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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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SUBCOMMITTEE ON THE WESTINGHOUSE AP1000 DCD

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WEDNESDAY

DECEMBER 1, 2010

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Harold B. Ray, Subcommittee Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD B. RAY, Subcommittee Chairman

SAID ABDEL-KHALIK, ACRS Chairman

J. SAM ARMIJO, ACRS Vice Chairman

SANJOY BANERJEE, Member

MARIO V. BONACA, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR., Member

COMMITTEE MEMBERS (continued):

MICHAEL CORRADINI, Member

DANA A. POWERS, Member

HAROLD B. RAY, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

THOMAS S. KRESS, Consultant

GRAHAM B. WALLIS, Consultant

ACRS STAFF PRESENT:

WEIDONG WANG

PETER C. WEN

C O N T E N T S

P R O C E E D I N G S

[8:31 a.m.]

CHAIRMAN RAY: The meeting will now come to order. This is a well-attended meeting of the AP1000 Reactor Subcommittee, a standing subcommittee to the Advisory Committee on Reactor Safeguards. I'm Harold Ray, chairman of the subcommittee.

ACRS members in attendance are Jack Sieber, Sanjoy Banerjee, Sam Armijo, Dana Powers, Said Abdel-Khalik, Michael Ryan, Bill Shack, Charles Brown, Joy Rempe, and Mario Bonaca. We've got a chair here for Member Corradini, but we just received word, he's "snowed in" in Detroit. So we will see if he joins us, or not.

MEMBER POWERS: Or so he says.

CHAIRMAN RAY: This meeting is a part of the--well, excuse me. Tom Kress and Graham Wallis are also present, consultants to the committee, and Weidong Wang is the designated federal official for this meeting.

This meeting is a part of the ongoing review of the proposed amendment to AP1000 Pressurized Water Reactor Design Control Document, and it is also going to review matters associated with long-term tooling, or GSI-191. We have two items, really, running in parallel here, with the goal, and it remains just a goal at this point, that we would be able to complete subcommittee review on both matters, GSI-191 and the amendment, in advance of the discussion of the Full Committee later this week.

We previously had 11 meetings totaling 21 meeting days, and I won't recite when they all occurred. They're a matter of the record.

This AP1000 subcommittee meeting will continue to review the safety evaluation reports on Revision 17 of the AP1000 DCD, and we'll discuss, as I said, also GSI-191 and follow-up items that the subcommittee has been tracking.

We will hear presentations from the DCD Applicant, Westinghouse, and 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--and let me hasten to say don't get optimistic about the timeline shown on the agenda. The reality is that we will spend all the time that is available to discuss any matters that members wish to discuss, until it gets too late to continue, if that should be required. So the agenda is simply an order of presentation and not a timeline that we necessarily need to adhere to.

Some presentations will be closed in order to discuss information that is proprietary to the Applicant and its contractors, pursuant to 5 U.S. Code 552BC3 and 4. Attendance at this portion of the meeting dealing with such information will be limited to Westinghouse representatives, the NRC staff, and its consultants, and those individuals and organizations that have entered into appropriate confidentiality agreements with them.

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

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 previously published in the Federal Register. A transcript of the meeting is being kept. It will be made available as stated in the Federal Register notice. Therefore, we request that participant sin 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.

We will now proceed with the meeting, and somewhat unusually, I guess Eileen, you're going to start.

MS. MCKENNA: Yes. Actually, I do have one slight adjustment to the agenda. We have a topic on the action item, I believe it's 72, which has to do with some of the I&C issues. We'd like to do that, kind of as the last agenda topic rather than the first agenda topic.

CHAIRMAN RAY: Okay.

MS. MCKENNA: If that's acceptable. And yes, at this point we would start with the other part of that box, which was some feedback on the Tier 2* information with respect to the seismic structural material. We had some discussion about this at one of our last meetings, and we think we may have left a false impression about where we were with this review, and, you know, our understanding of how the information is going to be captured in the Design Control Document, to move forward as the licensing basis for the COL.

So I did want to spend a few moments to speak to that topic.

CHAIRMAN RAY: Indeed. And I would just say, and urge everybody to take the time required to ensure we've got all the information that should be exchanged, and that there's nothing left open that we could address, if we were to give the time to it. So go ahead.

MS. MCKENNA: Okay. I just have a couple of slides, just to kind a walk us through--

CHAIRMAN RAY: You're going to speak from over there, Eileen?

MS. MCKENNA: I can, or if you want up front--whichever you prefer.

CHAIRMAN RAY: Well, I think it'd be more convenient for the members if you--

MS. MCKENNA: Okay. I will come up front. And I may have neglected to send slides to the computer, so--

CHAIRMAN RAY: We'll follow along. Just tell us what page you're on.

MS. MCKENNA: I apologize for that. So what I wanted to do was, is that we talked at the last meeting, we were talking the shield building, and there was some question about how is all this wonderful information on the shield building going to be included in the Design Control Document, and what assurance do we have that the design that has been proposed is the design that's actually built.

So I thought it would be worth spending a few minutes to talk about how some of the information, structural matters, as captured in the Design Control Document. And in order to do that, I want to take you back, first, to Rev 15, which had a lot of information about seismic and structural analysis, and it was embodied in the DCD, in various parts of the document, including--there is a section in Tier 1 that's called Buildings, and it's--Tier 1 is part of the rule itself, and can only be changed as a rule or an exemption.

So in that particular part of the DCD, has information about buildings, and I listed some of the types of information that appear in Section 33.

CHAIRMAN RAY: Are you on page three?

MS. MCKENNA: I'm on page three of the slides. Yes; sorry. That's the design basis loads, the key dimensions, identification of the particular critical sections, like a dozen particular locations in shield building and aux building that are considered to be the most important with respect to the design, and have some of the more challenging structural components to them, and some of the figures about what these sections look like.

And then, in addition to that, there is Tier 2 designation on Other Material, and as you recall, the Tier 2* designation means that prior NRC approval is needed for any change to that information. And there was information in Section 37, which is on seismic design, 38 which is the--of the analysis, appendix 3H, with regard to Critical Sections are included, and it has this designation on some of the descriptions of what those buildings, and walls, and features look like.

The criteria of No. 4 says "plate thicknesses and stress results," and that was all part of Rev 15. And then in the rule, Appendix D, those are then captured through these, what are listed on page four. These are specific line items in the rule, that are designated as Tier 2*, and see, I've listed these right out of the rule, or in the seismic arena.

So that brings us, then, to the next slide, to, okay, where are we now, that we're in to 17, and soon eighteen? I'm aware of the reanalysis done for the change, to broaden the range of soil conditions, and, you know, so there's a lot of new analysis, and there were design changes, and most visibly, obviously, the new shield building.

And so therefore, the details, the Tier 2 information, and the Tier 1, that was in the DCD originally, needs to be brought up to date to reflect that.

What happened as we were going through the review was, there were periods of time where Westinghouse proposed to remove certain Tier 2* information and the staff questioned why were they proposing to do that.

And what it came down to was that there were things like stress results, that had been marked as Tier 2*, and kind of a realization that well, did we really want to see every change to some stress result for one particular piece of the building, that seemed, maybe, overly restrictive level of control, when you don't have the final design drawings to go right into construction.

So we kind a took another look at what was Tier 2* and what wasn't, and we did agree that we still wanted things like the loads, acceptance criteria, plate thicknesses, that kind of information to remain as Tier 2*, but that other material perhaps could be left at Tier 2, or not even necessarily be displayed in the DCD at all, if it's too fine a level of detail.

So in the course of our interactions, and submittal of the Shield Building Report, we did get proposed markups to the DCD from Westinghouse, to reflect the changes that they had made, and what information would be Tier 2*, moving forward.

So that brings me, then, to my slide six, which--this is where I think our discussion may have got us a little off-track--is as you're aware, initially, we're looking at material that's presented in technical reports, that it would provide a lot of background and discussion, and rationale, and analysis, and different things to support DCD markups. And staff was really focusing on that body of information, and we really hadn't "zoned in" on exactly what were the DCD markups that would go along with that, until fairly late in the game, and I think we are in general agreement about what type of information needs to be Tier 2*, critical sections, things like reinforcement thicknesses, but not to have to capture the stress results.

So we have Westinghouse's proposals. I think I would say we're doing a fine-tuning look, to make sure that we agree that what they--everything they've marked as Tier 2* is right, and that they haven't left something out, or that there's not something that--some wording about something, even as Tier 2, that we think could be improved, and we are going to be doing that in the near future.

In fact, we have plans to go, next week, look in detail at drawings and other information, to make sure that we're satisfied that everything that needs to be in the DCD is in there, and in appropriate fashion.

And if there are any changes that are necessary, or as a result of that final look, it would be reflected in a future revision. We don't think this is---it's a big possible delta, but, you know, we are open to the possibility that if that's necessary, we will do that.

The last slide I just had was, I think was--we talked about this last time, a little bit, about, well, okay, it's good to get all that stuff in the DCD, but then what happens, moving forward.

And so I just highlighted, you know, NRC's oversight doesn't stop with getting information into the DCD. The COLs have processes that they have to follow, if they make changes, moving forward during the construction process, that includes departure reports. They are required to submit reports to the NRC every six months, of any departures they make to the DCD.

There are certain departures where they would still need to get approval, if it was, for example, Tier 2*. So there is that kind of oversight that would occur. And then on the inspection side of the house, there's a range of inspection activities that would be overseeing the construction and any changes that occur.

One thing that's kind of a near-term thing, I think, is this engineering design verification inspection. There have been some discussions about performing one of those--I don't know the exact time, but relatively soon. What this does is it takes, looks at--I think they call it the Design Authority--in this case, presumably Westinghouse or some of their supporting partners--to see how this DCD FSAR-like information has been moved forward into the detailed engineering drawings and construction material, procurement documents, so that you do get the design being implemented, that you think is the design that you have approved, and obviously, there's the other two major parts of that oversight during construction, being the construction inspection and the ITAAC inspections.

So I hope I've clarified a little bit where we are with the DCD review, the Tier 2* information, and why we believe that the appropriate information is going to be in the licensing documents and control implementation in the future.

CHAIRMAN RAY: That is responsive, I think, at least to my perception of what we were talking about, Eileen. It is difficult, when questions that the committee feels are important, get satisfactory and responsive answers. But then you wonder, as you said at the beginning, how do we know this is the way it's going to actually turn out, since they aren't telling us what is actually, at the moment, incorporated in the application that we're reviewing? That's still, as you said, a work in progress.

And you've given us, I think, a responsive answer to that question. I guess I would only say that it is important to make sure that when we rely on something as the basis of reaching a judgment, that there be some way to ensure that that's what actually is done.

MS. MCKENNA: Yes. Two things. One is,

as I said, these markups were submitted with the-- either an RAI response or an open item response. So we have a specific document from Westinghouse saying this is what we're going to put in Rev 18 on these sections. And we will be receiving Rev 18, I believe today, thereabouts, and then we can go check for ourselves, that it's all in there, just the way they proposed to include it, and that we are satisfied with what it looks like.

CHAIRMAN RAY: Yes. And we are in a position of relying on you to that, because of course we don't have the visibility to these "moving parts" as they--

MS. MCKENNA: Yes. I mean, it's challenging, I think, for anyone to take, you know, three or four different RAI responses, and look through all the different pages, and make sure that everything's in there. And that's what we are doing, and we hope, and we think that we are very close on agreement.

ACRS VICE CHAIRMAN ARMIJO: Eileen, along those lines, the materials construction of the plant, those are Tier 2 in the tables that I've seen.

MS. MCKENNA: Generally, that's correct; yes.

ACRS VICE CHAIRMAN ARMIJO: Yes. And this is, in some cases there's some changes from Rev 15 to the current rev, in, let's say the piping material--

MS. MCKENNA: Correct. Right.

ACRS VICE CHAIRMAN ARMIJO: --going from a low carbon nuke grade, nuclear grade, to conventional type 304, type 316, and maybe to some it's not a problem; but it is to me.

But let's say everybody was happen with the choice. It could be changed at Westinghouse's discretion, and they do a 5059 type thing and let you know that they've done it; but they don't need your approval. Is that correct?

MS. MCKENNA: Well, the one who'd be doing that 5059 review would be the COL. Now it may be that Westinghouse--

ACRS VICE CHAIRMAN ARMIJO: Well, whoever does it; right.

MS. MCKENNA: --is proposing it on their behalf, but it would be the COL who would undertake that process, and they still have to satisfy themselves that they meet applicable requirements, whether it's codes that might be in play, acceptance criteria, information that's in the DCD, and then if they decide that yea, verily, they think that it is a satisfactory material, they would then do the 5059 review, and either determine that it could be made without a prior approval, or not.

But even if they made it without the prior approval, they do have the reporting requirement in the departures report. So there is a means for the NRC to be aware of it, albeit after the fact, but it's still--and there are records that have to be kept.

So in that sense, it's no different than an operating plant that--

ACRS VICE CHAIRMAN ARMIJO: No, I understand that, and the practice of having material specifications as Tier 2, it's been throughout the process, so--

MS. MCKENNA: Right. Exactly. Yes. Right.

ACRS VICE CHAIRMAN ARMIJO: --I don't want to say, well, we shouldn't do it that way. But I'm just--it makes me worry about material changes, particularly where they're sensitive to some environmental effects, could be changed with--well, certainly, without your approval.

MS. MCKENNA: It could be done. Again,

it depends on what the change is.

ACRS VICE CHAIRMAN ARMIJO: And we've got to just realize that.

MS. MCKENNA: You're correct.

ACRS VICE CHAIRMAN ARMIJO: Okay.

CHAIRMAN RAY: Any other comments or questions for Eileen?

[No response]

CHAIRMAN RAY: Thank you.

MS. MCKENNA: Okay. I think next, we have some Westinghouse presentations on--

CHAIRMAN RAY: Yes.

MS. MCKENNA: --various open items. Or action items.

CHAIRMAN RAY: Yes. We do. We have a collection of action items that we'll try and resolve on. I don't believe there's any particular pattern, except that these still have some outstanding aspect to them. So Rob.

MR. SISK: Thank you, Mr. Chairman.

I beg the committee's indulgence. We're going to have a parade of different people coming up on different topics. The first topic we're going to talk about is flywheel material, and I'm going to ask our subject matter experts to come to the front of the room here.

CHAIRMAN RAY: Yes. We talked before, at length. Okay. Who will introduce the topic?

MR. MELTON: Yes, sir. I will do it. Mike Melton, Westinghouse licensee. I'd like to introduce Dr. Gutti Rao, one of our senior colleagues in metallurgy, and you've seen Dale Wiseman before, for the *... and pump discussions.

Essentially what we're going to do this morning is go through the action items, to the point where we can get to agreement on closure. We're going to cover actions 4, 10, 55, and 73. I think the only one that is probably closed, in this particular success, is ten. So we'd like to take the action 10 and move that to the last of the actions we talk about.

On the action number 4, on the flywheel, I think we have scoured, looking for more information, we've done a little bit of work, but essentially we're at the point where--

CHAIRMAN RAY: Excuse me, Mike. Do we have handout copies of what you'll be presenting?

MR. MELTON: Yes; yes. We're making copies. We have just one talking point slide and this is it.

CHAIRMAN RAY: All right. But for our sanity, you'll give us a hard copy? Okay.

MR. MELTON: Yes, sir. Essentially, I think as we left the last actions, it was to--sam, I thought was going to look at some of the previous Westinghouse presentations.

I wanted to get Dr. Rao here to make a few points about the material. Essentially the 18 manganese, 18 chromium steel, is essentially a secondary side material. However, we did do some more research on the grain structures and materials, and I thought we could speak to that, just a little bit.

DR. RAO: Yes. I know some of this has been discussed before, but I want to bring in, very briefly, just a concern that the likely, unlikely event of catastrophic failure of the *8:54 [Believe he is talking about *"welds" or *"valves??? also, at times?] repainted ring material, which is *..., and in item 32, that the breaching of the 625 material, and then susceptibility of the 18, 18 material. So I would want to briefly touch upon the potential for breaching of the 625 base material and weld, as well as the susceptibility of 18, 18.

And then we can discuss more on 18, 18,

why, whether we need original boric acid corrosion expo--test corrosion data to establish its *8:55... for failure.

Now 625 is a material, it's been developed, many of you know, a alternate to 690 from 600, and probably 625, as far as the base material is concerned, it is a process of corrosion *8:55... and it has molybdenum in it, there's a lot of test data and so there's experience with that. And the bridging of the 625, the concern expressed about *valves, is more likely locations.

The valves themselves are 625, which are much more experienced than 690 valves, even, 52-150. Sixty--625 is--*durability is good, it has a high resistance to *NIL... ductility cracking. So the 8:56*... reasonably good confidence and experience with the 625 valves.

As far as the base material, it is designed for a process of corrosion resistance. It has molybdenum in it, and its pitting resistance is pretty high, much significantly higher than 316. There's a lot of data in there.

So in the unlikely event of any breaching in 625, now we've got to the point of 18, 18 material, which is basically cobalt to higher strength level--but the important thing here is 18, 18 is 18 manganese, primarily is a gamma stabilizer. It's a austenitic phase stabilizer, and basically we have like 316 or 304, as far as corrosion of boric acid exposure.

ACRS VICE CHAIRMAN ARMIJO: Mike, I'm not talking about boric acid. I'm talking about PWR water chemistry.

MR. MELTON: Yes.

DR. RAO: PWR chemistry. Our experience--we have been using austenitic materials as a protective layer for carbon seal corrosion. All the austenitic materials, as cladding or *8:57 roll bonding, whatever, and we have extensive experience to show that austenitic materials are a good protector, are highly resistant for boric acid corrosion.

So we expect 18, 18, since it is a gamma stabilizer, is an austenitic material basically, similarly to 316 or 304, with the exception that it has much higher *8:57:45 corrosion resistance for *products and nitrites. So it is superior for such corrosion cracking resistance, and it at least has same corrosion, boric acid corrosion resistant property. When I said boric acid, I mean primary water.

And in the unlikely--the only corrosion, really, concern for 18, 18, a lot of data developed is in the areas of contaminants beyond the spec limits. So we have test data to show hundreds of ppms of chlorides and nitrites, exposed to the 18, 18 material, and that show that it is immune for such corrosion cracking.

ACRS VICE CHAIRMAN ARMIJO: That's my fundamental problem, is all of this data is at boiling water temperature or less. We found no data--they put it in. You know, all the qualification testing has been done on retainer rings on generators, and the generator environment is extremely mild compared to the PWR coolant environment.

MEMBER SHACK: Lower temperature.

ACRS VICE CHAIRMAN ARMIJO: It's much lower temperature, okay, and it's just moisture, Bill. It's not primary water--

MEMBER SHACK: But it's oxygenated.

ACRS VICE CHAIRMAN ARMIJO: Yes. Well, it is--you've just--I'll give you an example, and this is from personal experience. When the boiling water reactor stainless steel pipe cracking phenomena started, and I was part of the team that had to sort that out, we had been testing, for many years, of BWR welded piping type 304, in big loops. High temperature, high purity water. Unfortunately, nothing cracked in the test tubes, even though we thought it was prototypic, until it started cracking in the field, and then we realized that there's more to the water that comes--that makes it oxide, comes from the core. So just tiny amounts of oxygen and oxidizing species turned a benign environment into a very severe environment.

So unless you test in prototypic environments, you don't have a clue, that this material is going to be resistant, and if you don't test, if you can't inspect it, I don't see how you can--you know, if you can't inspect to assure that your 625 can is hermetic, then you must assume that in a 60-year-life, or well before you have to look at this vessel, you must ensure that if it fails, something--that the 18, 18 is going to be resistant, and you have the test methods available.

Westinghouse has crack growth test facilities, crack initiation test.

These are very standard. You don't have to invent a test.

DR. RAO: Right.

ACRS VICE CHAIRMAN ARMIJO: So I'm puzzled why you keep referring to this set of data in other, in my opinion, irrelevant environments. Sure, it says, hey, it might work. And it might. I'm not saying it won't work. But you can't be sure unless you test it, and that's where I have a big hang-up--

DR. RAO: I understand that. I appreciate your point. I mean, if you look at the BWR experience at 9:01:16 *.. dation and the residual *.., it's only related to the weld. If you don't have sensitization, you don't have problem. But all the problems are because after the situation, we well understand what's happening there.

In this case, it is an austenitic material, and--

ACRS VICE CHAIRMAN ARMIJO: But--

DR. RAO: It is nothing, but it's austenitic material--

ACRS VICE CHAIRMAN ARMIJO: Oh, we failed so many austenitic materials, both in BWRs and PWRs. So austenitic material doesn't mean anything, unless it's a specific one, or if you have good experience. I don't think you have any experience of 18 chrome, 18 manganese steel, in any application in a BWR, or a

PWR, particularly in a high-stress component like this.

MR. ZIESING: Mr. Armijo, this is Rolf Ziesing, director of licensing, Westinghouse. We believe that we've evaluated these materials, and based on the evaluation, there's a low risk of SEC, based on our engineering judgment. But you do raise a valid and reasonable question, and Westinghouse is committed to addressing this question.

We are developing a test perspective and we will do some validation testing to evaluate the SEC resistance to this material. We just--obviously, it takes time to do that, so we don't have the results available; but we will commit to do that.

ACRS VICE CHAIRMAN ARMIJO: Well you know, that's great, you know, that's--I appreciate that, because I know you know how to do it. And we do it all the time. You know, if this thing was inspectable, and I agree that it's very impractical to try and inspect that outer cannon, and that's the only thing that would have to be inspected for hermeticity. You wouldn't have to take apart the rotor. You just have to be able to make sure that those welds aren't leaking.

If you could do that, routine--you know, periodically, then you're assured that the rotor will never see the environment, not--and it's just a straight mechanical design.

DR. RAO: Right.

ACRS VICE CHAIRMAN ARMIJO: But unless you can inspect it, you have to be sure that if it leaks you don't have a violent failure of your flywheel in triggering all the lock rotor issues that you analyze in chapter 15, and I think putting enormous stress on that heat exchanger that's hanging on the outside of that pump.

Those are the issues that I think are safety issues, as well as investment protection issues, and I appreciate that Westinghouse is going to do some testing on this material.

DR. RAO: Yes. We have established a preliminary test matrix, and we were just--want to review, briefly, the likelihood of such a thing happening. We believe it is very--highly low probability, but--

ACRS VICE CHAIRMAN ARMIJO: And it should be. You know. And I would expect you have done everything to say what's the best choice of materials. Because you've been changing materials over the past several years. Stainless steel to

*MAR-aging steels for that application.

But the ultimate test is how it performs in the environment, and if you perform those tests, my mind is really put at ease.

CHAIRMAN RAY: I think that the first three bullets up there are ones that, absent what has just been said, we would have to delve into and discuss further.

But I understand Sam's response to be, and certainly it would be my less expert opinion, that if the failure probability could be shown, to distress corrosion cracking, to be sufficiently low, then I doubt we need to debate the safety issues of flywheel failure, or am I wrong?

ACRS VICE CHAIRMAN ARMIJO: I'm convinced, if Westinghouse does tests, and they know how to perform these tests, and they do it in a prototypical environment, and either crack growth threat tests, or crack initiation tests--and you should do both--and you conclude that, hey, this stuff is really as good as we thought, I'm happy.

But if you find out it isn't so good, you're going to have to do some sort of design change.

DR. RAO: We agree. I mean--

ACRS VICE CHAIRMAN ARMIJO: You know, at this point, it would be--you know, you know what to do. But just not testing is what drove me--

CHAIRMAN RAY: Well, I think--I'm just focused back on these first three bullets. I think they accurately state what the state of the application is. It's just that if we couldn't get that kind of assurance, they're going to get a lot more discussion, because there are differing views on that, and--

ACRS VICE CHAIRMAN ARMIJO: For example, in chapter 15, the lock rotor analysis is really the worst case situation. That's the only event associated with a pump, that can give you an off-site dose. And granted, it's identified as sort of a nonmechanistic failure. I think, like the flywheel coming apart and acting like a giant break, could get you into a lot lock rotor event. I can't prove it; but it'd be hard to disprove it. So--

CONSULTANT KRESS: I don't see how you do a risk acceptance without initiating again frequency.

ACRS VICE CHAIRMAN ARMIJO: Yes, and that means something's got to break.

CONSULTANT KRESS: Yes.

CHAIRMAN RAY: So we need to get

assurance that the flywheel's not going to fail if it's subjected to *rapid cooling.

ACRS VICE CHAIRMAN ARMIJO: That's it.

CHAIRMAN RAY: And that seems like something that would pretty well be in everyone's interest to do, and it's very helpful to understand that it's your intent to do it.

Do you folks have other things that you'd like to say? We'll be glad to hear them.

MEMBER SHACK: Are you testing alternate materials, just in case this doesn't work?

MR. CUMMINS: This is Ed Cummins. That's not part of our current plan.

ACRS VICE CHAIRMAN ARMIJO: It's always good to have a backup.

MEMBER SHACK: That's an engineering issue.

CHAIRMAN RAY: At this point it would-- I'd just expect to see that we would rely upon satisfactory test results in reaching our conclusion.

DR. RAO: 9:07:47* didn't speak to that. A better material, the 18, 4, which has been used in retainer rings, that work has been done, to compare and include the susceptibility, resistance for cracking. The 18, 18, apparently the best sort of material for--

ACRS VICE CHAIRMAN ARMIJO: Yes. You know, I think the retainer ring issue I think makes a good point. The retainer rings in the generators, using the high manganese steel, the original 18 manganese 5 chrome,--

DR. RAO: 5 chrome.

ACRS VICE CHAIRMAN ARMIJO: --failed miserably by intergranular stress corrosion cracking, because they didn't do much of a test program on it. After those failures, they did an extensive testing to qualify the 18 chrome, 18 manganese, and they tested not only in their prototypic environment but also more aggressive. They added nitrites, chromates--you name it.

And that material has worked beautifully, because it's been tested and qualified. And that's really my point. A similar approach should be taken for your retainer ring.

DR. RAO: Yes. Only my point is the only reason we don't have the primary water testing of this material is because of the experience we have with 304 and 316 in primary environment, and this is supposed to be held similar, because an austenitic *9:09:08 stabilized stainless steel, it's superior stress corrosion than 316 and 304.

I just want to make that point. We understand, we don't have data and we do have every reason to expect we have better on 316 and 304, but if we should have data in the back pocket to support that, we do need to do some tests.

CHAIRMAN RAY: We appreciate your response to this concern.

Are we done with item four, then? Anything else?

MR. MELTON: Yes. We're done with item four.

CHAIRMAN RAY: You're done. I'm asking if we're done.

[Laughter]

CHAIRMAN RAY: Okay. Thank you, and we'll move on, and like I say, we'll make a comment that we're relying on these test results being satisfactory in reaching our conclusion. Thank you.

MR. MELTON: Okay. Our next subject is action number 55, post-seismic testing, squib valves.

CHAIRMAN RAY: Okay. Is Mr. Brown in the room here?

MEMBER BROWN: Oh, yes. Well, I wasn't going to be--

[Laughter]

MEMBER BROWN: If I get up and leave, you'll have to stop. Or you don't have to stop.

MEMBER SHACK: But you're going to get up and leave?

MEMBER BROWN: Yes. I will get up and leave; yes.

[Laughter]

MEMBER SHACK: Just coming back for a second, Harold--

CHAIRMAN RAY: Yes, sir.

MEMBER SHACK: --on how we verify, in fact, this is satisfactory. Do we expect the staff to add an ITAAC, that this has to be satisfactory? Or do we just sort of--you know, we have an ACRS ITAAC that isn't really part of the staff ITAAC?

CHAIRMAN RAY: I'm not sure, Bill. That's a fair question. I'm inclined, in the first instance, to say what I indicated--recommend we say what I indicated in the letter, which is we're relying on that satisfactory test results, and then to explore with staff what the answer to your question is. I don't have an answer, right off the top of my head .

MEMBER SHACK: Well, I sort of expected

Eileen to say something.

MS. MCKENNA: Well, yes, I'm not sure an ITAAC is necessarily the right way to include this. I think we can--

ACRS VICE CHAIRMAN ARMIJO: What are the alternatives?

MS. MCKENNA: --think about other ways that--

ACRS VICE CHAIRMAN ARMIJO: Eileen.

MS. MCKENNA: Sorry?

ACRS VICE CHAIRMAN ARMIJO: What are the options?

MS. MCKENNA: Well, it could be that we ask that it be provided as a reference with-- obviously not Rev 18, because it's still on the table now--but we are reasonably thinking that there's a good likelihood would be the 19, for whatever reasons that were out there, and it could be the document that would be referenced--

ACRS VICE CHAIRMAN ARMIJO: Isn't there some sort of an ITAAC on the pump itself, acceptance testing, and all--

MS. MCKENNA: There certainly would be--

ACRS VICE CHAIRMAN ARMIJO: Could be sort of a subpar--sentence within such an ITAAC that's--

CHAIRMAN RAY: Charlie--*audio static.

[Laughter]

ACRS VICE CHAIRMAN ARMIJO: I'm not telling you how to do it, but, you know, we'd really want assurance that it'd been done and it was done--

MS. MCKENNA: I understand that, and I just would need to figure out the best way to get that captured, given we don't have a test document, or a plan, in hand, today. You know, we have a commitment, but we need to capture that in some appropriate fashion.

CHAIRMAN RAY: I have confidence, in the first place, if it's committed, it'll be--

MR. CUMMINS: Well, I was going to say that this will be a one-time thing, rather than for each plant, and therefore it's more like a DAC than an ITAAC. But DAC have also issues. And the other way we make commitments, typically, is with COL open items, and I think maybe the staff and the COL applicants, and Westinghouse, need to get together and discuss what the options are to have a commitment.

CHAIRMAN RAY: Yes. This is a matter of dotting i's and crossing the t's, but I have no doubt that work will be done as they indicate. So we just need to make sure we--

MS. MCKENNA: Yes. Where--I'm sorry to interrupt.

CHAIRMAN RAY: No; that's all right.

MS. MCKENNA: You know, we need to talk among ourselves and come up with an approach that we think would meet the committee's needs, and that would meet everybody else's needs. We understand the issue, and we just need to figure out the best way to implement it.

CHAIRMAN RAY: All right. Why don't you proceed, slowly. Charlie will be back in a moment.

MR. MELTON: We're going to talk about the materials. In our pre-job brief, I told everyone that don't worry, if metallurgists are talking--you know, we go right hand, left hand, a lot, and it looks like we're arguing but we're really enjoying ourselves, so--

[Laughter]

MR. MELTON: Talking about materials. We have a good time, so don't get nervous about that. Okay. This, as we wait for Charlie to get back, is action item 55, a follow-up for the AP1000 squib valve, and Ron is here, Wessel is here to help lead our discussion on that.

CHAIRMAN RAY: You can begin. Charlie will read fast.

MR. WESSEL: Good morning. We were here two weeks ago, and Jerry Riegel, the valve design engineer, presented a lot of information on the squib valve, and to address the first two items that are on this slide. Based on that presentation, that we received a secondary inquiry from Charlie, that is shown on the third bullet of the slide.

So that's what I'm here, really, to discuss, is this third question here. I am capable of going back and discussing some of the other issues, if you so desire. But mainly, I'm here to discuss the seismic testing that we're going to do on the squib valve.

MEMBER BLEY: Okay. While we wait for Charlie, I might just mention that I think his concern isn't just with the squib itself, but it's with the actual valve mechanism, knowing that nothing has bound up inside it.

MR. WESSEL: Yes.

MEMBER BLEY: Not to speak for him.

[Laughter]

MR. WESSEL: I expect that same question from Charlie, so it is really not in the slide. I want to discuss the testing that we are doing, and why we're doing that testing. But I can also answer further questions about the whole valve assembly also. The seismic testing. In our opinion, there's two critical areas for the squib valve to do a safety relay in function. One is the actuator works upon demand, and two, that the tension bolt that holds the piston up--if you remember from the presentation two weeks ago, there's a tension bolt that holds the piston in the proper position, so the proper amount a gas is built up prior to it breaking and sending the piston down to shear of the cap of the valve.

So those are, really, the two critical things. The tension bolt is critical, because if it would break during a seismic event, the piston would come down. There's not enough force on, with the piston coming down to actuate the valve, but that would make the valve inoperable. They would not be able to build up the pressure, or required sheer, if the valve was--if the piston was in the lower position.

So we have developed testing for both of those types of--

MEMBER BROWN: What was the first one?

MR. WESSEL: The first one is the

actuator itself, the--

MEMBER BROWN: The charge?

MR. WESSEL: The propellants and the charges, and everything. And the second point is to make sure that tension bolt remains integrity--

MEMBER BROWN: I got that.

MR. WESSEL: --until it's needed to break. So that is the critical parts of the squib valve operation. The squib valve is very, really a simple design. It has a piston, it has a tension bolt, and that we had discussed two weeks ago, and it comes down and shears off the cap. So it's a pretty simple design.

But these are two of the critical things. In the testing that we're going to do, to show those work, is, first of all, is the actuator. We're going to test the actuator portion of the squib valve. We're going to do a full IEEE 323 harsh environmental qualification program, based on Regulation Guide 189 and Regulation 10 CFR 5049, all the good testing that's required to show that the actuator will properly fire, on demand, to do its safety-related function.

ACRS VICE CHAIRMAN ARMIJO: Could you remind me of what you mean by actuator starting the charge, the tension bolt, the sliding thing, and the cap comes--

MR. WESSEL: The actuator--what we call the actuator in the squib valve program is the initiator, which has the electrical wire bridge that would shoot off, and inside the initiator also is a small amount of pyrotechnical material. That the initiator, the bridge wire will heat up, set off that, which then will fire off the main propellant that's contained in the cartridge.

ACRS VICE CHAIRMAN ARMIJO: Okay. Then the tension bolt and the--

MR. WESSEL: The tension bolt is--

ACRS VICE CHAIRMAN ARMIJO: Part of the actuator system?

MR. WESSEL: No. The tension bolt is part of the valve system, and we maybe want to bring that drawing up--

ACRS VICE CHAIRMAN ARMIJO: That's what I didn't understand.

MR. WESSEL: --that's on the--it's on here.

MEMBER BANERJEE: But when you do the test, you set off the explosive, don't you?

MR. WESSEL: Yes; yes.

MEMBER BANERJEE: Because you don't break the tension bolt, but you take it out, and--

MR. WESSEL: Right. The first, I'd like to discuss, is the actuator portion, and I want to get the picture up. It's not in that. Go in this folder here. That's Jerry's old folder. I just grabbed all his stuff, and if you get his presentation that he had had.

This is from the presentation that Mr. Riegel had before you.

So this is basically a 14-inch valve. This is the tension bolt, here. The cartridge isn't shown here, but it screws into this portion here, and that would contain the cartridge, there's a steel cartridge, and it's *9:21:26..., and then the initiator screws into the top of the cartridge, and then there's electrical connections that are made to the top of that.

So when it fires as--how did Jerry get to do this thing?

[Laughter]

MEMBER SHACK: It was pretty slick.

MR. WESSEL: Sorry.

MEMBER SHACK: You may have to--

MEMBER BANERJEE: You definitely should

show that to the Full Committee, the animation.

MR. WESSEL: I actually have a video, if you'd like to see what are the prototype tests of this valve going off.

MEMBER SHACK: That goes pretty fast.

MR. WESSEL: Yes; it does go very fast.

Mr. Scarbrough's been there to see some of them go off.

MEMBER BANERJEE: It's already moved.

MR. WESSEL: Yes; yes.

MEMBER BLEY: Shears it.

MEMBER BROWN: Do it again.

MR. WESSEL: Okay. Here we go. Ready. Go. Okay. So there it goes.

[Laughter]

MR. WESSEL: The fire--the pressure builds up in this portion right here, the piston moves down and it hits the shear cap, and the shear cap breaks, and then the 14 inch, it has, it's on a hinge, and it falls down, out of the way, to allow full flow.

MEMBER BANERJEE: Now Charlie asked at one point--I don't want to paraphrase--but the way I understood it, that, you know, post-seismic, if something goes a little bit out of kilter, you know, so it's not all perfectly lined up, then, you know, how do you know that?

MR. WESSEL: Yes. We'll get into that. That's really the third part, that I haven't slides, but we can discuss that portion. We'll continue with what testing we're going to do and then I'll talk about how we assure the clearances are there for the piston to come down to do--

ACRS VICE CHAIRMAN ARMIJO: I just wanted to understand that an actuator test is more than an initiator test. It's a combination of the initiator and the piston, and the tension bolt, and all of that stuff? Or not?

MR. WESSEL: No. The actuator is the initiator, the initiator, the propellant that's in the initiator, the propellant that actually sets off the big part of it, and the cartridge that it's contained in. In addition to it, the top of that is built to simulate the actual mounting in to the valve. So it's in a safety container, with a top part that fits down into this body.

This whole top part is simulated in our test fixture with the initiator--or the cartridge screwed into it. And then there's a can on it, that contains a pressure vessel, that we measure the amount of pressure that is built up, and that's how we determine if it was successful or not, by measuring that pressure when we set them off.

MEMBER BROWN: And Sam, the point is they do not--that's only the actuator, the igniter, the propellant, and it pressurizes whatever that little container is. It does not test the valve that it comes down and shears the cap, post-seismic. That's not part of the post-seismic testing.

MEMBER BANERJEE: And does not break the extension bolt or--

MEMBER BROWN: It doesn't break the tension bolt. It doesn't do any of that--

MR. WESSEL: Not in the actuator test; okay?

ACRS VICE CHAIRMAN ARMIJO: I understand what an actuator--

MEMBER BROWN: That's all they do, post-seismic, and that's fundamentally my issue. They don't test the valve.

MR. WESSEL: So just to give you a better idea of what we do here, we have 22 of these cartridges that we start out the program with. They go through thermal aging, they go through radiation aging, they go through vibration aging, they go through both single-axis testing for pipe-mounted equipment, and we also do random multi-frequency tests on the actuator.

So that's all the seismic tests that are done, and then the remaining ones that are left are put in a pressure vessel, and actually run through the design base accident condition, and they are fired during that.

So cartridges that have gone through that whole sequence are fired during the design base accident simulation. But after the seismic tests, we take two of those out, and we fire them and measure the pressure.

MEMBER BROWN: The actuator.

MR. WESSEL: Yes. After each step, after thermal aging we fire off a set. After radiation aging, we fire off a set. After vibration, we fire off a set. After seismic, we fire a set, and then we fire the set that are in the vessel during the accident simulation.

CONSULTANT KRESS: You do those aging processes as if they were independent of each other?

MR. WESSEL: That's correct. First, you do the thermal, then you do the radiation, and then you do the vibration, and it's all based on the sequences in the IEEE specifications that are endorsed by Reg Guide 189.

So that's the testing that's done for the actuator; okay?

So the next slide, please, Mike.

MEMBER POWERS: Dr. Kress, you raised the issue of sequential testing with thermal or radiation. I wonder--do you have ideas that perhaps there's synergism between thermal and radiolytic aging?

CONSULTANT KRESS: I don't have any direct data. It just appears to me that's possible to have synergistic effects.

MEMBER POWERS: From the developing of databases for cable aging, that work by Clough showed there to be synergistic effects between radiolytic and thermal aging.

CONSULTANT KRESS: Yes. That particular kind of material; yes.

MEMBER POWERS: That was for, primarily for the aging of insulation on cables.

CONSULTANT KRESS: Yes.

MEMBER POWERS: Which of course are not the same as either explosives or other materials. But they're not a "wild departure" from--

MEMBER BANERJEE: They're polymeric materials.

MEMBER POWERS: They are polymeric materials.

MEMBER BANERJEE: But in certain senses, explosives are too.

MEMBER POWERS: That's right. So one wonders.

ACRS VICE CHAIRMAN ARMIJO: The IEEE guidance does not require concurrent aging at temperature in a radiation environment?

MR. WESSEL: No; it does not.

ACRS VICE CHAIRMAN ARMIJO: But that's what you would consider--

MR. WESSEL: And all qualifications for harsh environment program, that is very--very--not much done, it's not easy to do both temperature and radiation at the same time because of the facilities that are available. There has been some work done, over in Japan, of trying to do that. But in this country, the current practices here, it's done separately.

Now of course you always evaluate. We are propellant manufacturers, which is the important part here. They have much military experience, that they've used it in military applications, and aircraft applications, and that they have looked at that, and they can't see if any synergy effects that would be--that you would need to do these at the same time.

You've got to remember, you know, we're trying to put this thing at its end of life. That's our process here. We put it to its end of life before we do the design basis accident.

So that's the purpose of the thermal radiation and vibration aging.

MEMBER BANERJEE: You replace this cartridge every eight years or something?

MR. WESSEL: Yes. Every outage, 20 percent of the cartridges are replaced. So over an eight year period, all 12 valves will have changed out their cartridges.

MEMBER BANERJEE: And when you replace them, do you test the old cartridge?

MR. WESSEL: Yes; that's the purpose. That's part of the IST testing for the squib valve, is you take the cartridge out, and you fire the 20 percent, and to show that they were still viable.

ACRS VICE CHAIRMAN ARMIJO: So that got the concurrent, everything.

MEMBER BANERJEE: In whatever--

MR. WESSEL: Yes.

MEMBER BROWN: You made the comment, in the previous brief, relative to Sanjoy's question, that the propellant manufacturer guaranteed performance for what? ten, twelve years or some--that was a statement that was made during the discussion--and that you then pulled them out, 20 percent every two years, which means the oldest one would be roughly eight years old, if you--

MR. WESSEL: Right. That's correct.

MEMBER BROWN: That was part of the dialogue in the last meeting, relative to the actuators themselves.

MR. WESSEL: Right. And so in our qualification program of the actuator, we will accelerate, age the actuator, including the propellants, for an eight year qualified life to match that out. We're also doing additional aging for shelf life to demonstrate shelf life for approximately 15 years. So that's all part of the qualification program.

MEMBER BANERJEE: So will you have--you know, one of the problems you run into with things like explosives, and so on, some of the manufacturers go out of business, or whatever. It's very hard to get the same stuff. So you're going to buy enough of this to start with or--

MR. WESSEL: The manufacturer, Goodrich, is out in California. They've been in business for many many years, and mostly in the military and space program that--

MEMBER BANERJEE: So hopefully, this manufacturer will not, but--

MR. WESSEL: But what we do have in that case, we do have all the formulations, and all that, so, you know, if they would happen to go out of business, Westinghouse does own all the recipes and all the processes that go to make up these. They're all written and can't be changed, because we can't change something in the middle of the process, that had gone through to qualification program. So that is all very well documented, and it's called a baseline program, so they can't deviate.

We own all that. So if they would go out of business, then we'd take all these papers and find a new guy, say, "Here--make this."

MEMBER BANERJEE: So you actually have that, because in some cases, you're pointing out in the past what has happened, is the ownership, of where that is not so clear, and when the manufacturer went out of business nobody could reproduce the--

MR. WESSEL: Westinghouse owns all this, so it is all well-documented, and so if that manufacturer would go out of business, we would have to find a new propellant manufacturer.

MEMBER BANERJEE: Okay. So your testing would be--

MR. WESSEL: Yes, and during each batch--each time they make a batch, they have--and Jerry just talked about some of this last time we were here--there's lot acceptance testing that they go through, various testings and firing of the propellants in test cases, to make sure that it's the same as what we're testing here.

So every time they mix up a new batch of propellant, it goes through rigorous testing, to show that it's the same as what we had before.

CONSULTANT KRESS: Is your tension bolt removable in place?

MR. WESSEL: You remove the--picture--do you still have that up there, Mike?

CONSULTANT KRESS: It's a screw-in device, and you could remove the top. I'm trying to get at the question of inspecting the valves in place, and if I knew that tension bolt was still in good shape, that would go, that would do a lot of weight--

MR. WESSEL: You would have to remove the top enough--the design is changed a little bit since this picture. You would have to remove the top of the bonnet or top of the valve to inspect the tension bolt.

CONSULTANT KRESS: Is that difficult?

MR. WESSEL: No. Just take sponge bolts off the top.

CHAIRMAN RAY: It is bolted on?

MR. WESSEL: Yes. The top of the bonnet here is bolted on to the top of the valve--

CONSULTANT KRESS: And you could look at the tension bolt--

MR. WESSEL: Yes, you could pull out that thing--

CONSULTANT KRESS: Pull it down.

MR. WESSEL: --and the tension bolt would be there. You can inspect the tension bolt. You can look at the top of the piston and see if--

CONSULTANT KRESS: Are there any plans--are there plans to do that sort of inspection?

MR. WESSEL: Every ten years I believe

they have to have--and correct me--but they have to do some kind of inspection or--

CHAIRMAN RAY: It was not listed in your list.

MR. CUMMINS: Ed Cummins. I don't know. I think we really on ASME code requirements. I don't believe that that's in there; but I'm not sure.

MR. WESSEL: I believe like after ten years, you have to do some kind a inspection, you know, to make sure there isn't corrosion and all that other. But that isn't--that's not in my EQ realm, so that's all I can recall from hearing that.

MEMBER BLEY: Have you done some of this seismic qualification testing yet?

MR. WESSEL: No. This testing is scheduled to start in March of this coming year.

MEMBER BLEY: So we don't know what those natural frequencies are now?

MR. WESSEL: Well, have the design analysis of the valve from the ASME code analysis, and the lowest one is 123 hertz, so--

MEMBER BLEY: 123?

MR. WESSEL: Yes. This is a big--this valve's 9,000 pound. It's a big hunk a metal, you know, so, really--

MEMBER BLEY: But for the tension bolt and the--

MR. WESSEL: Yes, the--

MEMBER BLEY: --grooving, or whatever you have in there to--

MR. WESSEL: Yes, the body of that. You know, it's just a big hunk a metal, really.

MEMBER BLEY: But just on this--the squib valve assembly itself is 690. That's what you said last time.

MR. WESSEL: I believe that's true. I'm the EQ guy, and, you know, I'm not real "up" on all the different materials and that, but we could get that info--it might be in Jerry's presentation. But I'm sorry, I'm the guy that just tests it, so--

MEMBER BANERJEE: And you're exposed to the atmosphere on the other side; right? Whatever the--

MR. WESSEL: On the 14 inch. On eight inch, it's actually in--

MEMBER BANERJEE: Yes; yes. I understand. The other side is the containment atmosphere.

MR. WESSEL: Yes. This side, here, is the containment atmosphere.

MEMBER BANERJEE: And that's the only atmosphere that has access, if at all, to the piston and things like that?

MR. WESSEL: No, the shear cap, this shear cap here--

MEMBER BANERJEE: Yeah.

MR. WESSEL: --is there, and that's the only thing exposed to the atmosphere until it's actuated.

MEMBER BANERJEE: That's what I mean; yeah. It's not exposed, in any way, to the coolant, at all.

MR. WESSEL: No. The coolant--on this side there's a cold trap. On that. So the testing is scheduled to start in March, of both the actuator and the tension bolt testing.

In February of this year, we're going to have sort of what we call a design review. We're going to have, at Wylie Laboratories, where we're going to do this testing, we're going to invite both our customers and the NRC staff to join us, and we're going to go through all the procedures and review them, and get any observations anyone may have into our program, so that everybody's aware of what we're doing, and everybody's on board, and satisfied with what we're doing, so--

CONSULTANT WALLIS: You're talking about clearances and seals and things, and during *9:37:43, there is some pressurization of the containment before this thing goes off.

MR. WESSEL: Yes.

CONSULTANT WALLIS: So there's gas, which is trying to get into this thing, underneath the piston. You've got seals and things that are there--

MR. WESSEL: Yes, that's--

CONSULTANT WALLIS: It's not clear. There's no detail in these things, so--

MR. WESSEL: Yeah, there are seals that--this isn't actually a pressure boundary. Up through here is all pressure boundary, so--

CONSULTANT WALLIS: So the seals at every place where things can get in from contain--

MR. WESSEL: It's ASME code pressure boundary on everything this side of the shear caps, and above.

MR. CUMMINS: This is Ed Cummins. Just the regulatory basis of all this. There's a ITAAC for all of the safety-related valves, including the squib valves, that says provide seismic qualification, and then another ITAAC that says provide environmental qualification, and then there's tables that list all the valve numbers that you have to demonstrate to the staff that you've done those before.

And so this is viewed as a post-certification process.

MEMBER BANERJEE: And the seismic testing is for what? a design basis earthquake of some sort?

MR. WESSEL: Both the aging portion of it, to give it the fatigue, we don't call it--nowadays, we don't call it OBEs. We call it half SSEs. But it's the same thing if you go to IEEE 344, it's what's considered and OBE. They are aged with the OBE runs, and they're run through the--through the single access testing, it's actually, in each direction, it's ran about sixteen times, from one to 64 hertz at 1/8th off all the way up through, so that we hit it there, and then we have the multi-frequency test that we do after that. So it gets shook a lot.

That sixty, taken on that single axis, is a very severe test.

MEMBER BANERJEE: Horizontal and vertical acceleration?

MR. WESSEL: Yes. And each with the three directions. And then the random or multi-frequency is the tri-axial test.

CONSULTANT WALLIS: So how is it mounted? It's actually mounted in that way, or is it turned around and mounted vertically?

MR. WESSEL: It's mounted this way.

CONSULTANT WALLIS: It's mounted that way?

MR. WESSEL: Yes. Now we didn't talk a whole lot--we got off from the tension bolt. The tension bolt test, we're mocking up, we're hanging in a cylinder, we're hanging one of the pistons actually on the tension bolt with a cap and we're going to run those same seismic tests that we do on the actuator on the tension bolt, and of course the purpose of that test is to make sure it does not break.

CONSULTANT WALLIS: And what's upstream is water? Or is it gas?

MR. WESSEL: RCS is--

CONSULTANT WALLIS: So a vent or something to let gas out of there?

MR. WESSEL: I'm sorry?

CONSULTANT WALLIS: Is there a vent to let gas out of there?

MR. WESSEL: No; no.

CONSULTANT WALLIS: So you don't quite

know what's upstream at this time? It's a high point, isn't it, in the *circa 9:40:47?

MR. WESSEL: Well, there's a cold trap from it, from the RCS system, and I'm not a system guy either, so maybe--I'm not--

MEMBER BANERJEE: So the ADS 4 valves are up, and then horizontally placed like that?

MR. WESSEL: Yes; just like that.

MEMBER BANERJEE: So there's sort of a standpipe, right, that goes off the--

MR. WESSEL: Well, it comes down off, and then there's a cold trap, and it comes down at an angle in a cold trap, and then it comes up, like this, from what I understand. But just like that.

MR. CUMMINS: So Ed Cummins. The physical arrangements is the 18-inch line on the top of the hotleg that comes up, and it splits into two 14-inch line that run horizontally. So there's a vertical 18 inch and then a spilt into two 14-inches that are horizontal, and then two 14-inch lines that have a cold trap, which is like a little U, and then comes the valve.

MR. WESSEL: Yeah. There's a block valve in front of the cold trap for servicing purposes.

CONSULTANT WALLIS: So there's a vent.

MR. CUMMINS: There's not a vent in this line.

CONSULTANT WALLIS: So you could get gas up in that line, presumably?

MR. CUMMINS: You could, though it's not--it's not--it is a high point in that little part of the line. It's not in the whole system. But yes.

MR. WESSEL: During the QME testing, which I really didn't bring any slides on here, we will do full functional tests of the whole valve under full design steam flow, that actually has the cold trap built into the system, that'll show the actuation and the flow requirements are met. That's all part of our qualification program for a squib valve.

ACRS VICE CHAIRMAN ARMIJO: And that would be one valve of each size, or--

MR. WESSEL: One of each. We're doing all the--

ACRS VICE CHAIRMAN ARMIJO: That's a "full up" functional test?

MR. WESSEL: Yes, under design basis conditions.

MEMBER BROWN: That's not a seismic circumstance. That's not post-seismic?

MR. WESSEL: No; no.

MEMBER BROWN: This is just--it's just showing the actual system operation, or confirming it.

ACRS CHAIRMAN ABDEL-KHALIK: Everything on the left of the cap is part of the pressure boundary.

MR. WESSEL: That's correct.

ACRS CHAIRMAN ABDEL-KHALIK: How about that junction between the cap and the sleeve?

MR. WESSEL: This part here?

ACRS CHAIRMAN ABDEL-KHALIK: No; no. The interface between the cap and the sleeve.

MR. WESSEL: I'm sorry.

ACRS CHAIRMAN ABDEL-KHALIK: The vertical ring that is sheared off, is that also a part of the pressure boundary?

MR. WESSEL: Yes. It's all part of this piece here. See, this is--

MR. CUMMINS: It's machined.

ACRS CHAIRMAN ABDEL-KHALIK: It's machined. I understand.

MR. WESSEL: This is all--

[Simultaneous conversation]

MR. WESSEL: --and it is actually

replaceable. These valves are serviceable. If it goes off, they can, within 72 hours they can reservice them and have them back in service.

MEMBER BANERJEE: That white piece, you can replace it.

MR. WESSEL: This portion here, the shear cap portion, you take the flange off and you put a new one in.

MEMBER BLEY: Without an isometric to see, it's hard for me to see, even on initial fill, you don't get air trapped in this thing. So there must be some other high point that--but if you got the cold trap, I don't know why it wouldn't be full of air after initial--

MEMBER SIEBER: Well, other than the corrosive effect, it shouldn't make any difference for the operation--

MR. WESSEL: It doesn't affect the operation of the valve, at all.

MEMBER BLEY: I wouldn't think so, but it's not what--

MR. WESSEL: But that will be tested in the QME test, because we have the cold trap built into the test for--

MEMBER SIEBER: It will be absorbed in

water, eventually, I think.

MR. WESSEL: We have no--in fact, in the test that Jerry was talking about, when he was here before, they've already done the test on the prototype valve. One like that.

MEMBER SIEBER: I would think the more severe test would be one where there is no pressure on the upstream side.

MR. WESSEL: Well, we're going to use the lowest pressure that's available, because we don't want help pushing it open.

MEMBER SIEBER: That's right.

MR. WESSEL: That's part of the QME test. We're going to go with the low pressure point, so--

MEMBER SIEBER: That becomes--

[Simultaneous conversation]

MR. WESSEL: --we know the pressure, high pressure will help us, so we're going to use the low pressure in the depths.

MEMBER BROWN: Now we've diverted from the initial issue--

[Simultaneous conversation]

MEMBER BROWN: The actuators are tested--my conclusion, they were tested satisfactorily. My conclusion on--

[Simultaneous conversation]

MR. WESSEL: I guess we need our backup on here, Mike.

MEMBER BROWN: --on the tension bolts, that was satisfactory, so their environmental runs through, even though I'm not a propellant or explosives guy, I listen to enough of you guys talk. I was happy with that. Fundamentally, though, the one thing you do not do is test that the valve operates after the seismic excursions that you test. It is--

MR. WESSEL: Well, we saw the actuator will produce the necessary--

MEMBER BROWN: I'm not arguing--I got that. The actuator works. I'm not worried about that. It's the valve, the valve cap, the flopping open, it's the travel of the piston after a seismic event. None of that's tested, and I would echo my peer's comment earlier. If you don't test it after you shock it, like if you don't test for stress crows and cracking, how do you know it's going to be okay? And multiple things can happen.

You could have a L6COA, or some type of leak that occurs during a seismic event, although it's not supposed to. You could demand these work, and they don't, because they have been deformed slightly. The cap is deformed slightly.

MR. WESSEL: That can't happen.

MEMBER BROWN: Why?

MR. WESSEL: It can't happen.

MEMBER BROWN: Explain.

MR. WESSEL: This is why it can't happen.

MEMBER BROWN: Why? You don't test it after seismic. How do you know--

MR. WESSEL: I do a class one ASME code analysis on all the body and all the internal metal parts.

MEMBER BROWN: Analysis doesn't always work.

MR. WESSEL: You have a big hunk a steel here, Charlie.

MEMBER BROWN: I've got a piston that's going to drive down and break a seal, and it's--

[Simultaneous conversation]

MR. WESSEL: Yes. And you know what the analysis shows on that piston? The clearance required is point zero one for the valve to operate. The calculated deflection is point zero zero six in a 335 percent margin on that. So I am very confident, and code analysis will tell me that there's plenty of clearance in the piston, that it will operate as long as the actuator produces the required pressure.

MEMBER BANERJEE: But you do seismic qualification, which means you actually test--

MR. WESSEL: We test the actuator.

[Simultaneous conversation]

MEMBER BANERJEE: You never test the whole valve?

MR. WESSEL: We test a whole valve assembly in the QME testing but it has not gone through seismic qualification.

MEMBER BANERJEE: Okay. I didn't realize--

MR. WESSEL: We take credit for the ASME code--this is just like a motor-operated valve.

MEMBER BROWN: This is the first--this is--

[Simultaneous conversation]

MEMBER BROWN: We've been having motor-operated valve for 50 years. Okay?

MR. WESSEL: Let me talk to you about this; okay? We got a--

CHAIRMAN RAY: Wait a minute. Keep the emotion down.

MEMBER BROWN: I never get emotional, Harold.

CHAIRMAN RAY: I wasn't directing it at you.

[Laughter]

MEMBER BROWN: My point being is that we've got a lot of experience with motor-operated valves, and regardless of that, we don't have any experience with these. It's a first-time application, and you're asking us to accept, on the first-time application that in fact the analysis will--

MR. CUMMINS: This is Ed Cummins. That's not exactly true. I mean, there are safety-related squib valves and BWRs that are about three inch size. We definitely are not in the three inch size but--

MEMBER BROWN: I would agree with that.

MR. CUMMINS: But there is some past nuclear experience with safety-related squib valves.

MEMBER BROWN: But his mechanical valve operation ought to give you confidence that he can compute these clearances, which is what he needs to do.

[Simultaneous conversation]

MEMBER SIEBER: Well, it's a different--

MR. CUMMINS: I mean he's still calculating clearances--

MEMBER SHACK: Yes, but with a motor-operated valve, I've got a giant motor that's driving the valve in one direction. I've got constant--I've got torques applied and forces applied that don't--this is a pulse operation. Bang--it's got to go. Explosive expand, go down and do it.

MR. WESSEL: Let me ask you this, Charlie. On a motor-operated valve, you don't seismically test the whole thing. But you do an ASME code analysis that shows that the disk will go down and close satisfactorily, and everything else. So this is no different than what we do for any safety-related valve.

MEMBER BROWN: I'm not arguing with you on that. If I go back in the programs that I've operated in, after we seismically tested these--or shock-tested them, we operated them, to make sure they would operate. All the motor-operated valves that were critical to safety got operated, post-shock and vibration testing.

And I understand the fact that you have not done this typically in the industry, and I'm just giving you credit for the fact that you've had them in service for a number of years, and plants have withstood--they have then experience, they have had seismic experience, and the valves have continued to work based on operating experience.

Here, I don't have that. So that's the issue. That's my concern. How many times do you have to do this over and over again on every plant? Maybe not. But every design should be confirmed. That's my opinion. And so, you know, I understand the analyses of clearances--oh, no, I don't, I'm not a mechanical engineer--

[Simultaneous conversation]

MR. CUMMINS: Ed Cummins again. Just a comment, that the ASME code comes in here, and most people are pretty happy when the industry follows the ASME code. So it doesn't mean that you have to be happy. But that we're not inventing an analysis process here.

MEMBER BROWN: I understand that. I understand that.

MR. WESSEL: The other thing that gives us confidence is we've taken prototype valves--there's two valves that have gone through 17 firings, and those valves, after every time they were fired, and they were fired under loaded conditions, and everything, we did not see any deformation of anything that would not preclude the valve to operate during those 17 tests.

MEMBER BANERJEE: Have you ever fired them after shaking them up?

MR. WESSEL: I'm sorry?

MEMBER BANERJEE: Have you ever fired a valve after shaking them up?

MR. WESSEL: No. We have not seismically test--

MEMBER BANERJEE: Do you plan to fire a valve after shaking them up?

MR. WESSEL: No.

MEMBER BANERJEE: Even in a qualification program?

MR. WESSEL: No.

MEMBER BANERJEE: It was a straight answer.

MEMBER BROWN: It was a very easy answer.

CHAIRMAN RAY: Well, all right, and I don't think we're making any progress here.

MEMBER BROWN: I think we can--you know, Harold, I would go on. I mean, we've got to make a decision--

MEMBER BANERJEE: Well, we at least have

clarity on that.

MEMBER BROWN: Yes. We've got clarity--

CHAIRMAN RAY: Well, we're not making any further progress beyond clarity.

[Laughter]

CHAIRMAN RAY: So--

ACRS CHAIRMAN ABDEL-KHALIK: Could you just expand on the word "values" in the last bullet. Which one has the minimum safety factor? What are you referring--

MR. WESSEL: These, these are actually-- when I went through the design reports, the lowest safety, margin of safety factor I found on stresses, and everything else in the valve body, and all the metallica parts, was 32 percent. I actually went back and I looked at where they've calculated the clearance between the valve body and the piston, and those--that is all done with a combination of the maximum design pressure operating loads, pipe end loads, and six-g seismic, in three directions, by sum of the squares, and that's where they got the point zero zero six deflection of the piston, and the clearance is point zero one.

So that gives us confidence that there is more than enough clearance, 335 percent margin in the clearance between the wall and the piston, that the valve will fire.

And all those loads are combined in, and included in the calculations for those clearances.

ACRS CHAIRMAN ABDEL-KHALIK: That's fine. Thank you.

MEMBER BANERJEE: Is there any detailed, finite element sort of analysis required here for the stresses and things that might arise in an earthquake?

MR. WESSEL: That's what--the ASME code analysis was done with our ANSYS.

MEMBER BANERJEE: And that it shows you're well into the last *SIC 9:53 regime?

MR. WESSEL: It shows us all in great shape. The 35 percent was the lowest that I found in all three of the design reports.

MEMBER BANERJEE: And what was the financial analysis code that you used for this?

MR. WESSEL: ANSYS.

MEMBER BANERJEE: ANSYS. Did you use it yourself?

MR. WESSEL: It was done by the valve manufacturer.

CONSULTANT KRESS: Is this the heavy

valve, cantilevered out *9:54...?

MR. WESSEL: It is well-supported right at--on this, on the one that we had the picture, right on--

CONSULTANT KRESS: As a support--

MR. WESSEL: --the outside. Yeah; it's all supported.

CONSULTANT KRESS: All supported?

MR. WESSEL: Yeah.

MEMBER BANERJEE: And correct me. But this analysis was done for the OBE?

MR. WESSEL: No. It was done for the SSE, six g's; yeah.

MEMBER BANERJEE: SSE.

MR. WESSEL: It also included all operating loads, piping loads, all loading conditions. It's a Level D ASME code analysis level that includes everything in that analysis.

CHAIRMAN RAY: Anything else?

MR. CUMMINS: May we comment on six g's. This is Ed Cummins. Six g's is basically the industry was frustrated with equipment manufacturers because they would design their valves for the in-service accelerations, and so the utility requirements document decided that we need these valves to go wherever we want them, and so they required valves--the utility requirements document required valves to be designed for six g in the three separate directions, so they could be used anywhere. That's the concept.

And the actual loading on any place from the piping analysis has to be shown to be less than six g, so there's margin here.

CHAIRMAN RAY: Thank you. Okay. Again, one more time. Any other questions concerning this valve, and its qualification testing, and in-service testing?

[No response]

CHAIRMAN RAY: Thank you.

MR. WESSEL: Thank you.

MR. MELTON: Okay, Mr. Chairman, just a second. On the phone, do I have Keith Schwab-*Palozza [phonetic]?

CHAIRMAN RAY: Is that a question or--

MR. MELTON: Yes. I'm asking our team.

[Pause for phone]

CHAIRMAN RAY: This is the sampling frequency and demonstration, that won't exceed 120 percent and so on.

MEMBER BROWN: Yes. They sent a writeup

on it and I read it, and I have a comment on it.

CHAIRMAN RAY: We'll take it up here in a second.

MR. MELTON: I think we're going to go in discussion mode on that one.

[Pause for phone]

MR. MELTON: I think they're on.

CHAIRMAN RAY: Well, if they'd something, we would be more confident.

[Laughter]

MR. SCHWAB: Keith Schwab is on.

MR. MELTON: Thank you, Keith. We have Chris Provenzano on for Ron *Waka [phonetic].

CHAIRMAN RAY: All right. Proceed.

MR. MELTON: Okay, Mr. Chairman. We are moving on to action number 73, and we didn't provide--this is more of a discussion mode, or response to Charlie's questions related to the overall overspeed trip system. I think at this time, Keith, if you could take us through the response that we gave to Charlie in the ACRS in the discussion mode, and we'll go from there.

MR. SCHWAB: Okay. My--our understand--this is Keith Schwab. Our understanding is the concern with Table 2.2-2 of Chapter 10 of the DCD, has a table that goes through a sequence of events that gives the expected turbine speeds when you have a turbine trip, or you open your generator breaker. The control system responds when you're in normal turbine control.

It begins to close valves as it senses speed increasing on the turbine. If you're in a trip mode, it will--the speed will rise to no greater than 108 percent overspeed.

If we're--we don't have a trip and we do have an increase in speed, the control system will respond and bring speed back under control, and you continue operating.

That's the first part of that table. But the second part of that table gives the two overspeed trip points, which if there's a problem with the control system, and that's the 110 percent, the 111 percent trip point by the diverse systems that we've talked about previously, in previous meetings.

And those points are only reached if you have a problem, which I think everybody understands. That our understanding is there's a concern with the note that says--at the bottom of the table that says, even if you go through all that, your control system, your normal speed control system fails, and you reach your overspeed trip points, that the turbine will not exceed 120 percent over speed, which, by the way is the design speed of the turbine rotor, even though we operate at a 100 percent speed, normally.

And I think the concern was, you know, the note says we may approach 120 percent but we will not exceed it. And we are basing that on our existing turbine control systems design, the sampling rate of the control system, and the valve closure times, as documented in the DCD in table--I think it's 10.2-3. I don't have that table handy. The valves will close in .3 seconds, or less.

So we typically don't do an analysis to show that 120 percent will not be exceed because there's sufficient--we feel there's sufficient margin between the trip points, which are actually lower for AP1000 than in the standard review plan, gives, and because the response time of the control system. And I think--I think that pretty much characterizes our understanding of the concern.

MEMBER BROWN: Yes. Well, the concern was that there's no specific test that verifies that, in fact, due to a failure in the control systems, that the overall response in the way it accelerates the turbine rotor will not generate a speed which has--if it performs and trips as it says, that it will not exceed 120 percent.

And so that's what triggered my comment relative to the table. And if you go look in the ITAAC or other testing, or other--in service testing there was--not in service, excuse me--but in other plant testing, there was no specific test to verify that claim, that there's no way you'll exceed, based on anything, the 120 percent overspeed, since that is the design speed of the rotor itself.

So that was it, and--

CHAIRMAN RAY: This is a control system response question--

MEMBER BROWN: Well, there's two, two or three issues. Number one, you can have load rejections, in other words, you're at a 100 percent load, the breaker opens, and now you've got all the steam going in there and it's got--it speeds up That's one casualty that you can have, which makes them speed. The other is you can have a plant trip, where similar actions occur, it's roughly the same--

CHAIRMAN RAY: My point, Charlie, was that as we wrote the action item, the concern arises, though, from the fact that you don't demonstrate that you've got a sufficiently short sample time and response--

MEMBER BROWN: It wasn't sample time. It was--what is--

CHAIRMAN RAY: That was what was written here.

MEMBER BROWN: Yes. I know. I didn't "mouse milk" every word that was in that response. It was understood that the note is fairly explanatory. It says you don't exceed 120 percent, ever, and there was no test for it, to verify that you would do that. The other mode would be to postulate a failure of the control system, the demand part of the control system, not the trip part of the control system. I don't have any problem with the overspeed trip functionality, the design of that; but if you demand an acceleration, once you're at a 100 percent, and you start accelerating it, or you accelerate it from low load, and you pass through the normal operating speed, then you don't stabilize, then you can have sufficient acceleration that you will overshoot more than you would under some of these other circumstances.

And there was no test to show that, or an analysis. I mean, it doesn't have to be a test. It could be an analysis of the turbine generator response and the governor response itself.

So that's the concern. They provided, in their white paper, that they do two tests, in Chapter 14. One is a 100 percent load rejection test, and the other one is a plant trip from 100 percent power.

And they made a statement, in here, that both of those tests will demonstrate that you do not exceed the 108 percent, which is listed in the table as a maximum under those circumstances.

If you go look at those tests, as they're embodied in the Chapter 14, the performance criteria does not say anything, at all, about speed. All it does is say that the TG will stabilize. It effectively measures plant response.

In other words, you stabilize temperatures, flows, pressure, steam generator, valves don't trip, etcetera, on and on and on. But there is no acceptance criteria or performance criteria. It doesn't have to be--you know, it says we don't exceed 108 percent speed.

If there was some type of an acceptance criteria on those two tests, which said I don't exceed 108 percent, that would be fairly reasonable, I would think that would be good enough, as opposed to doing any other analysis. So that's my thought process on that.

CHAIRMAN RAY: Okay. Response to what he just described, then?

MR. MELTON: Keith, would you like to elaborate.

MR. SCHWAB: I agree with his assessment. Yes. We test the trip and the load reject. I would have to look at the specific wording in Chapter 14.

MEMBER BROWN: I've got it right here, if you want.

MR. SCHWAB: But if we added the criteria of 108 percent, would that satisfy the concern?

MEMBER BROWN: Yes, in both the tests. I'd be happy as a pig in a mudwall.

MR. SCHWAB: I personally don't see an issue with that.

MR. PROVENZANO: I do not either. this is Chris Provenzano. I was trying to follow some of that and I was--with the acceptance criteria. But adding 108 percent there, that won't be an issue because, you know, from a control system standpoint, that's not an issue.

MEMBER BROWN: That resolves it as far as we get a commitment to include that in Chapter 14--

CHAIRMAN RAY: All right. Well, perhaps, Ed, you can feed back to us tomorrow, or later today, or some other time, your willingness to--

MR. CUMMINS: There's just logistic issues associated with submitting the Revision 18 tomorrow.

[Laughter]

CHAIRMAN RAY: All right. Well, I'm not going to worry about that here. We're trying to reach agreement and understanding. How the heck it gets implemented, I just don't want to get bogged down in that right now.

All right, Charlie?

MEMBER BROWN: Yes. I'm happy with that one. I mean, if they put it in as a performance criteria, there's two separates, as performance criteria at the end, put it in along with the plant stuff, and I'm--I'd say I'm satisfied. It's a reasonable compromise.

CHAIRMAN RAY: Okay. Mike, what more do you have in the open session?

MR. MELTON: That would conclude our open session. The next item, ten, we'd like to--

CHAIRMAN RAY: What is the deal on item ten? You have that in closed session, is that--

MR. MELTON: That's correct. We want to do that closed session.

CHAIRMAN RAY: I see. All right. Well we're quite close to the scheduled break time, so we'll go ahead and take the break, and when we return, I'll ask that we verify that we're prepared for the closed session.

Anybody have anything they want to say, before we leave for a 15 minute break?

[No response]

CHAIRMAN RAY: So we'll be back at 10:25, please.

[Whereupon, at 10:09 a.m., the open session was concluded to resume at 2:44 p.m.]

CHAIRMAN RAY: We'll go back on the record. And, we have the staff with a presentation to us to complete some more open action items--action items, not open items. So, floor is yours.

MR. ROGGENBRODT: Thank you. Good afternoon. I'm Bill Roggenbrodt from instrumentation controls in electrical engineering Branch one, followed by Branch chief Terry Jackson and We're here to present to the ACRS Subcommittee, ACRS action items 65 and 72. Next slide

MS. MCKENNA: Go a little slow, Bill, because Charles isn't back yet. He's having--

CHAIRMAN RAY: Is he, is he coming Eileen?

MS. MCKENNA: Yes he is, he's going to get coffee.

CHAIRMAN RAY: All right, well, I'm going to put it down to him having worked during the coffee break and so okay we'll wait for a second until Charlie can get back. The coffee line down there, I can tell you, is pretty long.

For some reason. I think it's because they got a blood donor set up in the lobby. We'll wait a second until Member Brown returns. All right. We're ready now, I think. Please proceed.

MR. ROGGENBRODT: Once again, I'm Bill Roggenbrodt from instrumentation controls and electrical engineering Branch one, along with my Branch chief, Terry Jackson. We're here to present to the ACRS Subcommittee the action items 65 and 72. Next slide.

Purpose is to brief the ACRS Subcommittee on the current status of the AP1000 safety standard loading issue, sometimes referred to as the 7% loading issue. The automatic depressurization system for ADS style blocking signal and the diverse actuation system attributes. By the end of this session we hope to get, allow the ACRS to have a better understanding of the items that are captured above and we'll do that via our slide presentation, discussion of the talking points. Next slide, please.

Background for action item 65, the actuating system consists of two parts. Measures taken to ensure the protection safety monitoring system, our PMS, is capable of operating under maximum loading conditions and the operation of the PMS is watchdog timer.

The watchdog timer issue is considered resolved based upon our meeting for, middle of last month. Next slide, please, and the current status of the remaining portion of that is the staff understands that Westinghouse is committed to add information with tier one material, chapter two, section 252, table 25 2--dash, 8.

The inspections test analyses and

acceptance criteria within design commitment 11, the PMS hardware and software development process, and particularly the languages expected to be incorporated into the system integration and test phase. And, the staff finds that language acceptable.

Go to the next slide. You can see those items in red, as far as what's being added to the acceptance criteria and discusses the response time testing under maximum CPU loading.

CHAIRMAN RAY: Charlie?

MEMBER BROWN: I'm reading--it's the first time I've seen it. We had a quick discussion but let me--I understand the reason for saying maximum CPU loading. And I, you know, in other words, to keep it such that if somebody uses a different platform, that has a different number, that it, you know, you, you haven't limited yourself or given away the store somewhere.

I mean, in, in the Westinghouse case, the common Q case, it's established in the topical report as to where they talk about the 70%. And, so that one's fairly clean, I mean, you can find it. And I'm just thinking about how, somebody came along in five years and wanted a different platform, what that would mean to them.

CHAIRMAN RAY: Well, as with other things, you may want to think about it some more. At this point, I think the--

MEMBER BROWN: I'm not thinking--I'm looking to mouse milk it right now. I'm just, it's just, just my, I'm just trying to communicate my thought process and, you know, that's all I was trying to do. I'm not going to sit here and try to debate it ADS4 infinitum. I'm going to move on. But, that's in the direction. That looks, you know, that's, this would be in rev 18, I take it?

CHAIRMAN RAY: Or is it 19, Eileen?

MR. CUMMINS: It's 18.

CHAIRMAN RAY: Okay.

MEMBER BROWN: Okay, now, in terms of, is, is this, isn't a commitment, this is what Westinghouse has agreed to with you guys, that would be the response which you have agreed with and this would then be--what does this reflected--

MR. ROGGENBRODT: This is in tier one language in the ITAAC tables themselves.

MEMBER BROWN: Okay. Well, I understand this is tier one, the tier one table.

MR. ROGGENBRODT: So this would become

part of the--

MEMBER BROWN: Okay. All right, let's go on. Thank you. Okay.

MR. ROGGENBRODT: Sure. Moving onto action item 72. This action item also consists of two parts. That would be the status of the ADS block signal, and the following diverse actuation system, or DAS attributes, particularly the two out of two voting logic, the 30 day technical specific per the manual DAS out of service time, and the 14 day reporting time for the automatic functions of DAS out of service time. Next slide, please.

Looking over the first item. Within the ADS valve blocking signal, the staff required the addition--additional information, broken down into three items would be a logic diagram depicting the how and where.

ADS block signal interface with the PMS, basic analysis or discussion demonstrating why the addition of this circuit does not impede the, the ADS valves from completing their standard design function.

And, additional clarifying language into the AP1000 DCD. The staff has received the codes from Westinghouse that added the clarifying language within the design control document, and other secondary references and as a result the staff considers this issue resolved.

And, it's my understanding that what was discussed up to and including yesterday would be in part of DCD rev 18, but you want to check with the Westinghouse on that. That's--

MR. CUMMINS: That's true, they can.

MEMBER BROWN: Okay, so you have gone through, I mean, since I just saw it, I'm, you all looked at the logic diagram and concluded that that covers--

MR. ROGGENBRODT: The particulars, I can speak to the particulars.

MEMBER BROWN: I mean, this is a tier two piece of material.

MR. ROGGENBRODT: Right. What--the final determination is that the logic diagram that was proposed, actually, our understanding is that it's more software based than hardware based at this juncture. So rather than depicting the how and where, it's captured via specific note at the particular ADS valve line items going into the detail that there is a block signal and how it's actuated and what valves are utilized.

So, it'll lurch--it'll be the licensee reviewer or the plant operator licensee that there is in fact an ADS block signal.

MR. SANTOS: This is Dan Santos from the staff. We, we have copies if the members are interested of seeing the DCD under logic diagram, or--

MEMBER BROWN: The--you said this was going to be soft--a software based logic?

MR. ROGGENBRODT: No. I'm simply stating that the, the reason that it was implemented in such a fashion of the note itself is that the manner by which the ADS blocking signal is being implemented, it would not have been appropriate to be placed into that drawing as perhaps putting an additional and gate or something like that, so the more correct or acceptable manner by which to incorporate so that you're still aware that this exists was through the note process on the diagram itself.

MEMBER BROWN: So the specific execution of the unblocking, you mentioned CMT levels as an input.

MR. ROGGENBRODT: Correct.

MEMBER BROWN: That, how that gets executed is not shown, I, I don't see how that's shown. It's just the note--

MR. ROGGENBRODT: That's correct. Because, in, in that, in those particular drawings, staff's understanding is that that particular component that executes that would not be captured at that level on the, on the PMS diagram.

MR. JACKSON: It's, it's essentially that, that, the logic diagram captures the software logic in the comment you PMS.

MEMBER BROWN: As it exists today.

MR. JACKSON: Right. But the blocker would be--

MEMBER BROWN: This, this is there today. Minus the note.

MR. JACKSON: Yes, the blocker would be separate from the PMS software.

MEMBER BROWN: From where?

MR. JACKSON: Well, it would be, it would be, it would be implemented, might be, outside, it would be implemented outside the, it would be implemented outside the common tube portion of the PMS. And Westinghouse can probably discuss more about the design details as they go further.

MR. CUMMINS: Yes, I think that the, at least as the issue is presented in the U.K., the whole issue was common mode failure of common Q. So, one of the functional requirements of doing this was to do this independent of the common Q, and so we don't have a final design yet.

But, we have a commitment, not to do it, as far as the software of common Q. And so, it, what, what was said by the staff is correct, that, that it's not part of the common Q software.

MEMBER BROWN: Okay, no, I, I just not had a chance while you were talking, I was listening at the same time, multitasking is hard to do for this brain. The spurious actuation, then you talk about independence and you talk about, it will be diverse from the PMS hardware and the note then reflects it. It, it, it, go look at this, what you're going to propose here. Okay. All right, I think that, I think that's fine.

MR. ROGGENBRODT: Okay. Next slide, please. Moving onto the second item within action item 72, the diverse actuation system attributes. Concerning those attributes, two out of two logic for the DAS, that was certified in Revision 15.

The thirty day out of service time for manual DAS functions was also certified in Revision 15 and also comes as more of a chapter 16 review than it does the chapter 7 review, since it impacts the, either investment protection or tech specs.

And, again, that also applies to the 14 day out of service time for automatic DAS functions--

MEMBER BLEY: I've got a question. I, you know, we talked about this the also time. With systems that are operating in a plant, in many plants, for a long time, we have good data on how often they go into maintenance, planned or repair, and, and how long it takes to repair them.

With something that isn't out in the fleet, and something we used to see was equipment would often be out for the full time allowed in the tech specs. On this one, we look at the PRA and the PRA calculates a nice, low-level of unavailability for this system that's completely unrelated to the thirty day tech spec.

And, I'm, I'm just not sure why that's a reasonable thing. Somebody here said, well, you know, nobody's going to leave tout for the full thirty days. Well, you can. And, in the past, a lot of people did leave out for the full length of time, and one something like this where we've, we don't have it in the field, we don't know what might go wrong or how long it takes to repair it or how--

You know, it just, having that 30 day tech spec and then not using that as the basis for the unavailability in the PRA but using something much less, like, at least a tenth of that. I don't, I don't quite get it, or, I don't get why staff looks at it and says, yes, it's a reasonable thing.

I mean, the whole design when you rescind this, of, of the DAS is ray based. Came in as a result of the PRA, it's been used, designed based on the PRA. It's, its' requirements are based on the PRA and yet we don't set a, an allowed outage time that's consistent with that whole basis of the design.

It just leaves me with a great uncomfortable feeling, and I haven't heard a good argument yet from anybody why that's a reasonable state of the world.

MR. SANTOS: This is Dan Santos from the staff. If we could have the Applicant address your, your points, that would be better because again this thing you're mentioning, aprt of the certified this time but I would like to put that question to the Applicant to see how they went though it.

MEMBER BLEY: Yes, but I'm also first interested in why, why staff thinks it's a grand idea.

MR. CUMMINS: I'm Ed Cummins. The NRC rules and policies doesn't use the tech specs to enforce the PRA. If they use anything to enforce the PRA, they use the maintenance Rule to enforce the PRA.

MEMBER BLEY: That's right, but we've never had a system designed on the basis of the PRA before either that I know of.

MR. CUMMINS: Yes, but, I, you know, this would be, I would say, a horrible precedent to say that We're going to use tech specs to, to enforce the assumption of the PRA--the, the assumptions of, for the, for the, past reliability are consistent with the EPRI failure rates and, and, and repair rates.

There are some, some cases where the repair of DAS would require plant shutdown and entry, entry to places in the containment we can't have half an ability to repair up, that instrument or a connection. And so, you know, it, it can make sense to have a significant time in, in the tech specs.

The tech specs are to enforce non basis accidents, and--

MEMBER BLEY: Except, this system has nothing to do with--if it has anything to do with, with getting core damage frequency down low, then the plant damage frequency down low, so this is kind of unique.

MR. CUMMINS: Yes, but I, I agree with you on, the staff policy, and they can say this better than I can. I don't really want to say what--it, is, is, is, is, they look at enforcing a, a, a, I'll put quotes around enforcing, the PRA assumptions through the maintenance Rule.

Not, and so they look at how these times, repair times, and in the maintenance Rule. Not in the tech specs. And so if there is something that should be addressed to maintain the assumptions of the PRA, it should be covered in the maintenance Rule, not in the technology specs.

MEMBER BLEY: I'm kind of sitting out on a limb with this and I may saw it off eventually, but when I had the system designed, you know, on the basis of the PRA, there to support the PRA, it just doesn't make sense to me for it to fall under the normal approach to setting these outage times. Go ahead.

MR. JACKSON: Okay. And I, I would just add that, you know, from the staff's point of view, my staff isn't really prepared to answer questions about the technical specifications through the PRA, particularly on the, you know, the certified design, which we weren't involved with--

VICE CHAIRMAN ARMIJO: Could I ask a question? Clarification. Is it possible then that both the manual DAS and the automatic DAS could be out of service at the same time?

MR. ROGGENBRODT: Of course, yes.

MR. CUMMINS: Yes.

VICE CHAIRMAN ARMIJO: That's a good idea.

MS. MCKENNA: Well, the point, I think the point is, is that the maintenance Rule does try, also take into account whatever available compliment of equipment. That's one of the features, I think, of the maintenance Rule gives you beyond the tech specs is that it, they have to account for this component being out of service at the same time as that component being out of service for what period of time it's out of service in their risk assessments, for, for the maintenance Rule.

So, it is certainly is possible, yes, there's nothing that would prevent it. From these provisions, it would be maintenance Rule and it, whether the risk would be too high for the period of time that you'd be in that, that situation.

VICE CHAIRMAN ARMIJO: But, but an operator wouldn't necessarily know that the maintenance Rule is going to take care of things, whereas the tech spec is right there in front of you.

MEMBER BLEY: That, that'll come later.

VICE CHAIRMAN ARMIJO: So, so there's no connection between, in the tech specs as saying, this thirty days is okay, provided the other one is in service, or--

MS. MCKENNA: That's correct.

VICE CHAIRMAN ARMIJO: --this 14 days is okay, provided--there's nothing like that?

MS. MCKENNA: No. The tech specs are all very singular in their application.

MR. JACKSON: And, and the 30 day, allowed outage time for the manual DAS functions is in the tech, technical specifications. The fourteen day allowed outage time for the automatic DAS functions, investment type--two different, two separate programs.

But as Eileen did mention, the maintenance Rule would be a big player with regards to DAS, particularly not only from the unavailability time that may be gained if it's out of service for a while but also from the A4 standpoint where they have to look at the risk of, of, of current plant activities on a continual basis.

MEMBER BLEY: Yes, just from what you said, let me read you a line from the Westinghouse document that explains all this. Because the DAS manual control must be credited in order to meet the PRA safety goal--that's not a regulatory requirement--it was concluded that these DAS manual action manual controls should be included in the tech specs.

But, again, not at a level consistent with the safety pool. It just seems an odd connection of logic to me.

MEMBER BROWN: What page did you read that one on?

MEMBER BLEY: I'd have to go find it again. I've excerpted a bunch of that stuff.

MEMBER BROWN: It's the manual one, right? Is it the manual function?

MEMBER BLEY: Yes. It's the manual--

MEMBER BROWN: Yes, okay. I mean, I'll look through that, I'm trying to, I remember reading that.

MEMBER BLEY: Well, it, it seems like a worthwhile discussion for sure. I just wonder if we've exhausted all the exchange that we need to have here.

MEMBER BROWN: Well, Harold, I think we ought to make the, one fundamental, the reason I brought this up, okay, and, and try to, try to at least get it articulated is if you look at the, the standard primary SFAS, its' a microprocessor based system, common q based.

It, it has the same fundamental voting problem that the, that the PMS system has. In other words, is the voters lock up, it doesn't actuate. Argue how, but it doesn't actuate.

PMS, maybe we'll walk through that, because there's another function called a watchdog timer which provides that backup such that if the voters lock up, you'll get a, you'll get a trip, and the reactor shuts down.

With the SFAS, if they don't operate, their valence is, there is no deferral or default to a trip function for the, for the primary sfas. You don't want it to, okay, and so--

MEMBER BLEY: But it's not two out of two, you don't--

MEMBER BROWN: No, it's two out of four. They all lock up, it's not going to operate. So what's your backup? The backup is, the automatic DAS and then the manual DAS. Well, if they're both allowed to be out of service at the same time--

MEMBER BLEY: You don't have a backup.

MEMBER BROWN: They're not--have no backup.

MEMBER BLEY: I, I understand that.

MEMBER BROWN: And that's the fundamental issue I have with not having some of the--forget maintenance, how the maintenance Rule gets into this. I'm, I'm not so sure, there's just nothing in these documents as part of the plant operation that says We're not, We're not going to have these be combined at the same time.

MEMBER BLEY: Okay, but--

MEMBER BROWN: I'm not arguing with two out of two. But we've been over this several times now, I mean, I don't think anything's changed.

MEMBER BLEY: I wanted to make sure it was clear.

MEMBER BROWN: All right. That's all.

CHAIRMAN RAY: Does anybody lack clarity? Okay. I mean, you know, we've had the staff now respond to us, they told us their position. Westinghouse has told us their position. We'll have to decide what our position is, but this isn't the time to do it. Dennis, anything else, from your--

MEMBER BLEY: Oh, not a thing. Well, no, I mean, I'm, I'm serious. I, I'm, I mean, We're wring our hands over something--I'm not being smug about it, but I mean, you go back and you read the documents and in fact this is, is unique in our industry so far, it might not be in the future to have a system that's whole design approach is based on the PRA and then this seems inconsistent with that.

CHAIRMAN RAY: Well, yes. And I mean, I could comment that I went into a plant everyday where the maintenance Rule applied and we had a, the, the risk in the plant that day depending on what maintenance and what other failures that occurred during the night and all that kind of stuff, and.

You know, we tried to pay attention to it, but we didn't shut the plant down. Because of some particularly high risk that day, usually it was a turbine driven aux feed pump that was the culprit, but anyway.

So, we, I think we got all the facts before us, and if there's nothing more, we should move on. Anything more you guys have?

MR. CUMMINS: Can I make one more comment?

CHAIRMAN RAY: Yes.

MR. CUMMINS: The, the PMS has reliability equal to the PRA results of the current operating fleet, by itself. By itself. With no DAS.

MEMBER BLEY: If We're right about common cause, for which we don't have enough experience to know if We're right or wrong--

MR. CUMMINS: So, I mean, whatever. Yes. That's true.

MEMBER BLEY: That's right.

CHAIRMAN RAY: Well, learning to live in this world of much more, much safer plants. Okay. So, comparing this plant to the plants that We're used to operating probably isn't very useful most of the time.

Okay, with that I've got a short window here when we have an opportunity for Westinghouse to respond to Said's earlier question. Are you guys done? Eileen? All right. Did you have something more--we had a summary slide. Please, go ahead.

MR. ROGGENBRODT: Staff considers the watchdog timer issue resolved. We PMS maximum loading issue resolved. ADS block signal issue resolved, and DAS attributes are again, were certified in Revision 15 design control document.

CHAIRMAN RAY: I understand. Very good.

MR. ROGGENBRODT: With that, that's the end of our presentation. Thank you.

CHAIRMAN RAY: Thank you. Okay, with that we'll ask Westinghouse to provide us some instant follow up or feed back to question earlier today.

MR. OFSTUN: Okay, this is Rick Ofstun

again, from Westinghouse. I had time to confer with colleagues back in Pittsburgh, and they, they reviewed the, the kind of steady state calculation and determined that we were off on that value. They calculated a new time of about 353 seconds instead of the 337 seconds.

CHAIRMAN ABDEL-KHALIK: What I calculated was 378 seconds.

MR. OFSTUN: Okay. This, this was a preliminary unverified calculation. They just did it on the fly. Then I asked them to check what was used in the evaluation model and the value that's used is 410 seconds. So, we are--

CHAIRMAN ABDEL--KHALIK: In terms of calculating the pressure history?

MR. OFSTUN: Yes. And then I also asked Meghan to run a case extending the time for steady state coverage out to eight minutes instead of either five and a half of six or whatever we're coming up with here. So, 480 seconds.

And, and the result of that was that the pressure, the peak pressure increased by approximately .5 psi, so we're not very, we're not real sensitive to that time of steady state water coverage.

CHAIRMAN ABDEL--KHALIK: How much margin

did you originally have, and how much margin do you now have?

MR. OFSTUN: We have--I'm not sure exactly, I think it's about one and a half to two psi.

CHAIRMAN ABDEL--KHALIK: So, you know, a half psi increase is a--

MR. OFSTUN: Is about a third of our margin, yes.

CHAIRMAN ABDEL--KHALIK: Okay. All right, thank you.

MR. OFSTUN: Is that all?

CHAIRMAN RAY: I believe so. Anybody else have a question they';d like to ask on that subject? Have a good trip.

MR. OFSTUN: Thank you.

CHAIRMAN ABDEL--KHALIK: How often is this going to be documented?

MR. OFSTUN: Well, we're going to take out, we have a corrective action process so we'll have to take out a, it's called an I.R. report, and then do all the paperwork, but then I think we'll have to update the report. We have another update to that report going out soon anyway, to include the corrected time in the report.

MR. CUMMINS: So that, is, what, a 400,

evaluation model selection is in the WCAP submitted to the staff, or, or somehow submitted, or--

MR. OFSTUN: The--the 337--

MR. CUMMINS: No, the 400--

MR. OFSTUN: --the second number iwll have to change to 365 or whatever it turns out to be. You need--but the model, the, the--

MR. CUMMINS: The results of the analysis have been submitted to the staff, or have been audited by the staff, or--

MR. OFSTUN: No changes are required to, to that analysis.

MR. CUMMINS: This will be an internal change.

MR. OFSTUN: Yes, it will be an internal change and then the topical report will have to be changed--yes, adjust to different time.

CHAIRMAN RAY: All right. Thank you. Ed, do you guys have anything more that you want to say today?

MR. CUMMINS: No thank you.

CHAIRMAN RAY: Eileen?

MS. MCKENNA: No, sir.

CHAIRMAN RAY: All right, we're going to--

VICE CHAIRMAN ARMIJO: Can I, can I ask a question--clarification. I, in, in kind of looking--start, through the material, stuff related to the pump, I came across one Westinghouse technical report that I, I, may not understand.

And that is, with relationship to the primary loop piping materials. And there's some changes where they now refer to 300 series stainless steels and previous versions, they refer to low carbon versions. And, the question is, is, is it Westinghouse's intent to use the, the high carbon stainless steels for the piping and coolant boundary?

CHAIRMAN RAY: Okay--

VICE CHAIRMAN ARMIJO: And, and, and, is, is that okay with the staff.

CHAIRMAN RAY: Well, let's-let's first direct the question the way he did it, which is to the Applicant, and then--

MR. CUMMINS: Okay.

CHAIRMAN RAY: You may need to reframe it, he may not have been listening--

MR. CUMMINS: I did listen. I think the question is, what is the material for the primary loop piping, and, and, I know it's a stainless steel forging, but I don't know what it is and we'll have to find out.

VICE CHAIRMAN ARMIJO: Well, it, it says in these tables, it, it, what used to be the low carbon grade, the 316 and 304, it can now be the high carbon grades, which we know have caused enormous propbelsm on BWRs but it's also caused problems in some PWR's. And so the question is, is, is that really Westinghouse's intent, and the justification has to do something with availability and cost and stuff like that, and just, and it's part of the DCD section 5.2 table 5.2.1, so, you know, I, I just think that's, just want to know if both Westinghouse and the staff really intend to use these more susceptible materials in those, in those components.

CHAIRMAN RAY: Okay. All right.

MR. CUMMINS: We'll have to look this one up.

VICE CHAIRMAN ARMIJO: Okay. If you get back to us, I'd appreciate it.

CHAIRMAN RAY: So we'll look for you to give us an answer tomorrow.

VICE CHAIRMAN ARMIJO: I can't believe that you would want to use the high carbon.

CHAIRMAN RAY: Okay. Eileen, we want to ask you for a response--

MS. MCKENNA: Yes, I don't have the right people here to do that.

CHAIRMAN RAY: Did you follow it well enough--

MS. MCKENNA: I think so, it was what the primary loop piping material, whether it was this high carbon, and what the, the, that was--

CHAIRMAN RAY: Yes. We'll ask was he enough to respond before hearing anything from you guys, but that'll be a followup item that we'll have to look at tomorrow probably. While we're still on the record, and then we'll end, being on the record, I wanted to do at least two things.

And then, anything else that members want done. One will be to just scan through all the action items that we created, not attempting to read them in any detail. In fact, you can take this and look at it later in more detail, if you wish, to, in order to make sure that we've identified anything of importance to any of the members.

And we've overlooked that. Another item that I wanted to do at this point in time was to say that in these discussions, particularly here at this point in time, I've tried to emphasize the technical issue at hand and the response to it, whatever that may be.

There is left open the question that has been asked several times by Bill and Charlie, for example. Well, how does this get captured? And, I don't want to pick on any one item, but I do trust that where the ACRS is asked a question, we've gotten a response.

Probably we will reflect that that occurred in our letter, that there will then be some way of ensuring that it in fact gets done. I can't believe that that wouldn't' be the case. But as to whether or not it's going to be in ITAAC, if that's the right vehicle, we can have that discussion further if anybody wishes to do so.

But, I'm not sure we want to try and prescribe that either in our letter or to decide it here. Do you have any comment, Eileen?

MS. MCKENNA: I, I think that that's true, I'd hope that would be true. I think certainly if there was a lot of information has already been provided to the Committee you have it, and there's no future tense, if you will, to it.

There is a few like the test report for the, the test you have to be done on the 18 manganese chromete material that obviously has, hasn't, is not available at this point, and, and Westinghouse has made a commitment to provide that.

And we will be sure to follow up and make sure that they did and we provide it to the Committee. I think in some other cases, there were changes for example, the issue about the PMS response time, where there was an actual change to the ITAAC that's been proposed that was in the response to an issue that had come up to the Committee and that that's how that is being reflected in the DCD. So, I think there's a range of, of methods to capture this information depending on what it is.

CHAIRMAN RAY: Yes, so, you know, I think it would be, yes, if we said nothing about whatever the issue happened to be, then perhaps people could say, well, you know, we answered their question but We're not bound to do it in any particular way or what not.

But if we do say, well, we asked this question, we got this answer, then I think its' between the staff and the Applicant to decide how to memorialize that from that point forward.

Okay. With that, then, as I say, everyone has received a copy of the action items. I don't plan to plow through these item by item by item. But I did want to afford members the opportunity to--Weidong and

I believe that we've addressed all these items.

I believe the staff and Westinghouse think that we have. And, I just want to tender this to you, and say if that's not the case, either speak up now or advise us later that, but hopefully as soon as possible, that there's something that we haven't yet addressed fully.

Okay. Well, with that, let me ask if there's anything else to be discussed on the record. I hope to recall Sanjoy here after we go for the record, get from him some discussion that may prompt some feedback from you relative to where he stands on his letter.

I'll do the same on the status of a letter addressing the Amendment application. And then we'll be miraculously done for the day. Anything else? Okay, with that, we will adjourn the meeting, and we will continue the discussion briefly of the status of work for the preparation for the full Committee.

(Whereupon, the above entitled matter was taken off the record at 3:21 p.m.)

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS SubCommittee

Westinghouse AP1000 Design Certification Amendment Application Review

Seismic Design Requirements – Controls

December 1, 2010

Outline

- REVISON 15
- TIER 2* IN REVISION 15
- CHANGES FOR REVISION 17 (AND 18)
- STATUS OF STAFF REVIEW

Revision 15

- Revision 15 had seismic design information in Tier 1, Tier 2* and the majority as Tier 2
- Tier 1 section 3.3 (Buildings)

  - design basis loads

  - key dimensions

  - critical sections

  - figures
- Tier 2* designation for information in sections 3.7, 3.8 and 3H, for information such as descriptions, criteria, member forces, required plate thicknesses, stress results

Tier 2* in Revision 15 (and Appendix D to Part 52)

- Specific information is marked as tier 2*, requiring prior NRC approval if a COL wants to change it
- Broadly listed in the DC rule as:
  - Nuclear Island Structural dimensions
  - Design summary of critical sections
  - Use of ACI-318, 349, and AISC-690
  - Definition of critical locations and thicknesses
  - Seismic qualification methods and standards
  - Piping design acceptance criteria

Changes for Revision 17 (and 18)

- Due to reanalysis for range of soil conditions, and new design for shield building, the specific Tier 2* details needed to updated
- Realization that Tier 2* application to member forces and stress results was overly restrictive
- As part of RAI responses, submittal of shield building report, Westinghouse proposed DCD markups to reflect new design and analysis information, including subset to be designated as tier 2*

Staff Review

- Staff technical review focused on information in technical reports
- Staff general agreement about Tier 2* for critical sections, required reinforcements, but not on stress results
- Staff is in process of detailed review of W proposals, as planned for Revision 18
- Any changes would be reflected in future DCD revision

Construction Oversight

- COL application of change control processes
- Engineering Design Verification Inspection
- Construction Inspection Program
- ITAAC Inspection Program

AP1000 Reactor Coolant Pump Flywheel Action #4 Closure

December 1st, 2010

Safety of the Flywheel Retaining Ring Component

- Locked rotor analyses completed and reviewed and accepted by NRC staff
- Safety consequences accepted
- Risk assessment accepted
- A625 Ni-based alloy enclosure has proven primary water SCC resistance
- Low service temperature (300F design)
- Materials
  - Austenitic stainless steel – not duplex structure, no martinsitic structure
  - Manganese is austenitic stabilizer to address cold work
  - Immune to boric acid corrosion
  - Widely used in higher temperature primary water applications
  - Corrosion data applicable to potential exposure to upset primary water conditions

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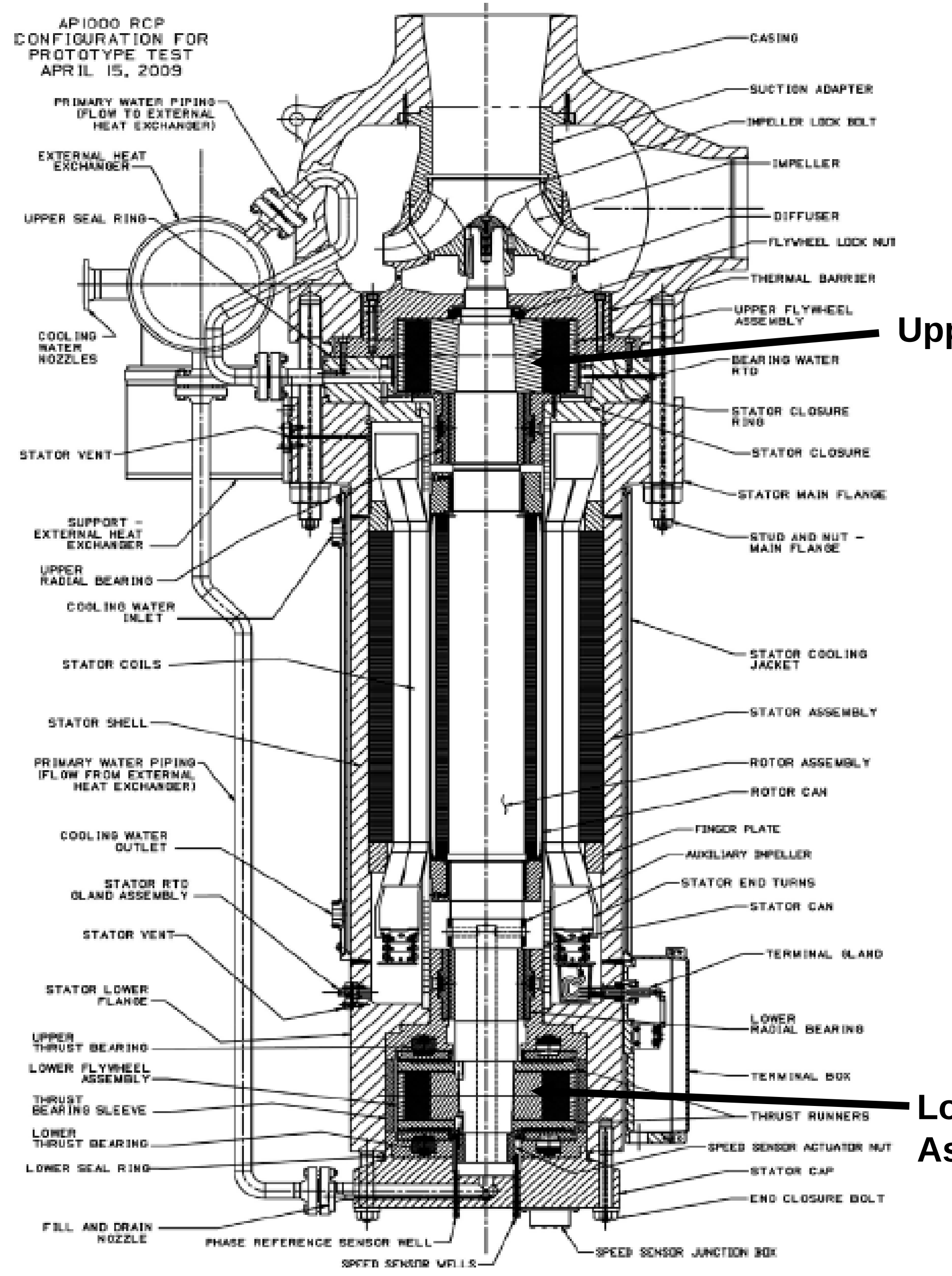
Back-up Slides

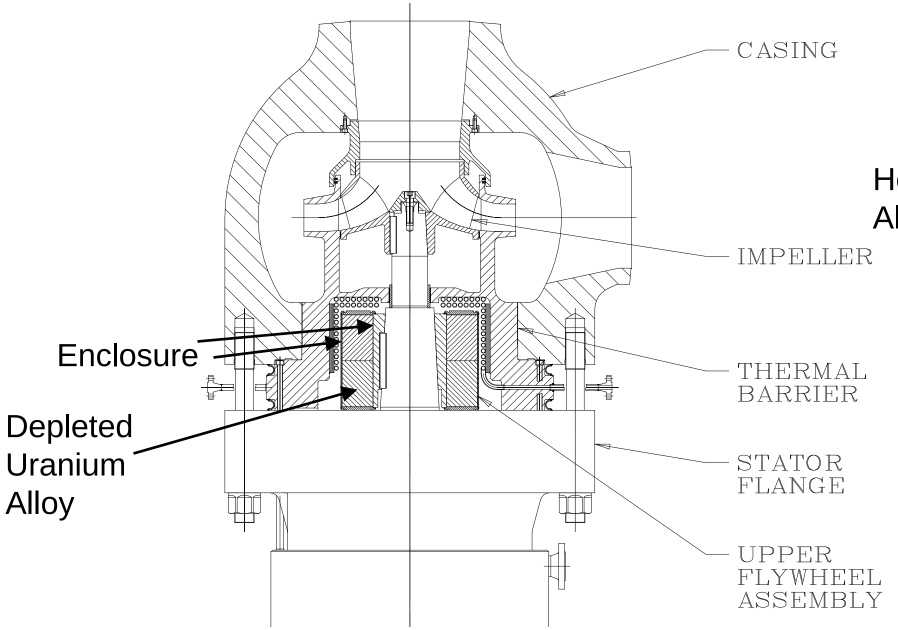
AP1000 RCP Outline

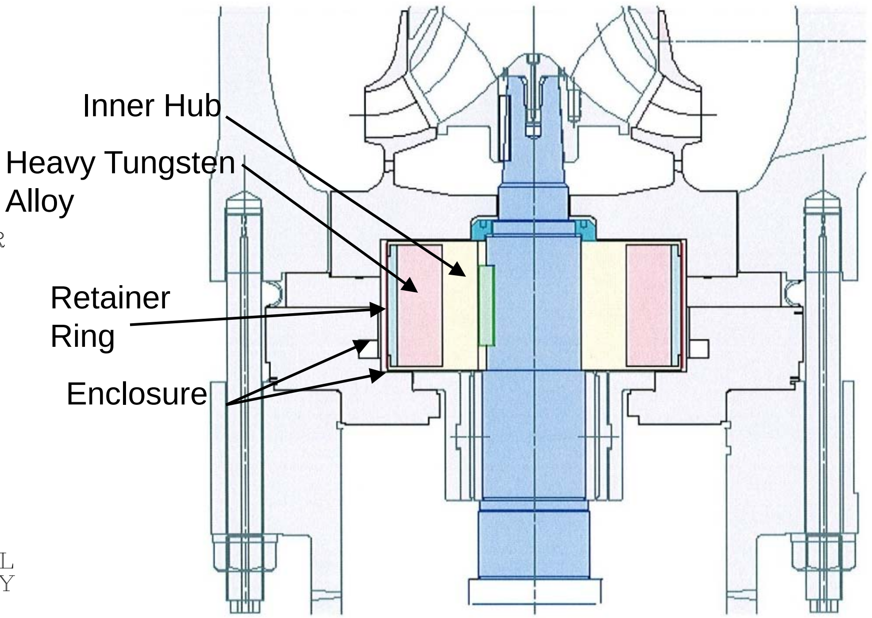


Upper Flywheel Assembly

Lower Flywheel Assembly

Flywheel Configurations





<u>DCD Revision 15</u>
Depleted Uranium Alloy
Enclosure

<u>DCD Revision 17</u>
Inner Hub
Heavy Tungsten Alloy
Outer Retainer Ring
Enclosure Plates and Shell

Flywheel Materials

	Shaft	Inner Hub	Flywheel	Retainer Ring	Enclosure
DCD Rev 15	403 SST	N/A	Depleted Uranium Alloy U-2Mo	N/A	Alloy 690
DCD Rev 17	403 SST	403 SST	Tungsten Heavy Alloy	18 Ni Maraging Steel	Alloy 625
Post DCD R17 (RAI 5/09)	403 SST	403 SST	Tungsten Heavy Alloy	18Cr-18Mn	Alloy 625

Flywheel Materials Specifications

	Shaft	Inner Hub	Flywheel	Retainer Ring	Enclosure
DCD Rev 15	ASTM 336 – Gr F6	N/A	Design Spec Specified	N/A	ASTM B168 and B564
DCD Rev 17	ASTM 336 – Gr F6	ASTM 336 – Gr F6	ASTM B777 Class 4	AMS 6519	ASTM B443 and B564
Post DCD R17 (RAI 5/09)	ASTM 336 – Gr F6	ASTM 336 – Gr F6	ASTM B777 Class 4	ASTM A289	ASTM B443 and B564

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Discussion of Material Changes

- **High Density Flywheel Material Change – Depleted Uranium to Tungsten Heavy Alloy**
  - Increase in Required Inertia - As the RCP Design was Finalized, Friction Losses Increased Due to Increased Power Requirements, Detailed Loss Calculations, etc.
  - Depleted Uranium was Structural Component – Increase in Inertia Required Increase in Diameter Which Resulted in High Stress Levels
  - Evaluated Alternate Materials – Tungsten Heavy Alloy
    - Advantages of Tungsten Heavy Alloy – Multiple Suppliers, Known Material Properties/Fracture Toughness (ASTM), Volumetric Examinations Standard, No Environmental/Health Issues, Owning/Handling Not Regulated
  - DCD Revision 17 Flywheel Configuration Changed Such that High Density Material is Not a Structural Part
    - Retainer Ring Holds Tungsten Heavy Alloy Segments, Only Structural Components are Ring and Inner Hub

Westinghouse

Discussion of Material Changes (Con.)

- Flywheel Enclosure
  - Change from Alloy 690 to Alloy 625
  - Advantages of Alloy 625 – Lower Coefficient of Thermal Expansion (Reduces Stresses in Enclosure); Higher Yield Strength; Easier to Weld
- Retainer Ring
  - DCD Revision 17 – 18 Ni Maraging Steel for High Strength
    - Flywheel Mockup for Manufacturability and Demonstrate Balancing
      - Cracked Retainer Ring
      - Hydrogen Embrittlement/Stress Corrosion Cracking
  - Retainer Ring Material Change Included in Response to RCP RAI in May 2009
    - Ring Changed to18Cr-18Mn
    - Material Developed for Retainer Ring Applications in Generators Because of Cracking in the Materials in Use (18Mn-5Cr)
    - Not Susceptible to Corrosion or Hydrogen Assisted Stress Corrosion Cracking
    - Lower Strength Requires Thicker Retainer Ring, Reduces Tungsten Alloy Mass

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Summary of Inertia Changes

	Rotating Inertia ($lb\text{-}ft^2$)	Reason for Change
DCD Rev 15	16,500	
DCD Rev 17	23,510	Detailed Design- Additional Losses
Post DCD R17 (RAI 5/09)	23,110	Change in Retainer Ring Reduced Tungsten Volume/Mass

- Flow Coastdown Requirements in Design Spec Have Not Changed
- Calculated Pump Coastdown Flows Have Always Been Higher Than Those Used in the Safety Analyses

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Flywheel Inspection/Testing Requirements

- Each Structural Component Inspected Prior to Final Assembly According to Requirements In Section III, NB-2500 of ASME Code
  - Inner Hub
    - Ultrasonic Examination
    - Magnetic Particle Examination
    - Liquid Penetrant Examination of Inside Surface After Finishing Operations
  - Retainer Ring
    - Liquid Penetrant Examination
    - Ultrasonic Examination
    - Liquid Penetrant Examination of Outside Surface After Finishing Operations
  - Enclosure (Non-Structural)
    - Dye Penetrant of Welds
    - Enclosure Leak Tested
- Impact Testing – Inner Hub and Retainer Ring Material
- No In-Service Inspection Required
  - Postulated Flywheel Missiles are Contained Within the Pressure Boundary
  - In-Service Inspection of the Flywheel Would Require Pump Removal, Disassembly, and Removal of Flywheel Enclosures
  - High Radiation Exposure

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Flywheel Missile Analyses

- Follows Procedure Used for Turbine Disk Fractures (Hagg and Sankey, "The Containment of Disk Burst Fragments by Cylindrical Shells")
  - Stage 1 – Inelastic Impact and Transfer of Momentum to the Pressure Boundary (PB)
  - Stage 2 – Dissipation of Energy in Plastic Tensile Strain in the PB
  - Calculation Assumptions
    - Ignore the Retainer Ring and Enclosure Components
    - Minimum ASME Material Strength Properties @ Design Temperature
    - All Heavy Alloy Segments Impact the PB
    - Upper Flywheel – Check Penetration Through Thermal Barrier and Stator Closure
    - Lower Flywheel – Check Penetration Through Stator Lower Flange
  - DCD Rev 17 Minimum Margin is 1.8 for Upper Flywheel Stage 2
  - Minimum Margin for Flywheel Design Change in Retainer Ring Material (May 2009 RAI Response) Increased to 2.0 for Upper Flywheel Stage 2 Due to Small Changes in Tungsten Alloy Segments and Pressure Boundary

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AP1000 Reactor Coolant Pump Flywheel

April 2010

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Purpose

- Respond to ACRS request for information on the reactor coolant pump (RCP) flywheel failure frequency used in the AP1000 Probabilistic Risk Assessment (PRA) model

AP1000 PRA Model Information

- AP1000 PRA does not model the failure of the RCP flywheel
  - Not modeled as an initiating event
  - Not modeled as a consequence of another initiating event or as a random failure during another initiating event
- A RCP flywheel failure frequency has not been used in the AP1000 PRA model

AP1000 PRA Model Information

- Not explicitly considering the failure of the RCP flywheel is consistent with current operating plant PRA models
- RCP flywheel failure is considered a very low probability event
- RCP flywheel failure could result in:
  - A transient event
  - A loss of coolant accident (LOCA) if the reactor coolant system is damaged

AP1000 PRA Model Information

- The frequencies of transient events and LOCAs from other sources is much larger than from RCP flywheel failures, therefore:
  - the impact on plant risk is negligible
  - RCP flywheel failure is not explicitly modeled