattened?

MR. LINDGREN: No.

MEMBER ARMIJO: Okay. Everything was lowered?

MR. LINDGREN: Everything. So, the dimensions from the intersection of the shell of the cylinder with the roof up, those dimensions did not change.

MEMBER ABDEL-KHALIK: We had used the cylindrical wall.

MEMBER ARMIJO: Okay. Okay, and you dropped that 5 feet, but it says that you got a 20 percent reduction in wind loads. How is that possible with such a small -- you know, I don't know how that could be.

MR. LINDGREN: You're reading from the SER?

MEMBER ARMIJO: Yes. Yes, I'm reading from the SER. It's Section 3.3.3, the evaluation in the SER.

MR. LINDGREN: Well, yes, the wind doesn't actually impact the sloshing analysis.

MEMBER ARMIJO: No.

MR. LINDGREN: Okay.

MEMBER ARMIJO: It just said, it just stated -- I don't know why they even said it, but it didn't make any sense to me, but maybe --

MR. LINDGREN: Okay.

MEMBER ARMIJO: Bill Shack and I discussed it, and he had an explanation, but I was hoping that you might have.

(Laughter.)

MR. LINDGREN: It's not that much of a change. So, I don't know.

MEMBER ARMIJO: So, you don't know? Could you find out?

CHAIRMAN RAY: Well, we will ask the staff.

MR. TUNON-SANJUR: We must have had something we said that led them to it. So, we'll find the right --

MEMBER ARMIJO: Okay.

MEMBER SHACK: He's got a vivid imagination.

(Laughter.)

MR. LINDGREN: Okay. Okay, you were looking in the 3.7 SER for that?

MEMBER ARMIJO: 3.3.3 is the check.

MR. LINDGREN: Okay. We are actually going to talk about that 3.3 section later.

MEMBER ARMIJO: Okay.

MR. LINDGREN: Okay? Okay, that's all we have in 3.7.

We will now talk about 3.8. Okay, 3.8 is the design of Category I structures. Everything that we have talked about in the morning fits in this section. But we won't be talking about most of what we talked about this morning.

Okay. What is included in 3.8 is steel containment. That is in 3.8.2. And a reminder that we have a self-standing shield building which stands inside the containment, inside the shield building, but it supports itself.

We have concrete and steel internal structures. These are primarily the structural modules that are inside containment and hold the reactor vessel in place, and those items.

We have a section on other Category I structures. That includes the aux building as well as the shield building.

And then, finally, we have a section on foundations or the basemat, as we call it, under the

nuclear island.

The changes from Rev. 15, which was the Certified Design, we did introduce the enhanced shield building, which was discussed this morning. We extended the AP1000 structure design to sites ranging from soft soils to hard rock. In some cases, that changed our design. In all cases, it changed our analysis.

Critical section design was updated. There are 12 critical sections all together, plus three in the basemat. These were updated. These were updated because of the addition of the soil cases and, also, for design finalization changes. We also did a settlement evaluation for settlement during construction to include the construction sequence limits.

Items have been resolved with the NRC, and the DCD changes are included in DCD Rev. 18. There were 20 open items that were identified in the SER. Since that was issued, there was one additional RAI that we addressed, and two of those items were actually placeholder items for NRC action.

Once again, I have picked up a selection of open items to address here. We had an open item and an RAI that were related asking about details

regarding the temperature and external pressure loads of the containment and explaining the assumptions we used to evaluate the containment external pressure.

We met with the NRC to explain the analysis. There are several NRC groups involved in this, both structures and thermal hydraulic type of people.

We provided an analysis for audit. In some respects, this is less important than it was because we included a design change to include a vacuum relief system on the containment. So, the external pressure maximum becomes what the relief system is set to, open for.

CHAIRMAN RAY: Are you going to discuss that any other time than now?

MR. LINDGREN: The vacuum relief system is scheduled to be discussed on Friday as part of the Chapter 3 items.

CHAIRMAN RAY: Okay.

MR. LINDGREN: Okay? We did update a load combination table in the DCD, also, to address this.

The structural part of this question is probably the easiest, once you know what the pressure is.

3.8.3, which is internal structures again. We had an open item that described how the loads in the module can be properly transferred from the module to the embedded bars in the base concrete. The end result of this was we made a design change to include the use of mechanical connectors. Previously, we had what was referred to as the lap splice approach, which were dowel rods coming from the base concrete through the structural modules. We have changed the design so that there is a mechanical connection or a weld to a base plate, to accomplish this load transfer.

Other Category I structures, there was a question about explaining and justifying the AP1000 implementation of the 100/40/40 method for a combination of the three-directional seismic loading. We provided a comparison of the calculated reinforcement demand with the 100/40/40 combination we were using to the technique that is identified in the ASCE 4-98 combination, and the Westinghouse method, the Westinghouse design was deemed to be acceptable.

Okay. Moving on to the basemat, there was a request to make several of our technical reports Tier 2* information or provide an acceptable

alternative. The resolution of this was to add information from TR-09, TR-85, TR-15. These mean nothing to you. That is the Containment Design Report, the Basemat Report, and the High-Frequency Motion Report, and include those in Rev. 18.

We also included information from the Shield Building Report as part of our response. And TR-57, which was a TR about critical sections, was withdrawn because essentially all the information in TR-57 was in the DCD. So, it really served no purpose anymore.

Now, at this time, this is a good time for me to go into -- this is where we addressed the Tier 2* information at the same time. So, we can show you what we did.

Now this is a review copy. So, it's a little busy.

CHAIRMAN RAY: What are you talking about?

(Laughter.)

MR. LINDGREN: Anyway, this shows that in the shield building, this is just to give you an idea of what we have done. I don't expect any real review here.

CHAIRMAN RAY: That's good.

(Laughter.)

MR. LINDGREN: So, we have identified in 3.8 the information about the shield building, and this includes assumptions and what the features are. Okay. And as you can see, we have added a page and a half of material.

I will tell you that this agreement was reached in the last two months. Both we and the NRC staff realized that we did not have time to come to a final resolution on what ought to be Tier 2*. So, they are treating that information as confirmatory. So, we have another chance to discuss what ought to be Tier 2*.

So, that is the kind of information we have added in 3.8 on the shield building. Just to remind you that in 3.8 there is a list of the critical sections, and that is this list is, in fact, Tier 2*.

There is additional information that has been added on testing and in-service inspection requirements. This is all 3.8, which is other structures.

So, we have identified places that need -- in this case we looked for leaks when we fill up the shield building, and this identifies where we

looked for it.

And then, we also have -- I skipped a page. Instruction inspection, we've got information inspection and we have added a couple of paragraphs on the shield building markup program and process control, that sort of thing.

Then, to top it all out, we have added a couple of COL information items on the structures inspection program and the construction procedures program. So, these are both COL information items that have been added.

Okay. Now we also put information about the shield building into 3h. So, we have added information about the tie bars here. This is all Tier 2* information.

The summary of in this case the shield building roof, this will be in Rev. 18. We have added information about the shield building cylindrical wall, the air inlets, the tension ring, the shield building roof, the compression ring, the knuckle region --

CHAIRMAN RAY: Is there ever any drawings in this?

(Laughter.)

MR. LINDGREN: Well, first of all, let me

do tables first. Tables come before.

So, what we have here, a reinforcement summary, and you see that what we have done is we have made the steel area provided as reinforcement as Tier 2*. So, you can't go below that without NRC approval. So, these tables are different, but they are pretty much all the same.

This is the air inlet and tension ring area that we have here. And, yes, we have drawings.

CHAIRMAN RAY: Good.

MR. LINDGREN: You can't see this one, but we do have a drawing. This happens to be for the shield building roof, and we have some dimensions here. So, when Rev. 18 comes out, you can --

MR. TUNON-SANJUR: And this is meant for the roof. It's got to capture the geometry of the roof, so that we won't change it again. So, we will have to do sloshing analysis all over again in the future.

MR. LINDGREN: We have a smaller scale on the intersection of the roof, the tension ring, and the vents.

MR. TUNON-SANJUR: And these are the drawings that Tod was going over in detail this morning.

MR. LINDGREN: And you will notice that here we do identify the tie bars and the spacing on the tie bars for both horizontal and vertical.

CHAIRMAN RAY: So, if I can read that, say the weld detail, which is one of the questions that was asked --

MR. LINDGREN: I don't believe the weld details are on here.

CHAIRMAN RAY: Okay.

MR. TUNON-SANJUR: But the way we are going to inspect it, it's in the DCD.

MR. LINDGREN: Yes. Well, the welds are really more standard-driven.

Let me get down and see what else I've got here to show you.

We have the vertical slice. This is the horizontal slice that also shows the tie bars, and I guess these are pockets.

And we have one that shows the interface of the -- and this is all the rebar that is required for the interface of the roof and the exterior wall of the tank. This is referred to as the knuckle region, if you see that reference.

Okay. Finally, we also have, in Tier 1, there is information that is in Tier 1. In this

case, it's mostly about the concrete, but it does include a little bit about the liner.

And then, there is an ITAAC that was already in there that talks about inspection of the structures. A report exists that reconciles deviations during construction, including the critical sections. So, this was already in here. That is not anything new, and there are figures in Tier 1 that identify the overall configuration of the shield building.

And then, finally --

CHAIRMAN RAY: Well, some of that stuff you're looking at, Don, would go to the issue that -- I mean, for example, one of the things you just flashed across there was be analyzed to design basis loads. Well, obviously, of course, they will be.

But to the extent that somebody around here is looking to margins, I mean I would think it would be irresponsible for you to specify all the margins as belonging to somebody other than yourself. And therefore, the margins I'm talking about would be margins that are taken credit for in the safety findings. In my mind, those would go well beyond making sure that design basis requirements are met. But that is where the uncertainty lies in my mind.

You've got a lot of detail in there that creates margins. I understand that. In other words, you've got information about reinforcing and many, many, many things that, when you put them all together, they create margin and you can't take that away. So, that's good.

MR. LINDGREN: We have included in the critical sections what, here, like the maximum required reinforcement.

CHAIRMAN RAY: Yes, absolutely.

MR. LINDGREN: And this is subject to the 50.59 kind of rules for any changes to the DCD.

CHAIRMAN RAY: Yes, and I've done a few 50.59's in my lifetime. So, if I was going to change, I would have to take a look and say, is it making any significant reduction in margin? Not just, can I still meet the code?

MR. LINDGREN: Right. Well, speaking of codes, because this question was asked, we do identify both ACI-349 and AISC N690 as codes we live to. And you will notice it says, "For design materials, fabrication, construction, inspection, and testing". So, these are in the DCD for these structures and they impact Tier 2*.

CHAIRMAN RAY: Well, is that in conflict,

for example, with the idea that -- does it refute anybody who would argue that the ultimate failure mode for any part of the structure was a brittle failure, for example? Brittle being something that is a term that is used. Whether it is accurate or not, we know what we mean.

I read that up there. It says, "The following standards are applicable to the design." Well, you can read that two ways. You can say they're applicable to the design to the extent that they apply to the design. Fine. But here's where it doesn't apply, you know.

MR. LINDGREN: I believe the question was, do the ACI-349 requirements for construction apply?

MR. CUMMINS: So, this is Ed Cummins.

I think earlier you were saying, what makes you make a construction joint the right way?

CHAIRMAN RAY: Yes.

MR. CUMMINS: Well, we have to meet the ACI-349 code for construction joints. I mean, so --

CHAIRMAN RAY: Yes. Let me stop you right there.

That really wasn't what I said. The question wasn't doing it the right way. It was doing

it the way you presented and was accepted as okay. That's different than doing it the right way.

(Laughter.)

In some people's minds at least.

MR. CUMMINS: Yes.

CHAIRMAN RAY: Okay.

MR. CUMMINS: But I mean a reference was made to the ASME code. If you follow the ACI-349 and N690, you get a whole bunch of requirements on welding and all kinds of other things which those sentences say that, when we have a conflict with some inspector, that's where we're going to go to settle the conflict because we are committed to the codes.

CHAIRMAN RAY: Yes, well, it is where the codes don't apply that -- anyway, let's not argue.

MR. LINDGREN: Okay. So, I hope I have given you a little more information about what we are doing.

CHAIRMAN RAY: Yes.

MR. LINDGREN: Okay. Also, on the basemat, we were asked to justify the assumption of uniform soil spring beneath the basemat. The resolution included a comparison of the maximum reactions of the nuke island for various soil and analysis methods. The comparison was completed.

We also completed a comparison between equivalent static and dynamic time history analyses, and both linear and nonlinear models were compared. The comparison demonstrated that the assumption was acceptable.

And that's all we have.

CHAIRMAN RAY: All right. Any questions? Any more questions?

(No response.)

Whoever is on the phone line, would you put it on mute, please? I guess we used to put them on listen-only, and we can do that also.

All right, moving right along then, we will go to item 8 on our agenda, Tegeler and company.

Anytime you're ready, Billy.

MR. GLEAVES: Yes, sir.

This presentation will be on Section 3.7 of the AP1000, the DCD seismic design review.

I'm Billy Gleaves, Senior Project Manager in NRC's Office of New Reactors and also the Project Manager for Section 3.7 and 3.8.

This entire presentation has been prepared in a non-proprietary manner.

At this point, all of the open items from the July meeting have been either closed or

considered by the staff to be confirmatory, which, of course, confirmatory awaiting the Revision 18 to the DCD, which is expected in the beginning of December.

The items in 3.7, one above, we plan to discuss one. For Section 3.7.2, we just plan to discuss five of those items.

But I would like to note that Westinghouse has already addressed all of the items that we had planned to address except for one, which is TR-0301.

CHAIRMAN RAY: Graham, could you move your microphone back away?

CONSULTANT WALLIS: Oh, I'm sorry.

MR. GLEAVES: So, hopefully, that will speed things up.

Missing from this slide is the contribution of Terri Spicher in DNRL, who helped to prepare the 3.7 and 3.8 phase 2 evaluation.

Pravin Patel will now discuss the open items as they have been changed or closed or converted to confirmatory that we believe are of greatest interest to you all.

Thank you.

MR. PATEL: Thank you, Billy.

My name is Pravin Patel, structural

engineer in NRO SED1.

Most of the items that we have identified that was a little bit of interest to the ACRS Committee were already addressed by Westinghouse, but I will go into some of them in a little bit more detail, if you like.

But, starting with the open items that were left out from the phase 2 presentation, one of them is an interesting item is SRP3.7.1-SEB1-19. It has to do with justification of the concrete model reduction to 80 percent.

To demonstrate, Westinghouse assumed a damping value for these composite steel construction of .5 percent damping value and then for concrete 7 percent.

The applicant performed a nonlinear time history analysis using the finite element code, which the concrete is allowed to crack intentionally, and, also, applicant provided plots to test what's the time in SC concrete.

Ensured that the predictors either were close to or at least to the cracking limit of 43 ksf.

So, basically, we looked at calculations and found that the cracking was uniform on the SC structure. So, appropriately, they considered the

value of piping on damping and a 7 percent damping reinforced concrete is appropriate.

Regarding justification of .8 modulus reduction, applicant, I mean Westinghouse also provided the plot of stress versus strain for the highly-stressed element in the shell building, which this morning was presented.

Based on the review of the staff, we found that this is also acceptable.

Next slide, please.

These two areas are similar, except the PRP-032 is related to CRDS, which is a 35 design response spectra, is up to 33 hertz. The staff had a concern that the flexible region of the wall and floor and roof are -- when we looked at the analysis of the model which is NI20, we found that they might not predict the flexible region in the structure's wall and floor and roof in the southern part of the building.

So, staff had a concern. So, Westinghouse performed a little detailed analysis with reducing the element size to NI05, which they mentioned. And the analysis showed that there are some flexible regions in the structure.

So, it created requirements in the DCD

how those regions will be evaluated by providing a table in a technical report as well as in the DCD to address those areas.

So, staff is satisfied with those requirements, that if there is any SSE test to floor or wall or roof, they will be addressed by using the specific response spectra for those locations.

Regarding the 3.7.1-SEB1-06, it is the same thing, except that is the high-frequency of input. It is up to 50 hertz. Those are the same way of analyzing except they have different input for the high-frequency.

Next slide, please.

This is the one that when they changed the design of the turbine building they wanted to carry the building as a Category II structure, the first bay, which is closer to the nuclear island. They changed the classification and, also, the rest of the turbine building was, according to Revision 15, that was non-acceptability.

So, staff is concerned, how are you going to implement this change with respect to between the southern building and nuclear island. So, applicant did the soil/structure intersection analysis and showed that there is very little effect on the

nuclear island with respect to this. And also, they provided a requirement that we follow, if they have site-specific requirements for the soil.

Next slide, please.

This is TR-3001. That is the open item was there on phase 2. Now it is confirmatory. This is related to the description and to the technical report that did not address any detailed modeling analysis for the shield building. Technical Report 3 was related to seismic analysis of the nuclear island structure, which is certified design requirements that are addressed in TR-3 related to all soil cases and hard rock analysis.

So, applicant added to, revised the Technical Report 3. So, staff is satisfied with that the description they have included in the TR-3 as well as that same carried forward to the DCD. Some of the information that is required are essential requirements.

Next open item, SRP3.7.1-SEB1-17. This RAI was related to the residual response of missing mass.

MEMBER SHACK: What is missing mass?

MR. PATEL: When you have an analysis that goes beyond certain frequency level, cutoff

frequency, which is 33 hertz, then the analysis is a little bit unpredictable. So, then, you started to lose much in calculations. So, that was Dr. Kennedy's people that helped me address those missing mass, according to that justification.

DR. LePAY: Just to clarify a little bit, when you do a relative position time history analysis, one of the parameters that you select is the number of modes to retain in the solution. To retain 100 percent of the mass, you would need a mode for every degree of freedom in the system, which is impractical.

So, typically, depending on the frequency content of the input, a cutoff frequency is defined. But these are the important structural modes.

Of course, when you add up the mass participation of those modes, it is less than 100 percent. So, the question is, well, what effect did the, quote, "missing mass" have on the overall response? So, there are mathematical procedures to incorporate the effect of that missing mass as a pseudo-mode which accelerated at the level of the input motion, and it gets added into the modal responses for the modes that you included in the mode position time history.

In the case of Westinghouse's implementation of mode position time history, they did not directly implement a missing mass correction methodology. Instead, they just added more modes beyond the cutoff frequency in the solution. So, we just asked them to confirm that their approach gave results that were comparable numerically to results that would be obtained if they had included a missing mass correction.

Their approach to doing that, as Don Lindgren discussed, was to compare the solution results for all the modes up to the cutoff frequency and then to include maybe another 20 or 30 modes beyond that and show that the results didn't change.

MR. PATEL: Next slide, please.

So, at this point, all the items in Section 3.7 are resolved or confirmatory pending the DCD revision, which is really already mentioned that is coming in December. And, also, technical reports belong to these sections, which is TR-3 and TR-115, will come also in December, at the same time.

So, this concludes my presentation.

CHAIRMAN RAY: Any questions?

(No response.)

Very good. Thank you.

All right. Now, Eileen, it looks like we're back to Westinghouse again for open items.

MS. McKENNA: Well, actually, we have the staff's 3.8 presentation --

CHAIRMAN RAY: Oh, oh, oh.

MS. McKENNA: -- and a couple of different players to come up.

CHAIRMAN RAY: Yes. Of course. Sorry. I was reading the wrong column.

Okay, it's a familiar face.

(Laughter.)

Who's in charge? Billy?

MR. GLEAVES: All right. This is the 3.8 shortened version presentation. Again, this presentation has been prepared in a non-proprietary manner.

As you can see from this slide, all the open items are either resolved or are considered to be confirmatory, waiting for the Rev. 18 of the DCD.

We have selected some of the items for the presentation that we believe may be of the most interest to the Committee.

For 3.8.2, we have selected two items, one item each from 3.8.3 and .4 and five items from 3.8.5. And unlike the 3.7 presentation, Westinghouse

has only addressed two of those.

So, the technical presentation today will be made by Mr. John Ma, who is the lead structural reviewer in Structural Engineering.

DR. MA: I have help from Joe Braverman and Professor Carl Constantino.

This steel containment issue, applicant was requested to explain whether the design and construction and inspection of the plan are in accordance with current Regulatory Guides. And the resolution is information they provided to demonstrate that design and construction of containment is in accordance with Reg Guide 1.57, Revision 1, for load combinations and design limit, Reg Guide 1.7, Revision 3, for hydrogen-generated pressure loads, and Reg Guide 1.199, Revision 0, for anchorage.

Inspection of other plant structures, the DCD will be revised to indicate that the COL applicant is responsible for establishing a structural inspection program consistent with the Maintenance Rule 10 CFR 50.65 and Reg Guide 1.160.

So, based on that, we believe they have complied with the Regulatory Guides.

Next one, please.

The next issue is additional information needed to describe the 3-D finite element model of containment used for local evaluation near penetrations and axisymmetric model used for analysis away from penetrations.

They used those two models. Both are three-dimensional finite elements. So, we want more information.

The information provided to describe both models with specific reference to TR-09 for more detailed information, and DCD markup provided to incorporate the additional description presented in the RAI response because at the time they did not describe clearly. So, in our RAI, we asked them to describe clearly how the model was generated and was done.

And based on what they gave to us, the information, we believe that is complete.

The next one, please.

The next one is the connection detail.

CHAIRMAN RAY: That information, though, would still need to be in Rev. 18? Is that the way I understand it?

MR. BRAVERMAN: Some of it is already in the prior DCD Rev. 17, but there was some additional

information missing. They gave us an RAI response which had proposed markups. So, we have to wait until that is placed into the official DCD. I believe DCD Rev. 18 markup version has that.

MR. GLEAVES: Yes, and that is why we call it confirmatory, because we are waiting just for that final confirmation. It is the response from Westinghouse gives commitments to make these changes to Rev. 18, but we actually haven't seen the hard final copy yet.

DR. MA: And the next issue is, when we reviewed their connection details from SC module to the concrete basemat, at that time we found some connection; the force transfer was not at the same plane. And we did not believe those connection details were good enough, and they did not provide any test data at that time.

So, the resolution is to revise their connection detail to utilize the direct load paths from steel faceplate to reinforced concrete basemat. So, it is a direct-force transfer by welding. So, we have no problem.

And the next one is they revised a detailed utilized steel dowels, which at one end dowel is welded to the steel faceplate, then use

mechanical connectors, and at the other end, embed into reinforced concrete base.

This connection is also acceptable to us. So, the connection problem has been resolved.

The next one, please.

This issue is the revisions made in DCD Rev. 16 regarding critical sections. That means the number of critical sections they reduced, and there is also incomplete information, and they also removed some of the Tier 2* information. So, we have an RAI to them.

The resolution is the markups for the additional critical sections provided to be consistent with the Certified Design in DCD Rev. 15.

And the markups for tabulated results that were removed from DCD Rev. 15 were provided. It was, in fact, the load combinations and member forces for critical sections. All those are put back

The next markups provided to include additional design information, like required reinforcement for concrete members and required plate thicknesses for modules.

The next markups provided to restore Tier 2* information, which we believe should be Tier 2, and they agreed to it.

And this issue has been resolved.

The next one, please.

The next issue is there is an inadequate description of the soil-bearing pressure evaluation and foundation stability evaluation.

And this problem has been resolved by they provided information to describe the methodology for soil-bearing pressure and the foundation stability evaluation.

And we reviewed that information, and the staff considers it acceptable.

And the markups for DCD provide these evaluations.

And this issue has been resolved.

Next, please.

Difficulties were encountered in demonstrating adequate factor of safety for the seismic sliding stability evaluation. They used the equivalent static method.

This problem was resolved by using a more realistic nonlinear time history analysis, and they used a revised 2-D ANSYS surface-mounted model. It means the model just rests on top of the soil, and they did not assume the soil provides the resistance to the sliding of the nuclear island.

And they also increased the seismic input by 10 percent, as a demonstration that provided a factor of safety of 1.1. This is the requirement in our SRP 3.8.5.

And the staff ordered this analysis, and we consider the analysis acceptable. So, this issue has been resolved.

The next one, please.

The other issue is the foundation seismic design was based on the assumption of uniform soil spring beneath the basemat, which is not consistent with the known soil pressure distributions. Usually, the higher stress will be around the periphery foundation than within.

So, what Westinghouse did was they performed a study, utilized the soil finite element representation and compared the results to the uniform soil spring model. Based on this model, the member forces in the foundation did go up in some locations. However, they performed a re-analysis for these higher forces, and the results indicates the basemat still meets the ACI-349 code design.

So, based on that, the staff considered this issue resolved.

The next one, please.

The next issue is talking about settlement. The staff believes additional information is needed to describe the development of the settlement criteria consistent with the evaluation of the effect of settlement on the structural integrity of the nuclear island.

So, Westinghouse provided a description on how the settlement criteria were developed by using a nonlinear analysis of the foundation during construction and over time after construction.

Settlement criteria were updated and markups for the DCD were provided to give guidance on the settlement criteria for the COL applicants.

And the staff reviewed this information and considers it acceptable, and this issue has been resolved.

The next one, please.

Requirement for soil angle of internal friction needs to be defined in the DCD for the COL applicants because this plant would be built at a different site. So, we want different site, whoever builds this plant to give us the minimum soil angle internal friction. So, in that way, the analysis they performed for the sliding will be covered.

Markups provided for revision of DCD Tier

1 and Tier 2 to define minimum soil angle of internal friction. So, that is included.

If minimum soil angle of internal friction cannot be met, then site-specifics evaluation is required.

And with this, the staff considers this issue resolved.

And that's it.

CHAIRMAN RAY: All right.

DR. MA: Any questions?

CHAIRMAN RAY: Yes.

MEMBER ARMIJO: I have a general question.

CHAIRMAN RAY: Yes.

MEMBER ARMIJO: Will we finish with Chapter 3 open items in this meeting or will that be some other later meeting?

CHAIRMAN RAY: We finish here, don't we?

MEMBER ARMIJO: Well, you know, I wanted to get back to that Section 3.3 of the SER.

CHAIRMAN RAY: About the wind loadings.

MEMBER ARMIJO: About the wind loadings. Because there seems to be a difference of opinion of what the geometry changes between the staff and Westinghouse.

The SER says Revision 17 proposes changes to the geometry of the shield building roof by reducing the roof rise from 25 feet 6 inches down to 20 feet 6 inches. It sounds to me that the SER says the roof is getting a little bit flatter. Westinghouse told us that the whole cylinder was shorter by 5 feet. So, that should be clarified.

MR. CUMMINS: This is Ed Cummins.

When we went from AP600 to AP1000, we needed more containment volume. So, we added 25 feet to the height of the plant.

MEMBER ARMIJO: You mean 5 feet?

MR. CUMMINS: Twenty-five.

MEMBER ARMIJO: Twenty-five? Oh, okay.

MR. CUMMINS: And then, when we had to make the airplane crash changes, we were trying to keep the same seismic response spectra, and we were worried that the additional weight from a thicker roof would change it. So, we tried to minimize that change by reducing the height by 5 feet.

So, if 5 out of 25, it could be that the increase from AP600 is somewhere near 20 percent less, but the 5 out of -- I don't know what the height is -- 180 is nowhere near 20 percent.

MEMBER ARMIJO: Yes. Well, there's

something very confusing the way it is written because, to me, roof rise means --

MR. CUMMINS: The roof rise didn't change.

CHAIRMAN RAY: Okay. Hold on a second.

Let's just turn to the staff. The discussion with Westinghouse I think is interesting, but not going to solve the problem.

MR. THOMAS: Right, right, right.

Brian Thomas, the Branch Chief.

It was my understanding -- and perhaps there is a need for some clarification in the wording in the SER -- but it was my understanding that the overall height of the structure was lowered.

MEMBER ARMIJO: The height of the structure would be lowered either if you flattened the roof a little bit, so it's not so steep -- you will get the same effect as if you reduce the cylinder, but --

MR. THOMAS: Right. Yes.

MEMBER ARMIJO: So, I don't know what actually is the design.

MR. THOMAS: No, it was my understanding that this was not a roof rise type of a change in the design.

MEMBER ARMIJO: But the language in the SER says --

MR. THOMAS: So, I think the language in the SER probably needs some --

MEMBER ARMIJO: All right. Okay.

CHAIRMAN RAY: Just give the citation, Sam.

MEMBER ARMIJO: It's --

MEMBER SHACK: Page 312.

MEMBER ARMIJO: Page 312, Section 3.3.1. So, the question is, what is the actual geometry change? And then, how can such a small change affect, get a 20 percent reduction in wind loading?

MR. THOMAS: Yes, and that's the other part of this issue, and I --

CHAIRMAN RAY: Wait a minute. I would rather you not speculate now.

MR. THOMAS: Okay.

CHAIRMAN RAY: Can you just come back and tell us tomorrow? Thank you.

Do you have anything else?

MEMBER ARMIJO: That's it.

CHAIRMAN RAY: All right. Anybody else have anything else?

(No response.)

All right. Eileen, did you want to say something?

MS. McKENNA: Well, I was just going to say, to answer the first question, the next agenda item is the rest of Chapter 3 for today.

CHAIRMAN RAY: Okay.

MS. McKENNA: But we may or may not be able to answer this particular question today. We might have to wait until tomorrow.

MEMBER ARMIJO: Sure.

CHAIRMAN RAY: Yes. The next agenda item, just to keep me straight, is nine. That's what we're talking about here?

MS. McKENNA: Correct.

CHAIRMAN RAY: Yes. I always think of that as an open item. It's both an open item and the last thing on Chapter 3, I guess.

But we will hear from the applicant first on open item No. 46, and then, as item 10 on the agenda, OI closure on Chapter --

MS. McKENNA: Yes, maybe I'm confusing you with my agenda. What I'm trying to indicate is that this was our Chapter 3 closure of open items for all the things other 3.7 and 3.8. Within that set of information is an ACRS action item 46. That is what

I designated with the hash marks, is that specific numbered items.

CHAIRMAN RAY: Okay.

MS. McKENNA: You can let me know if we are going to cover that topic in this session.

CHAIRMAN RAY: We are going to hear from the applicant and then the staff.

MS. McKENNA: Correct, correct.

CHAIRMAN RAY: All right. And when we are done with that, we are done with 10, we are done with 3, I think.

Okay, No. 46.

MR. LINDGREN: Are you ready?

CHAIRMAN RAY: Yes.

MR. LINDGREN: Okay. My name, again, is Don Lindgren. I'm here to talk about the balance of 3. That is everything that is not in 3.7 or 3.8.

Ron Wessel is here to support me if we have any questions on equipment qualification and high-frequency screening. Dale Wiseman knows all things components. Gerry Riegel is here to talk about valves and in-service testing.

One thing you will discover in the handout I just gave you includes the ACRS action items 46, 55, and 4. I understand that you want to

defer talking about 55 until Mr. Brown is here.

CHAIRMAN RAY: Yes, I believe that would be wise. I think item 4, the Reactor coolant flywheel, we have the interested member here. We can do that.

MR. LINDGREN: Okay. Then, we can figure out when we do 55 later.

CHAIRMAN RAY: Yes.

MR. LINDGREN: Okay. Tier 2, Chapter 3, which is design and structure components, equipment and systems It is a very wide-ranging chapter. It includes a lot of different items.

The items that are included are the general design criteria; classifications of structures, components, and systems; wind and tornado loadings; water level and flood design; missile protection; postulated pipe rupture dynamic effects; seismic design; design of Category I -- we have already discussed. Mechanical systems and components, seismic and dynamic qualification, and environmental qualification.

In 3.2, the classifications of structures components and systems, the classification approach is not changed in the Design Cert amendment. The classification, some of the details were changed to

reflect design finalization.

The open items were a result of NRC audit and review of design documents, design specs and design reports. These items are resolved. There are the details, if you care to look. I wasn't planning on going over them in detail. They are all resolved, and some of them were quite detailed.

We combined 3.3 and 3.5 here because the most interesting items are tornado missiles. We did change our evaluation of the impact of tornado-borne missiles. We included it at a higher elevation to support the COL applicants.

It turns out that you have to analyze the automobile 30 feet from above where it starts, not 30 feet above grade. So, if you have an elevated parking lot within a half a mile, you have to start from 30 feet up to that. So, we have included an evaluation that includes all the sites that have expressed an interest in the AP1000.

CONSULTANT WALLIS: So, why is there one automobile?

MR. LINDGREN: What's that?

CONSULTANT WALLIS: There are a bunch of automobiles in the parking lot.

MR. LINDGREN: That is true, but the Reg

Guides and Standard Review Plan, you do them one at a time.

CONSULTANT WALLIS: One at a time?

(Laughter.)

MR. LINDGREN: I think you can probably safely guess that you are not going to hit the same spot repeatedly, but I don't know.

CONSULTANT WALLIS: But a global failure you're talking about.

MR. LINDGREN: Well, that also is one at a time. They won't hit simultaneously. That would have to be a very smart tornado.

The open items were either a result of design changes, such as the radwaste tank, addition of radwaste tanks in the radwaste building, or came out of NRC review, in particular, the automobile and the siting missile. I will discuss these a little.

We had an open item on the impact of steel siding from either the annex building or the turbine building impacting on the modular wall of the shield building. We have addressed those issues, provided that calculation for NRC audit, and that is now resolved.

We had an open item that came about asking us to look at the effect of three added

radwaste tanks inside the radwaste building. The radwaste building is a lightweight steel frame structure that we presume is blown away in a tornado.

So, we looked at, we resolved this by determining that the tanks are anchored to the ground sufficiently that they will not become missiles.

And also, we did end up with an RAI on our elevated automobile. In addition to looking at the effects of a local impact, we looked at, does an automobile striking the shield building, is it going to stop at the shield building, and determined that that is not the case.

3.4 is water level or flood design. These open items resulted from design changes. We changed the roof design of the seismic category to structures. They were not previously. They were strictly flat and had no parapets or anything at the edges.

The fire tank volume was also increased, and these same radwaste tanks, we also looked at the possibility of them tipping over or rupturing and causing a flood up against that end of the aux building.

In all three cases, the roof design we determined that we had sufficient drainage capability

to drain the water off of these seismic Category II structures. So, there was not an issue with water buildup and the weight due to that.

The fire tank is on the opposite end of the turbine building and the ground is sloped away, and the radwaste tanks cause a very short-term 6-inch flood against the aux building that doesn't have any openings in it.

These items are all resolved.

Once again, there's more details, if you care to investigate further.

3.6 is about postulated pipe rupture dynamic effects, and I am including the SRP Section 3.12 here. There is no DCD Section 3.12.

So, this is a case where we ended up doing -- anyway, we will go over the individual items.

We added a COL information item to address the completion and the review of the piping design. You will see some people referring to this as a piping DAC, but in the Design Certification we did not actually add an ITAAC for this item. But there will be an ITAAC added on a plant-specific basis.

We added a COL information item to

address the completion of the pipe rupture hazard report. Okay.

Then, finally, the other question that came about was an issue on the computer code that we used for piping fatigue analysis, known as WESTEMS. We decided to withdraw it from review in the Design Certification amendment. The staff will evaluate piping design fatigue analysis at the time of the COL item closure, and there is a requirement that benchmark programs are required by the DCD if a piping analysis program other than those included in the design certification are used. So, those are how this piping fatigue analysis will ultimately be closed.

CHAIRMAN RAY: Why? Why did that occur?

MR. LINDGREN: Why did we add all of these or? Which one are you talking about?

CHAIRMAN RAY: Why did you withdraw from review in the Design Certification amendment the computer code and go down the path of putting it at COL item closure?

MR. LINDGREN: We could not come to agreement with the staff on the WESTEMS code in a time that was acceptable for closing out the Design Certification.

CHAIRMAN RAY: Okay.

MR. LINDGREN: I have included in your package the COL information items on both the pipe break hazard here -- so, we have identified what needs to be done to finish that out -- and the as-designed piping analysis.

We expect that Westinghouse will actually do this work to complete it, but it will show up as the responsibility of the COL applicants.

And once again, I have included the open items, if you care to investigate further. We had about five open items on WESTEMS that were closed by withdrawing WESTEMS from the review.

3.9, which is mechanical systems and components, is the next subject. The NRC generated some open items as a result of their review of design documents. In particular, the open items addressed the vortices coming off the flow skirt in the reactor vessel. The flow skirt is an item that was added to the design. It sits underneath the internals, and it is intended to smooth out the flow that is going into the bottom of the core.

The staff had some questions about vortices. We resolved those.

CONSULTANT WALLIS: It's resolved by a

CFD or something? How did you resolve that? It simply says they will be small, but how do you know they will be small?

MR. LINDGREN: Dale, can you answer that?

MR. WISEMAN: I think the evaluation was based on the size of the holes in the flow skirt relative to the question of --

CONSULTANT WALLIS: Well, these are simply the vortices from the holes. They are not global vortices or a donut-type vortex in the hole, lower plenum.

MR. WISEMAN: Right.

MR. LINDGREN: The question was just putting this flow skirt in caused you new vortices that you have to worry about.

We had a question on the attachment of the CRDM nozzle to reactor vessel head. It is attached with a weld, what's called a J-groove weld.

We ultimately resolved this by doing a plastic analysis of that weld and including that in our design report document. So, the NRC audited that and is now satisfied with what we did.

We also had a question about recirculation screen loads. That was also addressed. So, staff is satisfied.

Finally, there was an issue that came up on international CRDM classification questions. This came about after the SER with open items was issued. We have resolved this question to the staff's satisfaction, and they say so in the SER.

Once again, the open items are included here for your information, as well as the RAIs on the CRDM classification.

We had questions on valve testing. These came about, once again, from an NRC audit. We had a rather detailed audit, in part, because we are the first ones to come through with a design after the JOB MOV programs and the like. So, we are implementing these things on the front end instead of backfitting information. So, that provided a lot of interest from the staff. As a result, we came up with a few questions.

Westinghouse is implementing the testing. This is operability testing required by the Joint Owners' Group MOV Program and, in fact, are applying those principles to all power-operated valves.

We have additional information that is provided in our response to ACRS action item 46, which we will be talking about shortly.

Once again, I have included the open

items, if you want to look at it in more detail.

3.10 and 3.11 are very similar. One is seismic and dynamic qualification. One is environmental qualification. We have added a discussion about the screening of equipment for sensitivity to high-frequency motions, and we describe in Appendix 3I of the DCD.

We had RAIs on screening for equipment sensitive to high-frequency motion in conformance with Interim Staff Guidance 1. These RAIs have been resolved.

And the open item on equipment qualification requirements in design documents is also resolved.

Two of these were RAIs. The one is an open item, and it addresses the valves, the Standard QME-1-2000.

Okay. That's what we have for the balance of Chapter. Now I'll start answering at least two of these RAI responses. Oh, ACRS actions.

CHAIRMAN RAY: Yes.

MR. LINDGREN: Okay. ACRS action 46 talks about valve testing and risk ranking. The first two lines were the action as we got it. Components, MOV, POV testing. How is the risk-

informed rank. PRA is not sufficient and needs to review other criteria.

Strictly speaking, the risk ranking of valves to determine the frequency for valve operability testing is a COL responsibility mostly. The DCD includes a COL information item that the COL applicant must complete an evaluation to determine the frequency of valve operability testing. This evaluation includes risk ranking, and the DCD also includes a description of the evaluation to be completed to determine the frequency.

This risk ranking is not completed as part of the Design Certification.

The determination of operability test frequency uses a combination of functional margin and risk ranking. So, if you have high risk/low margin, you test more frequently; if you have low risk/high margin, you test less frequently.

And valve margin evaluates the load on the actuator versus the capability of the actuator. That is what they mean when they talk about margin.

In response to Generic Letter GL 96-05, the Westinghouse Owners' Group prepared a report on the risk ranking approach for the existing fleet. We would expect we would follow the same process.

The approach identified in the report includes six steps:

Identify the valves to be considered.

Calculate the valve at-power risk importance.

Assess PRA completion issues.

Evaluate other considerations.

Develop component ranking worksheets.

And conduct an expert panel for ranking.

And in fact, we have already identified in the DCD the valves that are subject to operability testing in Table 3.9-16.

Risk importance is in the case of AP1000 considered based on both core damage frequency and large release frequency.

For AP1000, we have quantified the shutdown risk, which one of the kind of open items they talked about in the report.

And both Westinghouse and the AP1000 utility personnel have participated in risk ranking expert panels for the Generic Letter 96-05 responses.

CHAIRMAN RAY: Bill, you are going to have to handle this for you and John.

MEMBER SHACK: On this particular one, for the test that you have done in 3.9-16, was that

done with the whole process or is this done on just the risk ranking?

MR. LINDGREN: Okay. What you will find, 3.9-16 is mostly an in-service test table. It tells you what has to be done for in-service testing for all the valves that are subject to safety. What you will find is that we have, in the notes there's a note that says this valve is subject to operability testing.

So, what we have done so far is identified the valves that need to be, that are subject to the operability testing. We have not completed the risk ranking process of how much risk is there to this valve or what the margin is on this valve.

In some cases, for instance, the margin, until you have selected both a valve manufacturer and an actuator manufacturer, you won't necessarily know what the margin is.

MEMBER SIEBER: But the standard testing is MOV ATS testing at shutoff heads.

MR. LINDGREN: Did that help at all?

MEMBER SHACK: How do you choose the ones that are subject to operability testing? What are the criteria for that?

MR. LINDGREN: Can you help, Gerry? Sorry. No, you can?

MR. WESSEL: That would be all the active valves that have a safety-related function for safe shutdown that you would have to do operability testing on.

MEMBER SHACK: Okay. I mean that sounds like a minimum set.

MR. WESSEL: Yes.

MEMBER SHACK: And so, what we have in 3.9-16 is the minimum set, and you will have to look at others later?

MR. LINDGREN: I believe that the ones that we are looking at are identified in the DCD. We believe we have done --

MR. WESSEL: At this time, the list is complete from our perspective, but the ranking hasn't been done yet, as Don has stated, because we have not necessarily got the vendors. We haven't done all the sizing calculations for the actuators and done those evaluations to determine exactly where we are at. Now we are in the process of doing that.

MEMBER SHACK: Okay. Is the scope, then, for GL 96-05 essentially all the operable valves? That is how the scope is defined in the Generic

Letter?

MR. WESSEL: That's correct.

MEMBER SIEBER: Class 1 valve, I think.

MEMBER SHACK: Okay.

MEMBER SIEBER: And then, in the AP1000 --

MEMBER SHACK: Okay. So, once you have done that, then you do the risk ranking to determine the frequency of the testing and --

MR. LINDGREN: Well, the risk ranking and the margin.

MEMBER SHACK: And the margin, right.

MR. LINDGREN: Yes.

MR. WESSEL: And that's done after you select a vendor and do all the sizing calculations, all the weak point analysis, and all the work that is done to show the margin that is contained in the valve design.

MR. LINDGREN: Okay?

CHAIRMAN RAY: Just a second.

MEMBER SHACK: But is there a COL item, then, to do the risk ranking?

MR. LINDGREN: Yes.

MEMBER SHACK: Okay.

MR. LINDGREN: Yes, we do have a COL

information item that says it has to be done and what the evaluation leads to.

MEMBER SHACK: And that, essentially, outlines the approach that you have given here for the --

MR. LINDGREN: I believe this approach is more detailed than what is in there.

MEMBER SHACK: What is in there then?

MR. LINDGREN: It says you have to do a risk ranking, okay, and that the evaluation -- well, the evaluation has to include risk ranking and to include the frequency. I focused on risk ranking because that's what the question was about.

MEMBER SHACK: Okay.

MR. LINDGREN: It does not specifically say that you will use the process in the report that was in response to --

MEMBER SHACK: 96-05?

MR. LINDGREN: -- 96-05, but, frankly, I can't imagine what else we would do. And it is far more than just coming up with numbers out of the PRA.

MEMBER SHACK: No, but I suspect that John won't be happy with a process that somehow just leaves it at risk ranking, which sounds awfully PRA-ish.

MR. LINDGREN: Risk ranking is a lot more than PRA.

CHAIRMAN RAY: As opposed to what, Bill?

MEMBER SHACK: As opposed to a process including the six steps that I see here for 96-05.

MR. LINDGREN: Well, those are the process that is used in risk ranking.

MEMBER SHACK: Okay.

MR. LINDGREN: Although we haven't committed to that.

MEMBER SHACK: You haven't committed to it is the problem.

MR. LINDGREN: Granted, we have not committed to that, but that is the industry method, and the same people are involved for the operating fleet as are involved for AP1000.

MEMBER SHACK: Well, I can't see why the risk ranking approach isn't specified closer to the six steps. It is what it is.

MR. LINDGREN: It is what it is.

CHAIRMAN RAY: Well, we'll not close this until we decide, then, if we have a comment.

MR. LINDGREN: Okay. Okay, then we have 55, which we want to defer to another time?

CHAIRMAN RAY: Yes.

MR. LINDGREN: Okay.

CHAIRMAN RAY: Another time, hopefully, meaning --

MR. LINDGREN: Tomorrow morning, I hope?

MS. McKENNA: Later this week.

CHAIRMAN RAY: Yes, I do, too.

(Laughter.)

MR. CUMMINS: This is Ed Cummins.

We see the six steps as a decision by the COLs rather than a decision by us. So, they get to commit to what they needed.

MEMBER SHACK: Oh, I see. We're going to put them up --

MR. CUMMINS: So, it is really not our scope. Once you take it out of our scope, then --

MEMBER ARMIJO: Then you don't want to answer.

MR. CUMMINS: -- we don't really want to answer, right.

(Laughter.)

CHAIRMAN RAY: Well, all right.

Bill, do you think we can move it off of this list and put it on a COL list? Are you comfortable doing that?

MEMBER SHACK: Why not?

(Laughter.)

CHAIRMAN RAY: Well --

MEMBER SHACK: Just so it gets done.

(Laughter.)

CHAIRMAN RAY: The "why not", you know, there's a number of answers I can think of. But, in any event --

MEMBER SHACK: But, no, my concern is that it gets done, and if Westinghouse wants to pass it to the COL, I guess that is up to Westinghouse and their customers.

CHAIRMAN RAY: As long as we don't see a problem with that.

MEMBER SHACK: Yes, I don't see a problem with it because, until you actually have to do it --

MEMBER ARMIJO: It's pretty hard to test something one time --

MEMBER SHACK: -- this process doesn't have to be in place.

CHAIRMAN RAY: All right. Just make a note of that, Weidong.

All right, let's go to 4.

MEMBER ARMIJO: It's 55 that's being --

CHAIRMAN RAY: No.

MEMBER ARMIJO: What happened to 55?

CHAIRMAN RAY: Charlie's not here.

MEMBER ARMIJO: Oh, okay.

MR. LINDGREN: Okay. Action item 4 was a question about the reactor coolant flywheel design. This is really a Chapter 5 question, but since I have Mr. Wiseman here, I have decided to do this now. We're not doing Chapter 5 otherwise this session.

This is the action item as we got it. We have determined that the potential for corrosion and consequences of a failure of the 18 Cr 18 Mn retainer ring material is not a safety issue.

Westinghouse has reviewed and analyzed industry testing. It is not planning on any more testing of the retainer ring material in support of DCD Rev. 18.

The flywheel, including the retainer ring, is sealed in an enclosure to prevent exposure to the reactor coolant. The pressure boundary criteria and requirements that are applied to the welding and the helium leak test for the enclosure are similar to pressure boundary criteria for the design and the fabrication.

Industry stress corrosion environments more severe than reactor coolant water has shown satisfactory resistance to stress corrosion cracking.

MEMBER SHACK: But that's for the can, not the ring.

MR. LINDGREN: No, this is testing of the ring material.

MEMBER SHACK: Oh, this is the ring?

MEMBER ARMIJO: No, I asked for whatever stress corrosion test reports that you or your pump supplier, which I guess was Curtiss-Wright, had performed on the retainer ring material. I never got anything.

Our ACRS staff member went into the technical literature to look for some information, whatever might be available, and it is incredibly sparse, and I didn't find any environment that even came close to the PWR coolant environment.

Since this is super-high-strength material, that is always suspect to being susceptible to stress corrosion cracking. So, I haven't seen any information that you've got that says this stuff would reasonably in the coolant environment, if this can leaked -- there's a lot of welds in lots of cans, and it's not inspectible. So, I don't understand the reluctance to do some stress corrosion cracking tests to make sure that this thing isn't going to --

MR. LINDGREN: I have some more

information to --

MEMBER ARMIJO: Well, you know, I had asked for this material long ago.

MR. LINDGREN: Okay. Testing includes test specimens under constant load for deionized water, 1 percent ammonium nitrate, and 1 percent sodium chloride at ambient temperature.

MEMBER ARMIJO: That has nothing to do with PWR water chemistry and temperatures. So, I don't know why you're even presenting that, but, you know, if that's the best you've got, that's the best you've got.

MR. LINDGREN: Okay.

MEMBER ARMIJO: But it's not at all representative of what would happen if those cans leaked.

And, you know, I did ask, and I may have misunderstood it, but I believed that you had told us that these were not inspectible, that the cans were not going to be inspected periodically during their service life because the pump has to be disassembled, and I don't know if that's really true, but that was my assumption when I wrote this.

MR. LINDGREN: That's correct.

MEMBER ARMIJO: So, you've got a 60-year

life of two cans spinning around at high speed, welded around very high-energy components, and you're presuming, assuming that in all that time that the alloy 625 can will not leak. And you are then presuming that, if the water gets in there, that this material that hasn't been tested in PWR water chemistry will not crack. And if it does crack, you've got these massive tungsten things that are going to fly apart, and that pump will come to a screeching halt. And, yes, I think you have demonstrated that the pump won't come apart, but why you let it get -- you even leave that in doubt, it's hard to believe.

You know, we get involved with worrying about leaks in 2-inch socket welds, and here this super-high-energy primary pump could come to a screeching halt with a lot of energy being dissipated in a very short time. And I just can't see how you just don't go the extra mile to protect yourself in case your containers leak.

And I can tell you, if you're relying on this so-called industry ammonia/sodium chloride test to give you comfort, then I think you're making a huge mistake because stress corrosion cracking doesn't work that way. You can't translate stress

corrosion cracking resistance in one environment to another environment. So, that information is pretty much useless.

But, you know, I'm not going to preach. My biggest question will be why the staff accepts this. I'll let it go at that.

CHAIRMAN RAY: All right. Anybody else have any questions on this point?

(No response.)

I understand your starting position on this is that it is not a safety issue if it does fail.

MR. LINDGREN: Yes.

CHAIRMAN RAY: Okay. And so, it doesn't sound to me like we're disagreeing about that, are we, Sam?

MEMBER ARMIJO: Yes, I think it is. I think it is an extremely narrow interpretation of what is a safety issue. The GDCs require that we build things and test things so that they will perform in the environment that is likely to occur. And unless you can show that the alloy 625 can is either inspectible or has been demonstrated to be immune to failure, either by fatigue or by a weld defect or by stress corrosion cracking itself, then I

think you haven't done your job.

So, I think it is. It is a safety issue.

CHAIRMAN RAY: Okay. Is there anything about the safety issue aspect that you want to pursue further now, just so there's no --

MEMBER ARMIJO: No. I'm going to have to do some more, look it up and put my arguments together for you, but --

CHAIRMAN RAY: Well, no, I mean I think that the likelihood of a cracking failure certainly under these circumstances can't be excluded. The real question is, do we have any disagreement about the consequences when that happens? That's all. This is the last time we have a chance to pursue that. That's all I'm --

MEMBER ARMIJO: I did read the Curtiss-Wright report, and I think that they showed they had a lot of margin about the casing and everything else hanging together. And I think, Harold, you asked the question of, you know, if this thing comes to a screeching halt, will it torque the bolts off --

CHAIRMAN RAY: Right.

MEMBER ARMIJO: -- and the thing come apart that way? And those are just two things that we came up with.

But it just seems to me that this is the highest-energy moving component to have -- it should be -- just the fact that it doesn't leak in the event of this kind of an accident, to me, it's just not sufficient.

MR. CUMMINS: This is Ed Cummins.

We hear clearly that this open item is still open, and we will see if we can do better.

CHAIRMAN RAY: Well, I'm not asking for anything more, Ed. I mean I think you have answered all that you can. If you can provide Sam any material information, I would do that at the earliest opportunity.

MEMBER ARMIJO: Well, I've been an engineering manager long before I did this. And I'll tell you, I would never let a component that my company supplied be run without having tested the material in an environment that is reasonably likely to exist, particularly if I can never inspect the seal can. If I could inspect the seal can, I might cross my fingers and take a look every once in a while and say, "Yup, it's still hanging together."

But, otherwise, I think you're sailing into harm's way.

CHAIRMAN RAY: Okay, but you're right.

For now, it's open, and right now we'll get it translated into comments one way or another, in all likelihood, unless we resolve it ourselves.

All right. Well, with that, then --

MEMBER SHACK: Can I just ask for --

CHAIRMAN RAY: Yes, sure.

MEMBER SHACK: -- an interpretation from the staff of this final sentence?

When it says, "This material", are we referring to alloy 625 or to 18 Manganese 18 Chrome?

MR. LINDGREN: 18/18.

MEMBER SHACK: Well, this is the staff's SER, right?

MR. LINDGREN: Yes.

CHAIRMAN RAY: Well, they're going to come up next. But you can get an answer right behind you, Bill.

MR. HONCHARIK: Yes, this is John Honcharik from the staff.

Yes, that was my part. I basically was talking about the 18/18 material that was basically tested, like they were talking about, for retainer rings for steam turbine generators which are basically in oxygenated water and, also, in hydrogen environments.

And basically, they came up with that material in `85, and they basically replaced all of their -- I guess, before, it used to be 5 Chrome 18 Manganese alloy steel. They changed it to this 18/18 in `85. And so far, they have had no problems with stress corrosion cracking.

MEMBER SHACK: Okay. So, your address of stress corrosion environment is different than his?

MR. HONCHARIK: Right, but this is based on analysis for --

MEMBER ARMIJO: Well, you know --

MR. HONCHARIK: But it's similar.

MEMBER ARMIJO: Well, you know what's troubling is I asked for this, whatever test reports and information you had to demonstrate stress corrosion cracking resistance months and months ago, and all I get is, the only thing I actually got was what Michael Benson of our staff looked up. And we transferred that information to the staff, and it was very little. And I received nothing from the staff about the stress corrosion cracking data that you are relying on.

So, I would really appreciate your report or your data that says, hey, this environment that this stuff has been tested in is close enough to a

PWR coolant environment that maybe it is applicable. I don't know. I have never seen it.

MR. HONCHARIK: Right.

CHAIRMAN RAY: Yes, I thought you were relying upon the alloy 625 enclosure when I read that.

MR. HONCHARIK: Well, yes. I mean, well, this is just part of an excerpt. I mean I talked about the 625 earlier, that also 625 has better properties than alloy 600, okay, for stress corrosion cracking.

But, also, I think, you know, as Westinghouse has stated, the safety consequence for a LOCA or missile has been analyzed.

CHAIRMAN RAY: Yes, and that's why I asked the question. We are not quibbling about that, at least not to the point of saying the analysis is wrong. But I think the point is, is that a sufficient reason to not insist that we address the other issue, which is, well, we have good reason to believe it won't fail?

Now you can say, well, we also think it won't fail because it's enclosed in this enclosure. But, then, if you can never inspect it or not often enough inspect it anyway, that really doesn't do the

job, for the reasons that Sam said.

All right.

MR. HONCHARIK: I guess one other point is, actually, the pump itself doesn't see the full reactor temperature because basically it's cooling. So, it runs at a much lower temperature than reactor coolant water.

CHAIRMAN RAY: Is that a significant factor?

MEMBER ARMIJO: It could be. It could be. But, you know --

MR. HONCHARIK: Yes. I mean, typically, they try to keep it -- because, actually, I went down to Curtiss-Wright while they were doing a test for the pump, and you could actually touch the pump while it was pushing reactor coolant pressure and water temperature.

And the flywheel and everything is basically cool. So, the operating temperature --

CHAIRMAN RAY: Aren't there two flywheels?

MEMBER ARMIJO: There's two flywheels.

CHAIRMAN RAY: Aren't there two flywheels, Dale?

MEMBER ARMIJO: On each pump, there's a

bigger one --

MR. HONCHARIK: Yes.

MEMBER ARMIJO: -- on top and then the smaller one.

MR. HONCHARIK: That's correct.

MEMBER ARMIJO: But the cooling to the flywheel assembly, is that separate from the reactor coolant system? Is that a separate cooling --

MR. WISEMAN: It's cooling the motor, basically.

MEMBER ARMIJO: Totally separate?

MR. WISEMAN: It's a closed cooling -- it is reactor coolant, but it is in a closed system loop.

MEMBER ARMIJO: With its own cooling --

MR. WISEMAN: With its own coolant and external heat exchanger which dumps the heat to the component cooling water.

MEMBER ARMIJO: And the temperatures are real, real low? I would sure like to see that.

MR. WISEMAN: The temperatures of the cooling water are, I think, 150 max or somewhere in that range.

MEMBER ARMIJO: F?

MR. WISEMAN: F, yes.

MEMBER ARMIJO: So, you really do cool that. That's much cooler than what I thought you had. That wasn't clear in the Curtiss-Wright report.

MR. WISEMAN: Right.

CHAIRMAN RAY: Well, this is pretty close to the motor windings and everything, isn't it? I mean --

MR. LINDGREN: Yes, and you've got to keep those cool.

CHAIRMAN RAY: You've got to keep those cool.

MR. WISEMAN: Right. The flywheels are on both ends of the motor winding. The flywheel itself is at a higher temperature than that.

MEMBER ARMIJO: Sure. Yes.

MR. WISEMAN: It's in the 300 range, 300-degree F range is where it's operating.

MEMBER ARMIJO: And the water chemistry is intended to be the same as the water chemistry of the primary coolant?

MR. WISEMAN: Yes.

MEMBER ARMIJO: So, 300 is still --

CHAIRMAN RAY: Yes.

MEMBER ARMIJO: 150 would be a lot better.

(Laughter.)

CHAIRMAN RAY: You can't get it to 150.

MEMBER ARMIJO: I just really would like to see the staff's data, whatever data you've got.

CHAIRMAN RAY: Yes, well, it's a way to avoid having to deal with a comment.

(Laughter.)

So, it should be motivating to want to do that.

MR. LINDGREN: I do have some information to provide you.

MEMBER ARMIJO: Well, I would be happy to receive it.

MR. LINDGREN: I have a little more information on the details of the testing. I can pass that along. And I'll also make sure that the staff knows what we're telling them.

(Laughter.)

CHAIRMAN RAY: All right. We'll certainly take that into account, but I don't want to hold things up while we read it.

Is there anything more that you have to say?

MR. LINDGREN: I'm done.

CHAIRMAN RAY: Okay. Are there any more

questions for Westinghouse?

We still have the staff to go, and then we have got an important additional open item that we would like to get to today because God knows we can't afford to carry things over.

MR. LINDGREN: Okay, but when will we discuss when we are going to talk about 55?

CHAIRMAN RAY: Well, you said tomorrow morning, and I agreed with you. Let's hope that we can do it then.

MR. LINDGREN: Well, we'll show up first thing tomorrow morning.

MEMBER ABDEL-KHALIK: Five o'clock?

(Laughter.)

MR. LINDGREN: Whatever time you want. Before you kick everybody out for the AIA stuff, we will try to sneak it in there.

CHAIRMAN RAY: Yes, well, actually, let's see, aren't we starting off with --

MS. McKENNA: We were going to start with the AIA. Because of the security aspect --

CHAIRMAN RAY: Yes.

MS. McKENNA: -- we thought it would be better to do that at the beginning, so we could get --

CHAIRMAN RAY: Does that make sense to you, Eileen, to do 55 before we secure things for AIA? Is that possible?

MS. McKENNA: That's fine. I think, you know, we just --

CHAIRMAN RAY: Is Charlie coming in the morning?

MR. WANG: Yes.

MS. McKENNA: Okay.

CHAIRMAN RAY: All right. We've got to cross things off the list here.

MR. LINDGREN: I know, and my support is staying here for the night, but they won't stay here through Friday.

(Laughter.)

CHAIRMAN RAY: Yes. I understand.

Well, we've got a very busy day tomorrow. So, with that in mind, can we proceed on, then, to the staff's closure of Chapter 3?

MS. McKENNA: Sure. Let's start coming up.

CHAIRMAN RAY: I foresee that we will go until 5:50 at this point anyway. Make sure I read the clock right. Yes.

And I guess let me say one other thing to

my colleagues. After this is done, I want to go off the record and, before you scatter, discuss -- we can't afford to wait until Friday to try and make sure we identify any open items.

I am thinking particularly now of the first part of today's discussion. So, we need to have a few minutes on that subject, but it doesn't need to be on the record. Everything that we have talked about is on the record already.

But because it could involve proprietary discussion, we will make it after we can close the room, off the record, and just make sure we've got any open items nailed down.

Okay, let's go.

MS. CLARK: Okay. For this section of the ACRS meeting, we are going to discuss three items for the balance of Chapter 3: the 3.9.1, which is special topics for mechanical components; 3.12, piping design, and Appendix I.

For the first two, the project engineers, well, the project engineer, me, Phyllis Clark, and the technical people will be Robert Hsu and John Wu. They are going to discuss 3.9.1.

CHAIRMAN RAY: Okay. In the context of 3.9.1, would you say anything more that you want to

say about the issue we just discussed, which is the flywheel?

MR. WU: No, actually, because we just heard the Westinghouse presentation.

3.9.1, we will try to discuss these WESTEMS computer codes.

CHAIRMAN RAY: Well, now you guys did some review of this subject, didn't you, that we talked about, the flywheel and all of that?

MR. WU: Not the flywheel.

CHAIRMAN RAY: Huh?

MR. WU: We did not review the flywheel.

MS. McKENNA: It's a different section.

MR. WU: That's a different section.

CHAIRMAN RAY: All right. That's why I asked, is it in 3.9.1? The answer is no.

MS. McKENNA: No.

MR. SISK: Mr. Ray, it's in Chapter 5, actually.

MS. McKENNA: Yes.

CHAIRMAN RAY: Okay.

MS. McKENNA: But if you want any --

CHAIRMAN RAY: Yes, you're right. I'm sorry. I forgot.

MS. McKENNA: -- any discussion from the

staff about what they did, just let us know and we'll schedule that, but it's not --

CHAIRMAN RAY: All right. No, I forgot that it was stuck on Chapter 3 when Westinghouse did it, for matters, reasons of convenience. Okay, I apologize.

Go ahead.

MR. WU: Well, I'm going to present Section 3.9.1. It is related to WESTEMS computer codes.

CHAIRMAN RAY: Good. It's on my list to ask you about.

MR. CUMMINS: This is Ed Cummins.

This isn't part of the review scope.

CHAIRMAN RAY: Why?

MR. CUMMINS: Because we went through it. I mean I don't know why we're talking about it. It doesn't make any sense whatsoever.

CHAIRMAN RAY: All right. We're talking about it, Ed, because I would like to know why you went through it.

(Laughter.)

MR. CUMMINS: Okay.

CHAIRMAN RAY: And since ultimately it will have to be addressed, I think it is reasonable

for the Subcommittee to understand how it will be done later and, as part of that, to understand what we are about to be told.

So, proceed.

MR. WU: For WESTEMS computer codes, five items were identified, five open items was identified addressing concerns. There was quality assurance, methodology used in the WESTEMS code.

As the staff completes the audit and identified the continuing concerns with the quality assurance and the methodology resulting in two remaining open items. Three open items were closed. The staff documented the audit results in the WESTEMS audit summary reports.

Recently, we received a letter by date of September 29th that Westinghouse determined to remove WESTEMS from the DCD markup because it was identified during the review of the Revision 17. That put the WESTEMS in the markup Table 3.9-15.

Now, on the basis that Westinghouse will show that the current version of WESTEMS for AP1000 design analysis, we, the staff, closed all open items because all open items are not assessed anymore. It's closed. So, no more review.

Any questions?

MR. CUMMINS: So, just to put in context -- Ed Cummins again -- we were trying to close the piping DAC. So, we were working on all piping things. This is a small element of all piping things. It is how we do fatigue analysis.

Once we decided between us and the staff that we were not going to close the piping DAC, that is, we didn't have sufficient completion levels of all of our analysis, then this was not important to us in the current schedule to have our fatigue code approved or not approved because that's a futures action now.

CHAIRMAN RAY: Okay. Thank you.

MR. WU: Okay. 3.12 now, piping design.

By letters dated April 1st, 2010 and August 23rd, 2010, the applicant stated that Westinghouse would not remove the piping DAC and provide a DAC and ITAAC closure process.

On the basis that the piping DAC was approved in Revision 15 and additional clarification being provided with the DAC and ITAAC closure process, the staff finds this is acceptable.

So, probably you don't have a problem with this?

CHAIRMAN RAY: No, I don't.

MR. WU: Okay. The next topic is talking about hard rock high frequency ground motion response spectra exceedance seismic input.

Seismic input was identified in Section 3.7.3 as inadequate due to a mathematical model error. So, on that basis, Westinghouse revised TR-115, "Effects of High Frequency Seismic Content on SSCs", with adequate seismic input.

So, staff reviewed the TR-115 and staff identified the applicant's screening criteria selection for the piping package did not address the response spectra exceedance because, for the mechanical components, the response spectra, which is the input for all the mechanical components and piping design analysis and the qualification. And Westinghouse's screening criteria was based on ground motion high frequency response spectra exceedance.

So, by letter dated August 17th, 2010, the applicant revised the DCD Appendix 3I to evaluate a hard rock high frequency ground motion response spectra for all the ASME Class 1, 2, and 3 piping systems instead of a two-sample. So, previously, they only used two-sample. Now they put back 100 percent. They are to address 100 percent as their screen criteria.

So, on this basis, the staff finds this is acceptable. It will address the GDC2 concern.

CHAIRMAN RAY: Okay. I would think so, yes.

(Laughter.)

MS. CLARK: Okay. Next, Pei-Ying Chen is going to speak to the seismic and dynamic qualifications of mechanical and electrical equipment.

MR. CHEN: Okay. Basically, for the seismic and dynamic qualification of equipment, we looked at the major changes from Revision 15 to the Revision 17.

The changes, basically, they decided not to use the experience-based approach. Originally, they thought they wanted to use the experience-based approach to qualify all the AP1000 mechanical and electrical equipment. So, they take that one off.

The other significant issue is talking about the high frequency exceedance, the spectra exceedance. So, we had to address that.

Next slide.

So, the only one significant issue is the qualification for mechanical and electrical equipment which the spectra indicates exceeds the CSDRS. That

is the certified seismic design response spectra.

The hard rock high frequency issue is -- I mean the spectra indicates that that exceeds the CSDRS quite a bit. So, from the ground motion, it generates up to the floor response spectra. They have exceedance also. So, they have to qualify the equipment for those exceedance spectra.

Now, basically, we used SRP Section 3.10, ISG-1, SECY Paper 93-087, to address these issues.

CHAIRMAN RAY: I didn't follow that last thing you said because I was trying to figure out what happened to the screen.

MR. CHEN: Yes. Okay. All right.

Initially, Westinghouse submitted a topical report, TR-115, addressing the high frequency issues. So, we generated quite a bit of RAI, and then that is under the review of Topical Report 115. All right.

CHAIRMAN RAY: Just leave it alone.

(Laughter.)

Yes, it's getting too hard to follow what you're doing and what he's saying. It's becoming impossible.

MR. CHEN: I will wait.

MEMBER SHACK: I think you're out of

luck. Don't try to do anything at this point. Just get to the right slide.

CHAIRMAN RAY: Just leave it there.

MEMBER SHACK: Leave it there. Don't touch it.

(Laughter.)

MR. CHEN: All right. Then, I have to look at my slide instead of looking at the screen.

Okay. Anyway, the RAI that we asked under the review of TR-115 is directly applicable to the DCD Appendix 3I which addressed the same high frequency issues. So, all the response that we reviewed for TR-115 is applicable to the review of DCD Appendix 3I.

Now when we looked at the Westinghouse response to all those RAIs, there is one significant RAI issue which, based on Westinghouse's submittal, for those equipment subject to high frequency exceedance spectra, they only do the screening test, which is doing one SSE response spectra, achieving the response spectra, while, according to the regulation and the guidance that we have for seismic qualification of equipment, it is supposed to be qualified for five OBEs and one SSE.

Now screening test is one SSE. They did

not perform the five OBE for the hard rock high frequency spectra. So, we raised that issue through the RAI and discussed with Westinghouse how to resolve it.

Later on, they came back saying, since all the equipment is going to be qualified for the CSDRS spectra, that means they already have some testing done for those standard spectra. They can use that one to account for the five OBEs.

Well, the question will be -- I mean in our question we asked Westinghouse to demonstrate and through the calculation that the testing done using CSDRS spectra can be shown to be equivalent or greater than the five OBEs using the hard rock high frequency exceedance spectra.

So, Westinghouse did go back, and then they provide the calculation and demonstrate, yes, it's equivalent or greater than five OBE for the hard rock high frequency. So, this issue, at that time, it was resolved.

However, recently -- well, recently means they submit the TR-115, Revision 2, which calls all the spectra changes for the equipment. So, we said, well, by looking at the spectra, I will show you in an example that the issue becomes not only for high

frequency area, but the increase is in the mid and low frequency.

Well, that impacted the CSDRS testing because that exceeded the original CSDRS response spectra. So, we raised that issue, and then, of course, our regulatory basis is GDC2, SECY Paper 93-087, and the Interim Staff Guidance 1.

The Westinghouse response to that RAI, basically, they indicate that in the Appendix 3I of DCD Revision 17 they categorized all the AP1000 equipment into two categories. One is potential high frequency sensitivity equipment. The other table is not sensitive to high frequency equipment.

Well, for the Category 1 equipment, they already have a program for hard rock high frequency screening tests. But for the Category 2 equipment, which initially was qualified for CSDRS spectra, but not addressed in the high frequency program, and in that situation it was not clear how Westinghouse is going to qualify for the Category 2 equipment, which is the equipment not sensitive to the hard rock high frequency spectra.

So, in the ISG, there is an item which clearly stated that in the evaluation of all the components other than high frequency sensitive

equipment, for those cases where the ground motion response spectra-based in structural response spectra exceeds the standard in structural response spectra below 50 hertz, then the structural integrity and functionality evaluations are required.

So, they have to go back to going through all their qualification data or records to see which equipment needs to be further evaluated. This is through one of the RAIs, EMB-11.

At this point, Westinghouse agrees that they are going to go back and then look at all the equipment qualification data and then to see whether all the equipment is properly qualified.

Now I am going to give you the next slide. That is an example of the floor spectra exceedance. If you look at it, the dotted line is the floor spectra for equipment generated through the hard rock high frequency ground spectra. And if you look at it, the exceedance for this spectra is not in the high frequency area. It is in the mid frequency and low frequency, which will affect the equipment.

So, they have to go back and then to see each equipment location's required response spectra and their qualification data, and then to see if the qualification is properly done.

So, in conclusion, the changes from Revision 17 of TR-115, Revision 2, are acceptable, subject to two confirmatory items. Confirmatory Item 10, which is they have this calculation to demonstrate that the CSDRS qualification can be counted as equal or greater than five OBEs for the hard rock high frequency. So, they have to put that information into the DCD Appendix 3I. That is one of their agreements.

The second agreement is to resolve this RAI 11. What they are going to do is they go back to revise the response to the RAI 11, revise the Appendix 3I, to account for the increase or revised response spectra as a result of TR-115, Revision 2.

So, that's it.

CHAIRMAN RAY: Okay.

MR. CHEN: I think they already are going to do that.

CHAIRMAN RAY: Well, lots of things to do still, huh?

MR. CHEN: I don't know how far they have qualified all the equipment, and the other thing is the original qualification may be still good.

CHAIRMAN RAY: Yes.

MR. CHEN: So, it is depending on how the

results come out.

CHAIRMAN RAY: I understand.

Okay. Any questions?

MEMBER SHACK: I sort of hesitate to ask, but I am going to do it anyway.

If I go back to 14, slide 14, the floor motion is now higher, as you note, down in the low frequencies, too. You get an exceedance. Is that low frequency exceedance, you didn't get that before they added the high frequency part to the ground motion?

MR. CHEN: Yes, if you look at it, the black line is the CSDRS RRS for the equipment.

MEMBER SHACK: Right.

MR. CHEN: Okay. Now, as a result of high frequency ground motion, the spectra changed for that particular location. So, the original qualification to the black line is not good anymore because --

CHAIRMAN RAY: Yes. But I understand it is kind of amazing that the high frequency ground motion would result in the change that you see there, is the point.

MR. CHEN: Well, it goes through the filtering effect of the structural --

CHAIRMAN RAY: I understand, but it is still kind of amazing.

(Laughter.)

MR. CHEN: Sure.

MEMBER SHACK: Okay, your reaction is like mine.

CHAIRMAN RAY: Yes, yes. I've looked at that stuff a lot, and it's kind of amazing.

MEMBER SHACK: Okay.

CHAIRMAN RAY: But, anyway, all right now, Sanjoy, we're going to try to resolve one of your issues. I'm glad you're here.

Well, I've first got to make sure everybody is satisfied with these guys, but it is the coding one. It is the last item on our agenda.

MS. McKENNA: Well, okay, I think that was a placeholder. What I thought we had left on the general category of coding was this issue about wetting and whether the distribution and the --

CHAIRMAN RAY: There were two items. That was one of them, you're correct.

MS. McKENNA: And this was a placeholder that, if there were questions about that, but I don't know that there has been sufficient time to get the WCAPS to you to see if there were any questions. So,

I don't think we have anything prepared to discuss on that.

And what was the other one remaining?

CHAIRMAN RAY: The other one is Professor Banerjee's point here about the coding analysis, the micrographs. I thought this --

MS. McKENNA: Okay. We provided the references to Weidong.

MR. WANG: No, I haven't seen those.

MS. McKENNA: I don't know if they have been --

MR. WANG: We haven't seen them. At least I'm sure you have, but we haven't seen them.

CHAIRMAN RAY: This was something that --

MS. McKENNA: Micrographs?

CHAIRMAN RAY: -- Westinghouse was going to give us. It said, "Tim of Westinghouse will send the reference."

MS. McKENNA: I forwarded the references to your staff.

CHAIRMAN RAY: Okay.

MS. McKENNA: There were two reports that NRC had prepared, and I found them in ADAMS and --

CHAIRMAN RAY: You haven't seen them?

MR. WANG: No. There are three -- okay,

I don't recall three of them.

CHAIRMAN RAY: All right, stop it.

(Laughter.)

MS. McKENNA: Okay.

CHAIRMAN RAY: When we're done, you two guys talk and get him what he needs. All right?

MS. McKENNA: Okay.

CHAIRMAN RAY: Because I don't want to fool with this anymore.

And as far as the wetting is concerned, you're saying --

MS. McKENNA: My understanding was that there were a couple of WCAPS from like AP600 time that some of the Committee members had requested, and we had asked those of Westinghouse. With everything else going on, I haven't had a chance to find out whether they have been delivered to us and/or to --

CHAIRMAN RAY: You've been busy?

MS. McKENNA: Okay, they've been delivered to us.

Weidong, have you received them?

MR. WANG: That particular WCAPS things, I think Bill, he requested, and I sent out last Friday by FedEx.

MS. McKENNA: Okay. Okay.

MR. WANG: And I don't know if any of the members --

CHAIRMAN RAY: All right, listen. This sounds like staff needs to continue to working. We're not going to do 50, is what it turns out to be.

MS. McKENNA: Right. Yes.

MEMBER RYAN: Weidong, you sent it out as a DVD?

MR. WANG: Yes. Not a DVD; a CD, basically.

MEMBER RYAN: A CD, yes. Yes. That's all right. Close enough.

(Laughter.)

MEMBER SHACK: Westinghouse was going to come back with some work on the surface tension, too though, right?

MEMBER ARMIJO: That was new.

CHAIRMAN RAY: I've got lots of CDs.

(Laughter.)

Listen, let's end this, so we can get off the record here and do one other thing, and then call it a day.

Anything more for these folks here?

(No response.)

Thank you.

All right, Eileen, aside from this little confusion here about 50, is there anything else you want to tell us today?

MS. McKENNA: No.

CHAIRMAN RAY: All right. Except be here on time in the morning?

How about Westinghouse? Ed, do you have anything more you want to say?

MR. CUMMINS: No, thanks.

CHAIRMAN RAY: Okay. All right.

We will start tomorrow in open session to -- I'm so confused now, I can't remember -- to do something. Squib valves with Charlie. Charlie will not be here until just 8:30, I'll bet you. So, we will try to get that out of the way.

Then, we will do AIA, and then we will give the day to Sanjoy.

MEMBER BANERJEE: I'm sorry?

CHAIRMAN RAY: I said we will do AIA and then we'll give the day to you.

MEMBER BANERJEE: Why?

CHAIRMAN RAY: Because GSI-191.

MEMBER BANERJEE: All right. Fine.

MS. McKENNA: And some of the Chapter 15 LOCA issues --

MR. SISK: Mr. Chairman, just one quick point, if I may, sir?

CHAIRMAN RAY: Yes, Rob, go ahead.

MR. SISK: I just wanted to check. With the action items that were addressed during the shield building meeting, did they close out the action items for --

CHAIRMAN RAY: We're going to talk about that.

MR. SISK: Okay. I was just wondering.

CHAIRMAN RAY: But I am not going to attempt to resolve here now. That is a longer discussion, and I don't have everybody here because we had two meetings going on simultaneously today. People were going back and forth.

And I know we would all like the answer to that question, but right now I am just going to try to make sure we understand what the state of play is and what we need to do. Then, I'm going to quit.

MR. SISK: Thank you.

CHAIRMAN RAY: But we will give you that answer as soon as we can have it.

Well, with that, we are going to recess for the day and resume at 8:30 in the morning. I will ask the members to stay just a moment, so we can

make sure our head is clear about the question Rob asked, and then we'll go do something else for the rest of the evening.

With that, we're done.

(Whereupon, at 5:17 p.m., the proceedings in the above-entitled matter were recessed for the day, to reconvene the following day, Thursday, November 19, 2010, at 8:30 a.m.)

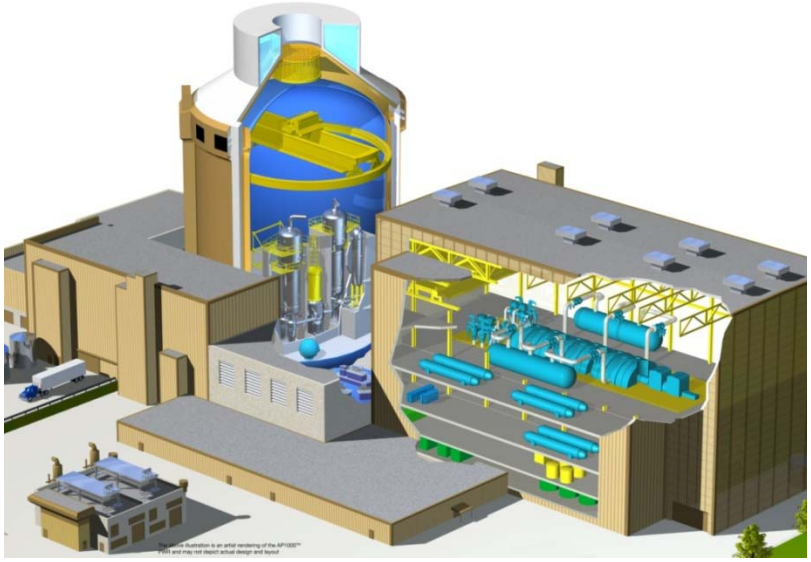
AP1000 Shield Building

Advisory Committee on Reactor Safeguards

November 17, 2010

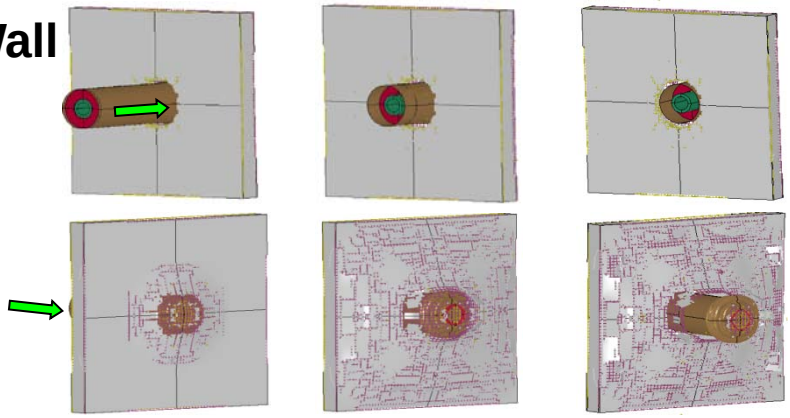
AP1000 Shield Building

- Shields the containment vessel and systems within the containment from external events during normal operations, such as tornados and tornado-driven objects
- Supports the passive containment cooling water storage tank (PCSWST)
- Provides for natural air circulation cooling of the containment vessel
- Provides an additional radiological barrier for radioactive systems and components inside the containment vessel

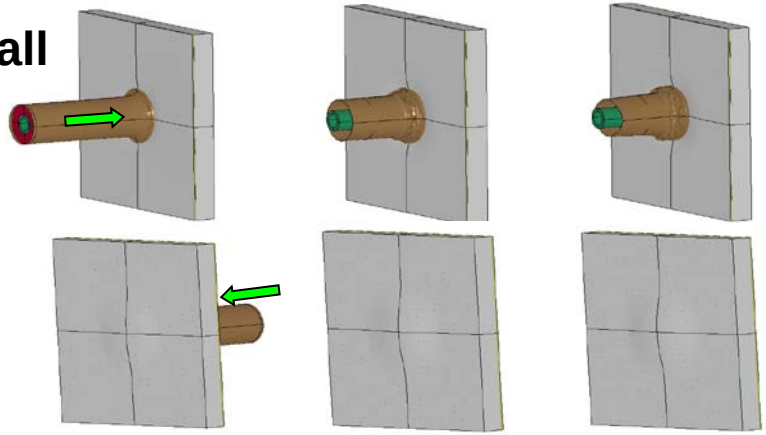


SC Construction Provides Superior Performance against Missiles

RC Wall



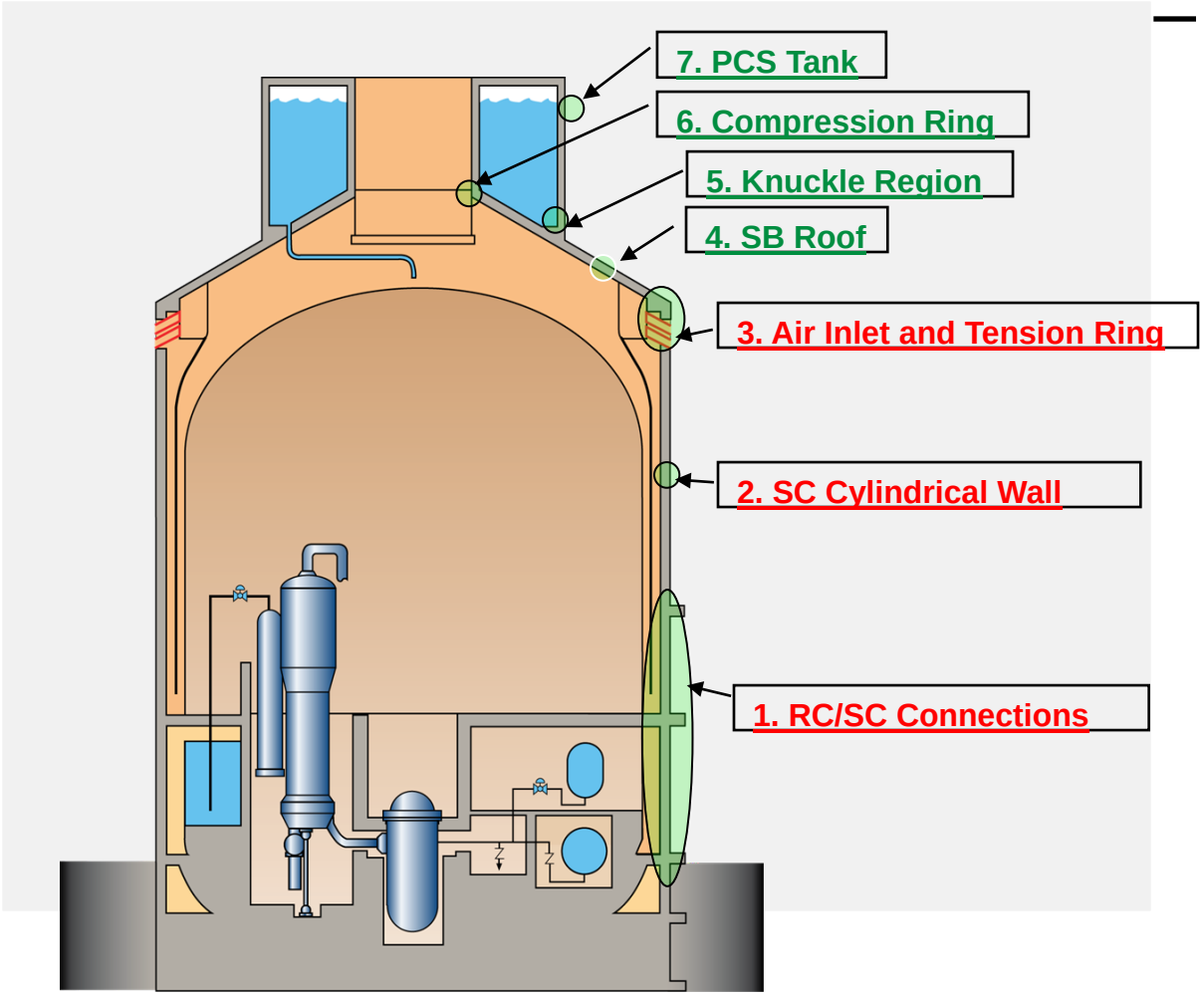
SC Wall



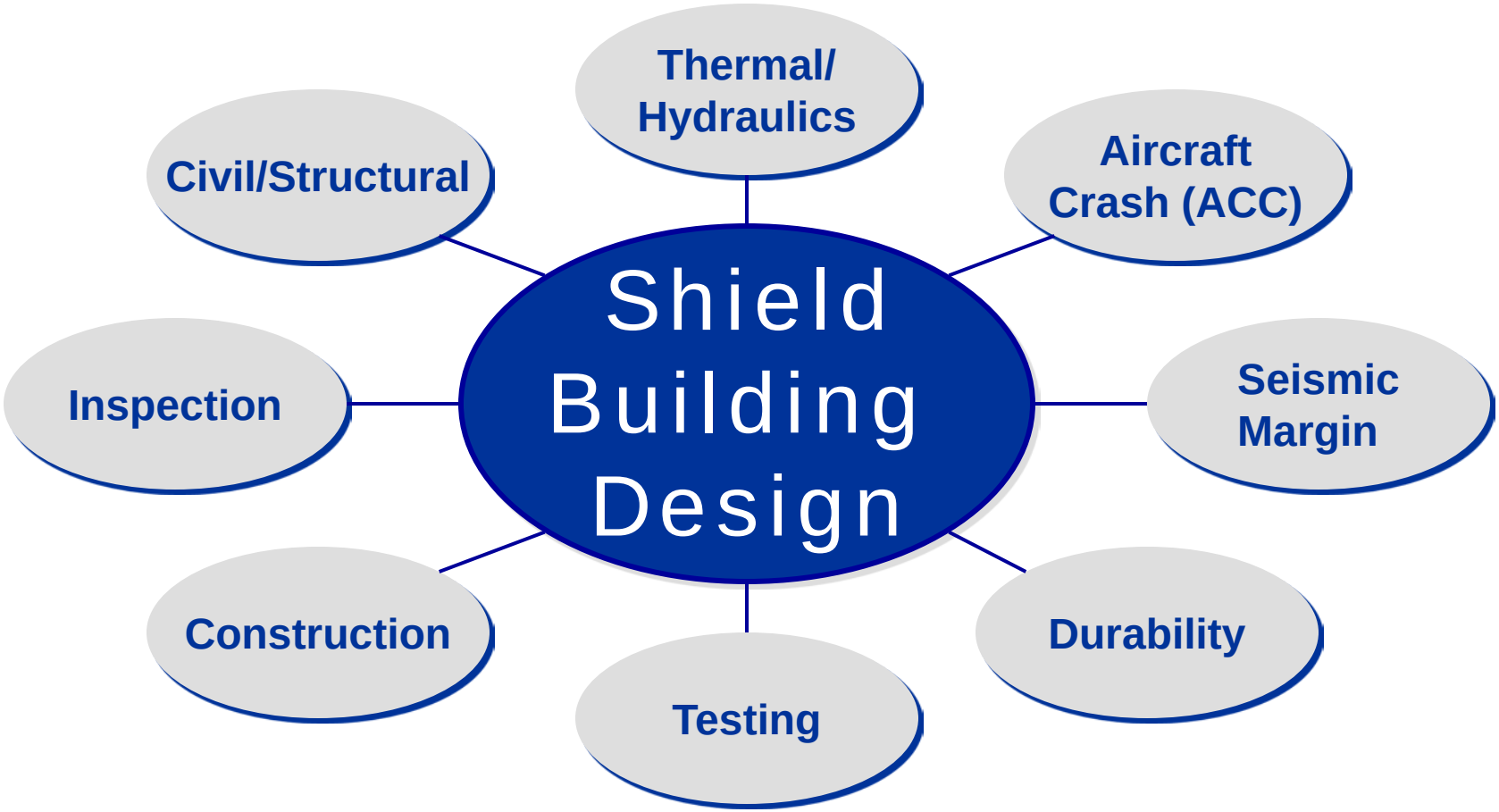
(5msec) (10msec) (15msec)

Shield Building Design Features

- Revised the air inlet/ tension ring design for constructability and strength
- Reinforced cylindrical wall with tie bars between steel plates
- Increased SC plate thickness to improve strength and ductility
- RC/SC connection redesigned to improve ductility



Integrated Design Process



AP1000 Shield Building Design – All Open Issues Resolved

- The SC was adopted for the Shield Building because of its superior performance in resisting aircraft crash
- The adequacy of the Shield Building to meet regulatory requirements with large margin has been demonstrated through testing and benchmarked nonlinear analyses
- Design has undergone substantial improvements. Features have been implemented into the Shield Building design that increase the safety margin and make the SC Shield Building act more as a unit
- The design changes have been implemented through an integrated design approach that has considered all aspects of design, including durability, construction, and safety
- The out-of-plane shear capacity is much larger than the force demands in all regions of the Shield Building
- Pushover analyses demonstrate that the Shield Building has large margin and can withstand SSE and beyond RLE level earthquakes and system failure occurs by ductile membrane action and not by out-of-plane shear brittle failure.

AP1000 Design Control Document Amended Design

Section 3.7

Seismic Design

Westinghouse

Section 3.7 Overview

- 3.7.1 Seismic Input
  - Design Response Spectra
  - Supporting media
- 3.7.2 Seismic System Analysis (Structures)
  - Seismic analysis methods
  - Soil-Structure interaction
  - Floor response spectra
  - Combination of modal responses
  - Seismic interactions

Section 3.7 Overview

- 3.7.3 Seismic Subsystem Analysis (Mechanical Systems and Components)
  - Seismic analysis methods
  - Combination of modal responses
  - Analytical procedure for piping
- 3.7.4 Seismic Instrumentation – No Changes
- Combined License Information
  - Timing clarification

Section 3.7 Changes

- Extension of hard-rock sites to soil sites
- Utilization of 3D finite element shell models
- Effect of High Frequency Ground Motion
- Use of the coherency function
- Classification of adjacent buildings

Open Items

- 15 Open Items in 3.7 SER
  - These open items are a result of NRC staff questions about changes to the DCD
  - Most of the questions are due to the addition of soil cases
- These open items have all been resolved

3.7 Open Items

- OI-SRP3.7.1-SEB1-19 – Justify the concrete cracking and damping value used in the analysis
- OI-TR03-005 – Justify 0.8 stiffness reduction factor for concrete cracking used for the SB analysis
- Resolution:
  - Additional nonlinear time history analysis supported the original analysis assumptions

3.7 Open Items

- OI-TR03-032 – Description of the proposed method using more detailed NI05 model to evaluate flexible regions.
- OI-SRP3.7.1-SEB1-06 – NI20 model for flexible regions up to 50 Hz
- Resolution:
  - The NI05 model has been reviewed for flexible regions where the out-of-plane response is considered flexible
  - The FRS for all “flexible nodes” is included in the design floor response spectra document as a separate table for area-specific spectra for use in local analyses.

3.7 Open Items

- OI-SRP3.7.1-SEB1-17 – Justify the treatment of missing mass in mode superposition
- Resolution:
  - The superposition time history analysis provides sufficient solution accuracy because the modes, which respond beyond cutoff frequency, have no significant contribution to the in-structure amplified response spectra.
  - A time history analysis at cutoff frequency was compared to an identical time history analysis with significantly more modes and the results were comparable.

3.7 Open Items

- OI-SRP3.7.1-SEB1-15 – Include methodology for structure-soil-structure interaction analyses of buildings adjacent to the NI
- Resolution:
  - Methodology included in the DCD
  - The seismic analysis performed for the adjacent Seismic Category II structures is a simulated 3D analysis.
  - Seismic Category II buildings are designed using envelope foundation input response spectra

3.7 Open Items

- OI-TR03-007 – Changes in the Shield Building dimensions required WEC to update sloshing analysis of the PCS tank
- Resolution:
  - NRC Audited WEC calculations and agreed with the conclusions

Questions?

AP1000 Design Control Document Amended Design

Section 3.8

Design of Category I Structures

Westinghouse

Section 3.8 Overview

- Steel Containment
- Concrete and Steel Internal Structures
- Other Category I Structures
- Foundations

Section 3.8 Changes from DCD Rev. 15

- Enhanced Shield Building
  - Discussed separately
- Extended the AP1000 structure design to sites ranging from soft soils to hard rock
- Critical Section Design Updated
  - Soil cases
  - Design finalization
- Settlement evaluation during construction
  - Include construction sequence limits

Section 3.8 Open Items

- Items have been resolved with the NRC and the DCD changes included in the DCD Revision 18
  - 20 Open Items have been identified in SER for DCD Chapter 3.8
  - 1 additional RAI
  - 2 placeholder items for NRC action

Section 3.8.2 – Steel Containment Open Items

- OI-RAI-TR09-08 – Provide details regarding temperature and external pressure loads of containment
- RAI-SRP3.8.2-SPCV-01 – Explain assumptions used in evaluation to determine containment external pressure
- Resolution:
  - Met with NRC to explain analysis
  - Provided analysis for audit
  - Design change to include vacuum relief system
  - Load combination table in the DCD is updated

Section 3.8.3 – Concrete and Steel Internal Structures Open Items

- OI-SRP3.8.3-SEB1-04 – Describe how the loads from the module can be properly transferred from the module to the embedded bars in the base concrete
- Resolution:
  - Design change has been made to use mechanical connectors

Section 3.8.4 – Other Category I Structures Open Items

- OI-TR85-SEB1-27 – Explain and justify the AP1000 implementation of 100/40/40 method for combination of the three direction seismic loading
- Resolution:
  - Provided a comparison of the calculated reinforcement demand with the 100/40/40 combination technique to the ASCE 4-98 100/40/40 combination technique
  - Westinghouse design deemed acceptable

Section 3.8.5 – Basemat Open Items

- OI-TR85-SEB1-10 – Request to make TR-09, TR-57, and TR-85 Tier 2* or provide acceptable alternative
- Resolution:
  - Information has been added to TR-09, TR-85, and TR-115 and is included in DCD Rev. 18
  - TR-57 was withdrawn because the information is included in DCD Section 3.8 and appendices

Section 3.8.5 – Basemat Open Items

- OI-TR85-SEB1-32 – Justify the assumption of uniform soil spring beneath the basemat
- Resolution:
  - Comparison of the maximum reactions of the Nuclear Island for various soil and analysis methods was completed
  - Comparison between equivalent static and dynamic time history analyses was completed
  - Both linear and nonlinear models compared
  - Comparison demonstrates that the assumption is acceptable

Questions?

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

Advanced Final SER
Section 3.7 – Seismic Design

Westinghouse AP1000 Design Certification Amendment Application Review

November 17, 2010

Overview

- Staff summarized its safety evaluation for DCD Section 3.7 at ACRS Subcommittee Meeting on July 21-22, 2010.

- At that time, seven Open Items needed resolution and there were eleven confirmatory items.

- All Open Items are now either resolved or confirmatory pending formal submittal of DCD and TR revisions.

Phase 4 Status of 3.7

SRP Section/Application Section		July 21, 2010 Status Phase 2	November 17, 2010 Status Phase 4
3.7.1	Seismic Design Parameters	1 Open Item 2 Confirmatory Items	1 Confirmatory Item
3.7.2	Seismic System Analysis	6 Open Items 8 Confirmatory Items	12 Confirmatory Items
3.7.3	Seismic Subsystem Analysis	1 Confirmatory Item	---------

Staff Review Team

- Technical Staff
  - Brian Thomas, Chief, SEB1
  - Pravin Patel, Structural Engineer
  - Bret Tegeler, Sr. Structural Engineer
- Project Management
  - Billy Gleaves, Sr. Project Manager
- Contractor Support
  - Brookhaven National Laboratory
    (C. Costantino, R. Morante)

Section 3.7.1 – Seismic Design Parameters

OI-SRP3.7.1-SEB1-19 (now Resolved)

- Justification for concrete modulus reduction to 80%
- Justification for damping values used in the building seismic analyses
  - Shield Building SC Walls - 5%
  - Reinforced Concrete structures - 7%.

    [80% reduction in concrete modulus issue is also addressed in the OI-SRP3.8.3-SEB1-03 resolution; resolution also closes OI-TR03-05]

Section 3.7.2 – Seismic System Analysis

OI-TR03-032 (now Confirmatory)

- Demonstration that additional local amplification in flexible regions (walls, floors, roof) is adequately considered in developing ISRS for the ground motion up to 33 Hz.

OI-SRP3.7.1-SEB1-06 (now Confirmatory)

- Demonstration that additional local amplification in flexible regions (walls, floors, roof) is adequately considered in developing ISRS for the HRHF ground motion up to 50 Hz.

Section 3.7.2 – Seismic System Analysis

OI-SPR 3.7.1-SEB1-15 (now confirmatory)

- Applicant changed classification of Turbine Building (TB). TB first bay is now Seismic Cat II and rest of the TB is Non Safety.
- Applicant addressed the effect of the non seismic portion of the TB on the Cat II section of the TB.
- Applicant addressed structure-soil-structure interaction between the NI and adjacent Seismic Category II building structures.

Section 3.7.2 – Seismic System Analysis

OI-TR03-001 (now confirmatory)

- Applicant will include the dynamic modeling details for the enhanced shield building design in TR-03.

OI-SRP3.7.1-SEB1-17 (now resolved)

- Applicant provided details on how residual rigid response (i.e., missing mass) is addressed. The staff accepted the applicant justification.

Conclusion

- All open items in Section 3.7 are resolved or confirmatory pending formal DCD or TR revisions.

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

Advanced Final SER
Section 3.8 – Design of Category I Structures

Westinghouse AP1000 Design Certification Amendment Application Review

November 17, 2010

Overview

- All Open Items are now Resolved or Confirmatory pending DCD/TR revision
- Remaining slides highlight resolution of Some Key Open Items that are currently identified as Confirmatory
- This presentation excludes discussion of Shield Building
- Next slide presents the current status of the review of SRP Section 3.8

Phase 4 Status of 3.8 (Rev. 17)

SRP Section/Application Section		July 21, 2010 Status	November 17, 2010 Status
3.8.1	Concrete Containment	Not Applicable	Not Applicable
3.8.2	Steel Containment	4 Open Items 2 Confirmatory Items	6 Confirmatory Items
3.8.3	Concrete & Steel Internal Structures of Containment	4 Open Items 2 Confirmatory Items	5 Confirmatory Items
3.8.4	Other Seismic Category I Structures (excluding SB review)	1 Open Item	1 Confirmatory Item
3.8.5	Foundations	8 Open Items 2 Confirmatory Items	9 Confirmatory Items
3.8.6	Combined License Information	2 Open Items	2 Confirmatory Items

Staff Review Team

- Technical Staff
  - Brian Thomas, Chief, SEB1
  - John Ma, Sr. Structural Engineer
- Project Management
  - Billy Gleaves, Sr. Project Manager
  - Terri Spicher, Project Manager
- Contractor Support
  - Brookhaven National Laboratory
    (J. Braverman, C. Costantino, & X. Wei)

Section 3.8.2 – Steel Containment

- CI-SRP3.8.2-SEB1-02

  Issue(s)

  o Applicant was requested to explain whether the design, construction, and inspection of the plant are in accordance with current regulatory guides

  Resolution

  o Information provided to demonstrate that design and construction of containment is in accordance with RG 1.57 Rev. 1 for load combinations and design limits, RG 1.7 Rev. 3 for hydrogen generated pressure loads, and RG 1.199 Rev. 0 for anchorage

  o For inspection of other plant structures, the DCD will be revised to indicate that the COL applicant is responsible for establishing a structures inspection program consistent with the Maintenance Rule 10CFR50.65 and RG 1.160.

Section 3.8.2 – Steel Containment

- CI-SRP3.8.2-SEB1-04

  Issue(s)

  o Additional information needed to describe the 3-D finite element model of containment used for local evaluation near penetrations and axisymmetric model used for analysis away from penetrations

  Resolution

  o Information provided to describe both models with specific reference to TR-09 for more detailed information

  o DCD markups provided to incorporate the additional descriptions presented in the RAI response.

Section 3.8.3 – Concrete and Steel Internal Structures of Containment

- CI-SRP3.8.3-SEB1-04

  Issue(s)

  o Connection detail of containment internal structures using concrete-filled steel modules does not rely on a direct load path from module steel faceplates to reinforced concrete base

  Resolution

  o Revised connection detail to utilize a direct load path from steel face plates to reinforced concrete base

  o Revised detail utilizes steel dowels which at one end are welded to face plates using mechanical connectors and at other end embedded in reinforced concrete base.

Section 3.8.4 – Other Seismic Category I Structures

- CI-SRP3.8.4-SEB1-03

  Issue(s)

  o Revisions made in DCD Rev. 16 regarding “critical sections” - e.g., number of critical sections reduced, incomplete information, removal of some Tier 2* information

  Resolution

  o Markups for additional critical sections provided to be consistent with the certified design in DCD Rev. 15

  o Markups for tabulated results that were removed from DCD Rev. 15 were provided – e.g., load combinations & member forces for critical sections

  o Markups provided to include additional design information – e.g., required reinforcement for concrete members and required plate thicknesses for modules

  o Markups provided to restore Tier 2* information.

Section 3.8.5 – Foundations

- CI-TR85-SEB1-04

  Issue(s)

  o Inadequate description of the soil bearing pressure evaluation and foundation stability evaluation

  Resolution

  o Information provided to describe the methodology for soil bearing pressure and foundation stability evaluation

  o Markups for DCD provided for these evaluations.

Section 3.8.5 – Foundations

- CI-TR85-SEB1-10

  Issue(s)

  o Difficulties were encountered in demonstrating adequate factor of safety for the seismic sliding stability evaluation using the equivalent static method

  Resolution

  o A more realistic non-linear time history analysis was performed

  o Utilized a revised 2-D ANSYS surface mounted model (conservative because no benefit of embedment considered)

  o At interface with soil, utilized finite elements with sliding friction and uplift capabilities

  o Seismic input was increased by 10% to demonstrate that the factor of safety requirement of 1.10 per SRP 3.8.5 was met.

Section 3.8.5 – Foundations

- CI-TR85-SEB1-32

  Issue(s)

  o Foundation seismic design was based on the assumption of uniform soil springs beneath basemat which is not consistent with known soil pressure distributions (i.e., higher around periphery of foundation than within)

  Resolution

  o Study performed which utilized soil finite element representation and compared results to the uniform soil spring model

  o Based on this study, some member forces in the foundation became higher

  o Basemat re-evaluated for higher forces, and the results indicate that the basemat still meets the ACI 349 Code

Section 3.8.5 – Foundations

- CI-TR85-SEB1-36

  Issue(s)

  o Additional information needed to describe the development of the settlement criteria consistent with the evaluation of the effects of settlement on the structural integrity of the NI

  Resolution

  o A description was provided on how the settlement criteria were developed using a non-linear analysis of the foundation during construction and over time

  o Settlement criteria were updated and markups for the DCD were provided to give guidance on the settlement criteria for the COL applicants.

Section 3.8.5 – Foundations

- CI-TR85-SEB1-37

  Issue(s)

  o Requirement for soil angle of internal friction needs to be defined in the DCD for the COL applicants

  Resolution

  o Markups provided for revision of DCD Tier 1 and Tier 2 to define minimum soil angle of internal friction

  o If minimum soil angle of internal friction cannot be met, then site-specific evaluation is required.

AP1000 Design Control Document
Tier 2 Chapter 3
Design of Structures, Components, Equipment, and Systems

November, 2010

Tier 2 Chapter 3

- Chapter Overview
  - General Design Criteria
  - Classification of Structures, Components, and Systems
  - Wind and Tornado Loadings
  - Water Level (Flood) Design
  - Missile Protection

Tier 2 Chapter 3

- Chapter Overview (continued)
  - Postulated Pipe Rupture Dynamic Effects
  - Seismic Design
  - Design of Category I Structures
  - Mechanical Systems and Components
  - Seismic and Dynamic Qualification
  - Environmental Qualification

3.2 Classification of Structures, Components, and Systems

- The classification approach is not changed in the DC amendment
- The classification details are changed to reflect design finalization
- Open Items were a result of NRC audit and review of design documents - These open items are resolved.

3.2 Classification of Structures, Components, and Systems - Open Items

Item	Subject	Status/Comments
OI-SRP3.2.1-EMB2-01	Seismic Requirements for Class D Systems	Closed - Use of seismic anchorage is consistent with SECY-96-128
OI-SRP3.2.1-EMB2-02	Seismic Classification for Electrical and other Equipment not in Table 3.2-3	Closed - Table 3.11-1 provide seismic classification of electric and instrumentation equipment
OI-SRP3.2.1-EMB2-03	Augmented QA for SC II SSCs	Closed – DCD revised to reference DCD 17.3 for augmented quality requirements for seismic Category II SSCs and pertinent portions of 10 CFR 50 Appendix B.
OI-SRP3.2.1-EMB2-06	SSCs Required for continued operation	Closed - DCD Subsection 3.2.1.1 revised to reference Appendix S. Regulatory Guide is not applicable to the design certification
OI-SRP3.2.2-EMB2-01	Supplemental Requirements for risk significant RTNSS Systems	Closed - AP1000 RTNSS SSCs apply quality standards commensurate with the importance of their safety functions
Correction of Table 3.2-3	From extent of condition	FPS Classification corrected.

3.3.Wind and Tornado Loadings
3.5 Missiles

- Impact of tornado borne automobile missile at higher elevations is included to support COL applicants
- Open Items were the result of design changes (radwaste tanks) and NRC review (automobile and siding missiles) – These items resolved

3.3.Wind and Tornado Loadings – 3.5 Missiles

Open Items

Item	Subject	Status/Comments
OI-SRP3.3.2-SEB1-01	Impact of steel siding missile on the modular wall of the shield building	Closed - Structural integrity of the Seismic Category I structures will not be compromised from the siding missile strikes
OI-SRP3.7.2-SEB1-02	Effect of 3 added radwaste tanks on collapse of Radwaste Building	Closed - Tanks will not become a tornado born missile
RAI COL03.05.01.04-1	Elevated automobile	Closed – NI Structure demonstrated to be not subject to global failure due to sliding and overturning at the base by impact of an automobile.

3.4 Water Level (Flood) Design

- Open items resulted from design changes
  - Roof design of seismic Category II structures altered,
  - Fire tank volume increased,
  - Radwaste tanks added to Radwaste Building.
- These items resolved

3.4 Water Level (Flood) Design – Open Items

Item	Subject	Status/Comments
OI-SRP3.4.1-RHEB-01	Analysis of Parapet roof design for Probable Maximum Precipitation	Closed – Parapet Roof not on Seismic Cat. 1 Structures. The roof drain design includes no weirs.
OI-SRP3.4.1-RHEB-02	Analysis of increase in fire tank volume	Closed – Site is graded away from Nuclear Island.
OI-SRP3.4.2-SEB1-01	Hydrodynamic load of tanks in Radwaste Building	Closed – Flood level of 6 inches is insignificant load on NI walls.

3.6 Postulated Pipe Rupture Dynamic Effects – 3.12 Piping

- COL Information Item added to address completion and review of piping design
- COL Information Items added to address completion and pipe rupture hazard report.
- The computer code used for piping fatigue analysis (WESTEMS) is withdrawn from review in the design certification amendment.
  - NRC Staff will evaluate piping design fatigue analysis at the time of COL item closure
  - Benchmark program is required by DCD if a piping analysis program other than those for design certification is used

3.6 Postulated Pipe Rupture Dynamic Effects COL Information item

3.6.4.1 Pipe Break Hazard Analysis

The following activity will be completed by the COL applicant:

Combined License applicants referencing the AP1000 certified design will complete the as-designed pipe rupture hazards evaluation and make design information available for NRC review. The completed as-designed pipe rupture hazards evaluation will be in accordance with the criteria outlined in subsections 3.6.1.3.2 and 3.6.2.5. Systems, structures, and components identified to be essential targets protected by associated mitigation features (reference is Table 3.6-3) will be confirmed as part of the evaluation, and updated information will be provided as appropriate.

3.9 Mechanical Systems and Components Piping COL Information Item

3.9.8.7 As-Designed Piping Analysis

The following activity will be completed by the COL applicant:

Combined License applicants referencing the AP1000 design will complete the as-designed piping analysis (DAC) for the piping lines chosen to demonstrate all aspects of the piping design. A design report referencing the as-designed piping calculation packages – including ASME Section III piping analysis, support evaluations, and piping component fatigue analysis for Class 1 piping using the methods and criteria outlined in Table 3.9-19 – will be made available for NRC review. The availability of the piping design information and design reports will be identified to the NRC. Combined License applicants may address this item in accordance with the process options for DAC/ITAAC closure outlined in Appendix 14A.

3.6 Postulated Pipe Rupture Dynamic Effects – Open Items

Item	Subject	Status/Comments
OI-SRP3.6.2-EMB2-01	• Evaluation of leakage and through wall cracks, • Complete as-designed pipe break hazards analysis report	Closed - COL information item - COL applicants referencing the AP1000 design will complete the as-designed pipe rupture hazards analysis report
OI-SRP3.6.3-CIB1-01	Review as-designed LBB analyses for other-than-hard-rock seismic input	Closed - NRC staff will review the final as-built LBB analyses results

3.9 Mechanical Systems and Components – Open Items

Item	Subject	Status/Comments
OI-SRP3.9.1-EMB1-03	Follow up WESTEMS audit	WESTEMS is withdrawn from Design Certification Review
OI-SRP3.9.1-EMB1-04	Provide guideline or criteria for developing or benchmarking transfer function stress database	WESTEMS is withdrawn from Design Certification Review
OI-SRP3.9.1-EMB1-05	Provide technical justification for this option in selecting peak and valley times for the fatigue evaluation	WESTEMS is withdrawn from Design Certification Review
OI-SRP3.9.1-EMB1-06	Provide benchmark acceptance criteria to validate the computer code calculation (WESTEMS)	WESTEMS is withdrawn from Design Certification Review
OI-SRP3.9.1-EMB1-07	Provide the configuration control and limitations of WESTEMS for an option to eliminate peak/valley points	WESTEMS is withdrawn from Design Certification Review

3.9 Mechanical Systems and Components 3.9.2, 3.9.3, and 3.9.4

- NRC Open items generated by the review of design documents are resolved.
  - Flow Skirt Vortices
  - CRDM Nozzle J-Groove weld
  - Recirculation Screen loads
- International CRDM classification questions resolved.

3.9 Mechanical Systems and Components – Open Items

Item	Subject	Status/Comments
OI-SRP3.9.2-EMB1-07	Potential for generation of vortices in the region of the flow skirt	Closed - Any vortices generated will therefore be too small
OI-SRP3.9.3-EMB2-05	ASME Code Requirements for reactor vessel J-Groove weld	Closed - Westinghouse completed a plastic analysis and revised design documents
OI-SRP3.9.3-EMB2-08	Address issues with Containment Recirculation Screens design specifications	Closed - Updated design documents to include loads on screens

3.9 Mechanical Systems and Components – Open Items

Item	Subject	Status/Comments
RAI-SRP3.9.4-EMB1-01	Seismic classifications of the CRDM latch mechanism and coil stack assembly	Safety analyses do not rely on latch assembly function during an earthquake.
RAI-SRP3.9.4-EMB1-02	International standards for CRDM components	Design, fabrication and quality assurance requirements for the CRDM latch assemblies are the same for U. S. and international applications.

3.9 Mechanical Systems and Components Valve Testing

- Open items for valve in-service testing and functional testing are resolved.
  - Resulted from NRC Audit
  - AP1000 is implementing testing required by Joint Owners' Group MOV program
  - Additional information provided in response to ACRS Action Item 46

3.9 Mechanical Systems and Components – Open Items – 3.9.6

Item	Subject	Status/Comments
OI-SRP3.9.6-CIB1-01	Resolve issues from onsite review of design and procurement specifications for pumps, valves, and dynamic restraints	Closed – Follow up review verified changes to design documents.
OI-SRP3.9.6-CIB1-02	Reference to static testing needs to be consistent with the JOG MOV Program, which might require dynamic testing	Closed – DCD revised to remove reference to valves outside JOG Program.
OI-SRP3.9.6-CIB1-03	Specify the edition of the ASME Standard QME-1 referenced in Section 3.9	Closed – DCD to reference ASME QME-1-2007
OI-SRP3.9.6-CIB1-04	Application of ASME OM Code Case OMN-1 as part of the AP1000 IST Program	Closed DCD specifies use of ASME OM Code Cases must be consistent with RG 1.192.

3.9 Mechanical Systems and Components – Open Items – 3.9.6

Item	Subject	Status/Comments
OI-SRP3.9.6-CIB1-05	Technical Specifications and Technical Specification Bases need to be revised to be consistent with the ASME OM Code	Closed - Technical Specifications and Technical Specification Bases to be revised to be consistent with the ASME OM Code
OI-SRP3.9.6-CIB1-06	Include Acceptance Criteria for Check Valve and clarify response to RAI-SRP3.9.6-CIB1-12	Closed – Revise DCD to include check valve test acceptance criteria
OI-SRP3.9.6-CIB1-07	Clarify Table 3.9-16 Note 31 be consistent with the JOG MOV periodic verification program	Closed – Revise Note 31 in Table 3.9-16 to be consistent with the JOG MOV periodic verification program
OI-SRP3.9.6-CIB1-08	Clarify the reference to ASME OM Code, Subsection ISTC-3700 to confirm that the exercise test frequency requirements specified in the ASME OM Code will be satisfied	Closed - Revised DCD Table 3.9-16 to indicate a separate Fail Safe test for the applicable valves with fail safe functions

3.9 Mechanical Systems and Components – Open Items – 3.9.6

Item	Subject	Status/Comments
OI-SRP3.9.6-CIB1-09	Address issues about testing for CVS valves	Closed - Revised DCD table as requested.

3.10 Seismic and Dynamic Qualification
3.11 Environmental Qualification

- Screening of equipment for sensitivity to high frequency motion is discussed in DCD Appendix 3I
- RAIs on screening for equipment sensitive to high frequency motion and conformance with COL/DC-ISG-1 have been resolved.
- The open item on equipment qualification requirements in design documents is resolved.

3.11 Environmental Qualification – Open items

Item	Subject	Status/Comments
OI-SRP3.11-CIB1-01	Revise design and procurement specifications to address NRC audit comments on equipment qualification	Closed - Valve design specifications require that active valves will be qualified in accordance with ASME Standard QME-1-2007

ACRS Questions

ACRS Actions 4, 46, and 55

ACRS Action 46
Valve Testing Risk Ranking

Components MOV, POV testing, how is the risk informed and ranked. PRA is not sufficient and need to review other criteria.

- The risk ranking of valves to determine the frequency for valve operability testing is a COL responsibility
- The DCD includes a COL information item that the COL applicant must complete an evaluation to determine the frequency of valve operability testing.
  - This evaluation will include risk ranking.
  - The DCD also includes a description of the evaluation to be completed to determine the frequency.
- Risk ranking is not completed as part of the design certification.

ACRS Action 46
Valve Testing Risk Ranking

- The determination of valve operability test frequency uses a combination of functional margin and risk ranking.
  - High risk, low margin → more frequent
  - Low risk, high margin → less frequent
- Valve margin evaluates load on actuator and capability of actuator.

ACRS Action 46
Valve Testing Risk Ranking

- In response to NRC Generic Letter GL 96-05, the Westinghouse Owners Group prepared a report on the risk ranking approach for the existing fleet.
- The approach identified in the report includes six steps
  1. Identify valves to be considered
  2. Calculate valve at-power risk importance
  3. Assess PRA completion issues
  4. Evaluate other considerations
  5. Develop component ranking worksheets
  6. Conduct expert panel session for ranking.

ACRS Action 46
Valve Testing Risk Ranking

- Valves subject to operability testing are identified in DCD Table 3.9-16
- Risk importance is considered based on both core damage frequency and large release frequency.
- Shutdown risk has been quantified for AP1000
- Westinghouse and AP1000 utility personnel have participated in risk ranking expert panels for the GL 96-05 responses.

ACRS Action Item 55
Squib Valve Functional Testing

Testing of Squib Valves - Verification/qualification program, IST program. - Banerjee

Details on how many tests, what's the configuration, what are the upstream pressures, and etc, aside from how do you test them once they are in service. – Brown

- The squib valve design includes functional testing, lot acceptance testing, equipment qualification testing and in-service testing.

ACRS Action Item 55
Functional Testing

- The design and development program includes functional testing of the design at the extreme conditions. Variables include propellant loads, material properties, environmental conditions, and machining tolerances.
- 17 tests have been completed with prototype valves with all valves opening
- Propellant loads included 80% of nominal, 120 % of nominal, and higher
- Tests were done with air at ambient and water at ambient and at pressures up to 450 PSI.
- Shear cap thicknesses include nominal, minimum, and maximum.
- Tension bolts at minimum and maximum break strength were included.

ACRS Action Item 55
Squib Valve Functional Testing

- Lot acceptance testing (LAT) is required of the production lots of critical one time use valve internal parts (shear caps and tension bolts).
  - For the current production orders there are 22 full scale tests.
    - Fourteen (14) – 14” ADS Valves
    - Six (6) – 8” HP Valves
    - Two (2) – 8” LP Valves
    - These will be done with the actuator loaded at 80% of nominal.
- The actuators (charges) also have a sample size of 10% of the entire lot, including deliverables, assurance, and LAT units tested.

ACRS Action Item 55
Squib Valve In-Service Testing (IST)

- The IST Table in the DCD requires a Charge Test Fire of 20% in 2 Years
  - The squib valve charge is removed and test fired outside of valve.
  - Squib valves are not exercised for in-service testing.
  - Consistent with ASME OM requirements
- Westinghouse will provide additional in-service inspection and testing recommendations to the utilities as appropriate.
  - Recommendations are a result of the design and development activities.

ACRS Action Item 55
Squib Valve Equipment Qualification

- The squib valve is qualified based on the guidance provided in IEEE Std 323-1974, IEEE Std 344-1987, IEEE Std 382-1996 and ASME QME-1 2007 with referencing to the power operated valve process. This includes actuator environmental seismic and Design Basis Accident simulation, qualification of the safety-related non metallic components, valve assembly functional testing, and flow testing.
- The NRC Component Integrity Branch has audited Westinghouse general equipment qualification methodology documents and the squib valve design specification.
- NRC personnel have observed the squib valve design reviews where equipment qualification has been discussed in detail.

ACRS Action 4
RCP Flywheel Design

I would like to receive stress corrosion test reports performed by W or pump supplier on the 18Cr 18Mn retainer ring material. I suspect that they have not tested this material sufficiently (if at all) to demonstrate SCC resistance in the coolant environment. Even though the ring is sealed in a Alloy 625 can, the assembly will not be inspected in service, and there will be no way of knowing whether the can will remain leak tight during service. If SCC of the retainer ring occurs, a serious accident would be likely. –Armijo

ACRS Action 4
RCP Flywheel Design

- The potential for corrosion and consequences of the 18Cr 18Mn retainer ring material is not a safety issue.
- Westinghouse has reviewed industry testing and is not planning any more testing of the retainer ring material in support of DCD Rev. 18
  - The flywheel including the retainer ring is sealed in an enclosure to prevent exposure to reactor coolant
  - Pressure boundary criteria and requirements are applied for welding and helium leak test for the enclosure design and fabrication
  - Industry stress corrosion testing in environments more severe than reactor coolant have shown satisfactory resistance to stress corrosion cracking

ACRS Action 4
RCP Flywheel Design

- If the enclosure would leak, the worst case is a flywheel failure which would not be a safety issue
  - Flywheel missile analysis has shown tungsten inserts would be contained within the pressure boundary and would not create a LOCA
  - If the rotor would lock due to the flywheel failure, analyses have shown the integrity of the reactor coolant pump to steam generator weld and reactor coolant pump to cold leg weld would be maintained and would not create a LOCA
  - The Chapter 15 safety analysis has shown the acceptability of core cooling during a locked rotor event

ACRS Action 4
RCP Flywheel Design

- We understand that the position of the NRC staff, as documented in the Chapter 5 SER, is that the material is acceptable for the application.
  - "Since this alloy steel is not a nickel based alloy, such as Alloy 600, primary water stress corrosion cracking is not a concern. The NRC also notes that the 18Mn-18Cr alloy steel outer hub will be enclosed in a Alloy 625 flywheel enclosure to prevent the outer hub from contacting the reactor coolant. Therefore, the staff finds the use of the 18Mn-18Cr alloy steel acceptable based on the current operating experience of this material in an aggressive stress corrosion environment,"

Questions

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

Westinghouse AP1000 Design Certification Beyond Amendment (Revision 17) Application Review

Advanced Final SER

Section 3.9.1 – Special Topics for Mechanical Components
Section 3.12 – Piping Design
Appendix 3I – Evaluation for High Frequency Seismic Input

November 17, 2010

Robert Hsu and John Wu

NRO/DE/EMB2

Staff Review Team

- Technical Staff
  - Robert Hsu
  - John Wu
- Project Management
  - Phyllis Clark

Overview of AP1000 DCD

DCD SECTION - SUMMARY OF CHANGES

DCD SECTION		SUMMARY OF CHANGES
3.9.1	Special Topics for Mechanical Components	• Remove WESTEMS Computer Program
3.12	Piping Design	• Add piping DAC and DAC/ITAAC closure process
Appendix 3I	Evaluation for High Frequency Seismic Input	• Revise the sample to be evaluated for the piping systems

Technical Topics of Interest, AP1000 DCA

3.9.1 Special Topics for Mechanical Components

- **WESTEMS Computer Code**
  - **Five Open Items addressing concerns with the quality assurance and methodology used in the WESTEMS Code**
  - **Staff completed audits and identified continuing concerns with quality assurance and methodology resulting in two remaining open items. The staff documented its audit results in the WESTEMS audit summary report.**
  - **By letter dated September 29, 2010 (ML1027703290), Westinghouse determined to remove WESTEMS from DCD markup that adds WESTEMS to DCD Table 3.9-15.**
  - **On the basis that the applicant will not apply the current version WESTEMS for AP1000 design analysis, the staff closed OIs.**

Technical Topics of Interest, AP1000 DCA

3.12 Piping Design

- **By letters dated April 1, 2010 (ML100970364) and August 23, 2010 (ML102380040), , the applicant stated that Westinghouse would not remove piping DAC and provide a DAC/ITAAC closure process.**

- **On the basis that the piping DAC was approved in Rev. 15 and the additional clarification provided with the DAC/ITAAC closure process, the staff finds this acceptable.**

Technical Topics of Interest, AP1000 DCA
3.12 Piping Design

- **Hard Rock High Frequency (HRHF) Ground Motion Response Spectra (GMRS) Exceedance Seismic Input**
  - **Seismic input was identified in Section 3.7.3 as inadequate due to a mathematical model error.**
  - **The applicant revised TR-115, "Effects of High Frequency Seismic Content on SSCs", with adequate seismic input.**
  - **The staff reviewed TR-115 and noted that the applicant's screening criteria selection did not address response spectra exceedance due to in structure response spectra (ISRS), which is the input for mechanical components and piping design analysis and qualification.**
  - **By letter dated August 17, 2010 (ML 102350447), the applicant revised DCD Appendix 3I to evaluate HRHF GMRS for all ASME Class 1, 2, and 3 piping systems instead of 2 sample piping systems. This evaluation is within the scope of the piping DAC.**
  - **On the basis that the applicant will address seismic evaluations for all Class 1, 2, and 3 piping systems, the staff finds this acceptable.**

U.S.NRC

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Westinghouse AP1000 Design Certification Beyond Amendment (Revision 17) Application Review

Advanced Final SER Section 3.10

Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

November 17, 2010

Pei-Ying Chen NRO/DE/EMB2

Staff Review Team

- Technical Staff
  - Pei-Ying Chen
- Project Management
  - Phyllis Clark

ACRS Subcommittee Presentation
AP1000 Design Certification Review

Section 3.10 – Seismic and Dynamic Qualification of Equipment

Summary of Major Changes from DCD Revision 15 to DCD Revision 17

- Westinghouse decided not to use Experience – Based Qualification Method for Seismic Qualification of AP1000 mechanical and electrical equipment

- Appendix 3I.6.4 of AP1000 DCD Revision 17 addresses the Certified Seismic Design Response Spectra (CSDRS) exceedance in high frequency spectrum region at some Central and Eastern United States rock sites.

CSDRS High Frequency Exceedance

- Staff Guidance: SRP Section 3.10, COL/DC – ISG-1, and SECY – 93-087

- Resolution of RAIs on the Review of APP-GW-GLR-115 (TR-115) is directly applicable to DCD Appendix 3I for high frequency issues

- One significant RAI issue – Westinghouse did not perform, in addition to the HRHF SSE screening test, low level testing (5 OBEs) for equipment identified as potentially sensitive to HRHF excitation.

CSDR High Frequency Exceedance (continued)

- Westinghouse provided the calculations to justify that equipment testing for AP1000 CSD ISRS is equivalent to or envelops the five one-half SSE events using the AP1000 HRHF ISRS, that resolves the 5-OBE issue (to be incorporated into the future DCD revision – CI-SRP3.10-EMB-10).

- **RAI-SRP3.10-EMB-11 (On TR115, Revision 2)**

  Some equipment GMRS-based (HRHF) ISRS is higher than previously evaluated for the exceedance over the CSDRS-based ISRS. Westinghouse was requested to demonstrate the seismic adequacy of all AP1000 mechanical and electrical equipment.

- Regulatory Basis: GDC 2, SECY-93-087 and ISG-1

CSDR High Frequency Exceedance (continued)

- **Westinghouse Response**

  Appendix 3I of AP1000 DCD, Revision 17

  - Category 1 equipment (potential HF sensitive) – In addition to CSDRS seismic qualification testing, HRHF screening test will be performed.
  - Category 2 equipment (not HF sensitive) – Only CSDRS seismic qualification testing is performed.

  - Not clear how Westinghouse is going to qualify Category 2 equipment if the GMRS-based ISRS exceeds the CSDRS-based ISRS to satisfy ISG-1 and requirements of GDC 2.

CSDR High Frequency Exceedance (continued)

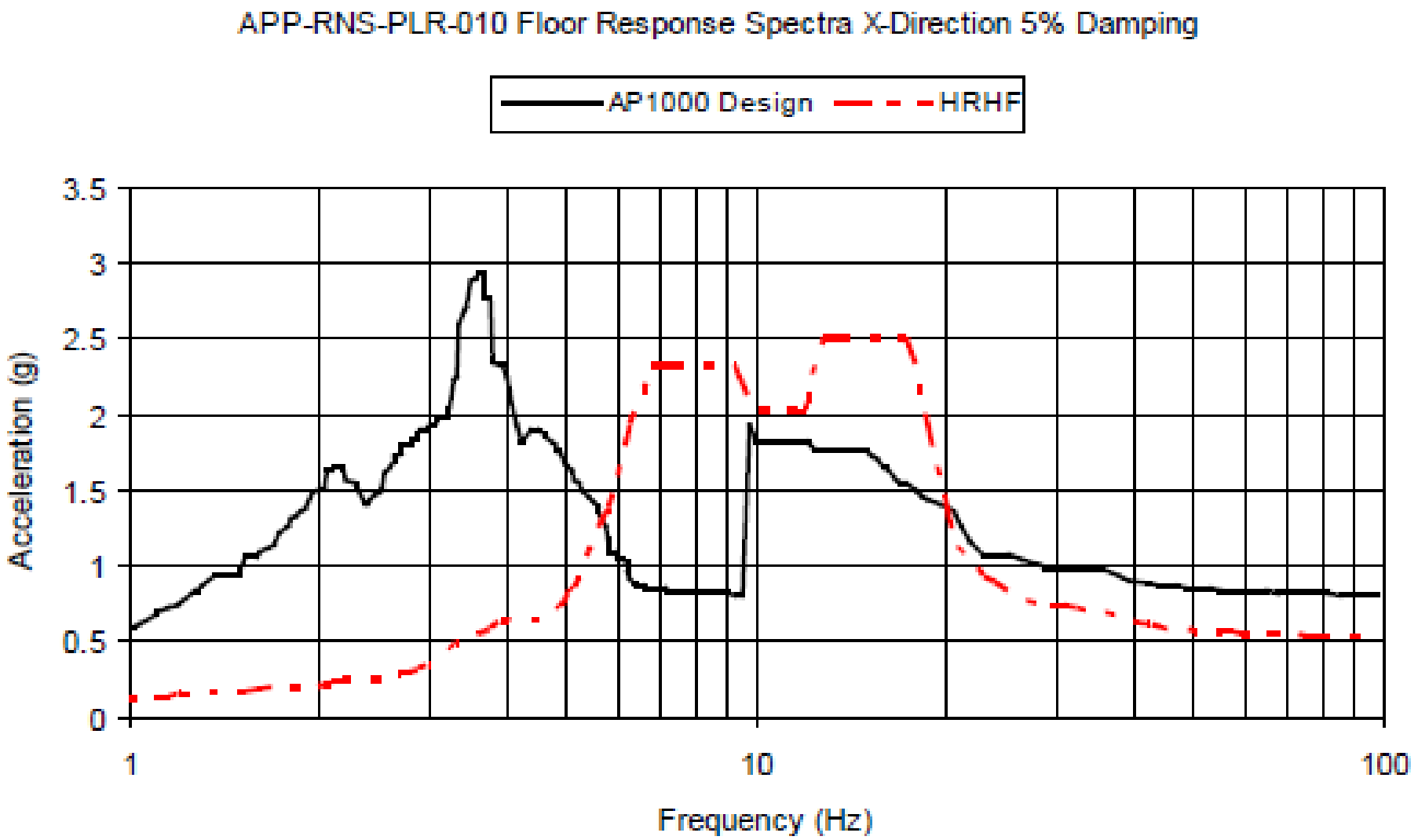
- **Regulatory Guidance (Section 3.2.2 of ISG-1)**

  In the evaluation of SSCs other than HF sensitive equipment, for those cases where the GMRS-based ISRS exceed the CSDRS-based ISRS below 50 Hz, further structural integrity and functionality evaluations are required.

- **Path to Resolution**

  Westinghouse agreed to revise its RAI response, Appendix 3I, and TR115 Revision 2, to verify the adequacy of the equipment seismic qualification for all AP1000 equipment for entire frequency range of interest, including mid and low frequency range exceedance. (CI-SRP3.10-EMB-11). Example:

CSDR High Frequency Exceedance (continued)



ACRS Subcommittee Presentation
AP1000 Design Certification Review

Section 3.10 – Seismic and Dynamic Qualification of Equipment

Conclusions

- Changes from DCD Revision 17 and TR115 Revision 2 are acceptable subject to Confirmatory Items CI-SRP3.10-EMB-10 and CI-SRP3.10-EMB-11, because the AP1000 mechanical and electrical equipment are seismically qualified for the entire frequency range of interest.