Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Westinghouse AP1000 DCD Subcommittee
Open Session

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Tuesday, November 2, 2010

Work Order No.: NRC-529 Pages 1-73

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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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WESTINGHOUSE

AP1000 DCD SUBCOMMITTEE

OPEN SESSION

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TUESDAY

NOVEMBER 2, 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 1:41 p.m., Harold B. Ray, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

HAROLD B. RAY, Chairman

SAID ABDEL-KHALIK, Member

J. SAM ARMIJO, Member

DENNIS C. BLEY, Member

MARIO V. BONACA, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

CONSULTANTS:

THOMAS S. KRESS

GRAHAM B. WALLIS

DESIGNATED FEDERAL OFFICIAL:

WEIDONG WANG

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

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

1:41 p.m.

CHAIRMAN RAY: On the record. I will take a break, but I just think it's too soon to do it right at the moment. Those of you who must have your laptops in front of you -- normally that would be me -- may go one at a time and get your -- Not supposed to be in the room we were told.

MR. WINTERS: Excuse me, Chairman.

CHAIRMAN RAY: What do you need?

MR. WINTERS: There was a question about the Westinghouse presentation. It is marked security related information.

CHAIRMAN RAY: Yes.

MR. WINTERS: That is not safeguards.

CHAIRMAN RAY: Yes.

MR. WINTERS: It is SRI only. So you can handle them as you normally would handle security related, not safety.

CHAIRMAN RAY: Okay.

(Off the record comments.)

MR. SISK: Was the answer we were going to talk about 19?

CHAIRMAN RAY: Yes, the answer is we're going to talk about 19.

MR. SISK: Okay. We've got the people coning right over.

CHAIRMAN RAY: Thanks.

(Off the record comments.)

Okay. All of this babble will be on the normal transcript I guess.

Let me ask Westinghouse also. There was a comment that there was a corrected copy of the report that Sam looked at yesterday and some of the others have looked at it.

MEMBER ARMIJO: En route.

CHAIRMAN RAY: It will be here and you will let us know when it arrives, will you?

MR. CUMMINS: That is correct.

CHAIRMAN RAY: Thank you.

MEMBER REMPE: Would it just be today that we have access to look it over? Or will it be here for today and tomorrow or what's the plan?

CHAIRMAN RAY: May we have it for whatever remains of today when it gets here and tomorrow morning?

MR. CUMMINS: Yes.

CHAIRMAN RAY: Thank you. Okay. We're getting the telephone line opened.

(Off the record comments.)

Okay. We're getting ready to begin the open session now of today's AP1000 meeting. We need to have the telephone in listen only mode.

Thank you guys for standing by and coming in at our request. Sorry we're running a little late today.

MR. ANDERSON: No problem.

CHAIRMAN RAY: We would like to have the slides up and running, but in the interest of time we're ready when you are. So if you've got any introductory comments or we can run off of these handouts that are being passed around.

(Off the record comments.)

Mr. Anderson, are you going to start?

5 OTHER CHAPTER 19 - APPLICANT

MR. RAY: Actually, I'm going to give the presentation this time.

CHAIRMAN RAY: All right.

MR. RAY: Everybody have a copy of the slides?

CHAIRMAN RAY: Yes.

MR. RAY: Okay. So this is the AFSER review for Chapter 19. We've already come for the original SER with open items. This is basically just closure of the five open items and I'm going to briefly cover them. I actually will very briefly cover the seismic margin 1 and the AIA because they've already been discussed.

CHAIRMAN RAY: Yes.

MR. RAY: This is just Chapter 19 overview. Chapter 19 has the PRA, the asbestos severe accident phenomenon, equipment survivability, obviously we're been talking about it all more, the malevolent aircraft impact, shutdown evaluation, and there is some assessment of the AP1000 design features.

With me to make sure I introduce him is Rick Anderson from Westinghouse. He's got the PRA lead for the AP1000 and Andrea Maioli from Westinghouse also. He helped with the seismic margin and is also here providing support.

There were as we discussed five open items that were identified in the SER with open items. I just listed here. I'll actually go over each one as we go through the slides.

The first one was a request for a more detailed resolved and requantified PRA model and any DCD updates that may have been necessary for this open item. You'll notice as we go further if you look at the two different open items there's a Number seven and Number 13. They're very similar. Number seven deals with the at-power PRA and Number 13 deals with the low power and shutdown PRA.

For this, originally the DCD Rev. 17 did not reflect the new I&C model provided in the PRA. So the PRA was requantified. Results for the at-power requantification show that that the core damage frequency and the large release frequency are very similar along with the top cut sets were very similar to what was in there before. So there were no DCD changes required for that requantification of the PRA.

For Number 12, we've already discussed this. This was the seismic margin analysis and pulling the DCD and putting a lot more information into Chapter 19.55 to be in compliance and the guidance provided in ISG-20.

Thirteen, again this was the shutdown PRA risk. We did provide more detail in the DCD Chapter 19.59-5 to reflect the results and insights of the requantified low power shutdown PRA. We discovered that when we did this requantification the results were different enough that we should update the DCD. So this is actually now a confirmatory item. The staff has gone through and reviewed it as part of their audits for Chapter 19. They agree with the numbers for the requantification.

MEMBER BLEY: And this will be in Rev. 18.

MR. RAY: Eighteen, that's correct. Yes.

Fourteen, this was actually there was some discrepancy and I'll say confusion on one of the calculations we had that discussed containment inventory radionuclides. So this was basically an open item for more information.

Also they wanted mechanical hatches and gaskets into the environmental assessments which we agreed upon. We said, "Yes, they should have been in there."

And there were some confusing terms in our severe accident words in Chapter 19 related to how the hydrogen monitors would be used in a severe accident. We actually -- There was some stuff in Rev. 17 that wasn't correct anymore with the design. And we needed to correct those words.

So we updated it. And again, that's a confirmatory item. DCD Rev. 18 will fix the section related to hydrogen monitors.

And the last one is the open item on the AIA based on -- The open item was left there based on needing the new guidance provided in the draft guide. At the time we issued the SER with open items, the draft guide wasn't finished. That's why the open item stayed. And we already discussed. They had issued us RAIs before the inspection. But we updated Chapter 19F or 19 Foxtrot on.

MEMBER BLEY: Now I don't want to bring up things we can't talk about here. But there were things identified in response to the violation on the AIA that were design changes. I don't know where they show up in the DCD or where they will show up Rev. 18.

MR. RAY: Chapter 9.

MEMBER BLEY: They'll be in Chapter 9.

MR. RAY: That's correct.

MEMBER BLEY: All right.

MR. RAY: There were -- And it's not even SRI in Chapter 9.

MEMBER BLEY: Okay.

MR. RAY: There were barriers originally for the RAIs that we had sent. They requested -- They sent us an RAI. They requested more information related to some of the barriers, the five PSI barriers. And we said okay. So we put two in for Chapter 9.

While Westinghouse is going through and preparing for the AIA inspection, realize that there actually needed to be three more barriers in a wall.

A design change was done right prior to the inspection and it was just a matter of timing. The design was done I think the Thursday or Friday before they came. So when they came they saw all the new updated design. And as part of that we said we will advise one of the RAIs that they'd originally asked us to include those extra three barriers so that the DCD does have all five.

MEMBER BLEY: And there were seals on airlocks going into the annulus that would change or were going to be changed so that they'd seal from outside in rather than inside out.

MR. RAY: I can't off the top of my head remember if those were part of the five that were added to Chapter 9.

MEMBER BLEY: I think not, but maybe they will be eventually. I think that response hasn't been sent. That's good enough.

CHAIRMAN RAY: There was also a matter of door closure timing. Again, by the way, I should mention I should have had a -- while we're still in safeguards -- thorough review of what all the action items were. I didn't do that. We will have to do that.

But I think my question was similar to the one that Dennis just asked here. During our discussion there was a question about ability to affect door closure and the comment that I noted was that it hadn't been decided yet how to address that. Does that go in Chapter 9 or not? This is during refueling outage.

MR. RAY: I'm not certain if that would go in nine at all.

CHAIRMAN RAY: I see. Okay. Because it's still an item that we didn't resolve during the discussion and it was just indicated.

MR. RAY: Yes, I'm not certain that that guidance would be a level of detail that would go into the DCD.

CHAIRMAN RAY: Okay.

MR. CUMMINS: Ed Cummins. I think if you wanted to make that guidance part it would be in Chapter 16 in Tech Specs if it was that important. And that's a judgment a bit.

CHAIRMAN RAY: All right.

MEMBER BLEY: If it's not in Tech Specs, it's hard to imagine how the operating folks would pick it up.

DR. KRESS: On your open item 14, what was the additional information that you supplied for the radionuclide inventory for equipment survivability?

MR. RAY: The radionuclide inventory actually was not -- We had --

DR. KRESS: It's specified in NUREG 1465. So did you use that?

MR. RAY: Yes. It was not more information that we put in the DCD. There's nothing extra that we put in the DCD. It was clarifying information that we gave to the staff.

DR. KRESS: I see.

MR. RAY: Because there was confusion on what we had in some --

DR. KRESS: Okay.

CHAIRMAN RAY: Any other questions?

Okay. This then constitutes Item 5 on our agenda, correct?

MS. McKENNA: Yes.

CHAIRMAN RAY: And we'd follow that with Item 6, Eileen, or

MS. McKENNA: We actually did Item 6 before the lunch break.

CHAIRMAN RAY: Okay. That was what was on the beginning of that discussion.

MS. McKENNA: Correct. And staff picked the two of those five open items that we thought were of most importance and we covered those with the Committee fairly briefly but very extensively obviously.

CHAIRMAN RAY: Yes. I remember Malcolm's discussion.

MS. McKENNA: Yes.

CHAIRMAN RAY: And so that's --

MS. McKENNA: And that's what we intended to cover on Chapter 19.

CHAIRMAN RAY: All right. Thank you.

So we're ready for Chapter 9, I believe.

DR. KRESS: I think you're pretty close to schedule.

CHAIRMAN RAY: Well, except that I do need at the end of the day and please don't let me forget we'll go back to the safeguards things. So make sure we've got the list of to-dos done correctly.

We'll move onto Chapter 9 now. Hear from the Applicant, take a break and then we'll hear from the staff and then hopefully we'll get either two or three action items addressed. That's my quota for every day from here on.

(Off the record comments.)

7 CHAPTER 9 APPLICANT

MR. LOZA: Good afternoon. I'm Paul Loza

with Westinghouse. We're here to discuss Chapter 9 in the ASFER closure. And with me is.

MR. SANDERS: Mitch Sanders with Auxiliary Equipment.

MR. MORROW: And I'm Rob Morrow with Auxiliary Equipment as well.

MR. LOZA: All right. We have several other people available on the phone should you have questions. Everyone couldn't come with the schedule being jockeyed around. We appreciate your cooperation with this.

CHAIRMAN RAY: Absolutely.

MR. LOZA: All right. Chapter 9 covers auxiliary systems including the fuel storage and handling, water systems, process auxiliaries, HVAC and fire protection.

In the Chapter 9 SER with open items we had 11 open items identified. We have closed them all satisfactorily with the staff. There were two sections not covered in the SER with open items. Those dealt with the fuel rack seismic analysis for the new and spent fuel racks. We had additional RAIs on those. They are now closed satisfactorily.

And rather than go through the 11 open items, we've chosen three topics to discuss. That would be the spent fuel pool criticality -- we had an open item on that -- the work that we did with the fuel racks seismic analysis and zinc addition which we propose for the AP1000.

First --

MEMBER BLEY: Since they're closed the fuel racks don't come up again, do they, except in the seismic concern?

MR. LOZA: Right.

MEMBER BLEY: I'm just curious because I'm not familiar with the Metamic stuff. I know we've had trouble with other materials. Is there a reason to believe we'll have less trouble with this material? Has it been used extensively?

MR. LOZA: Rob, do you want to speak on that?

MR. MORROW: I believe it is in use. I'm not sure how extensively but I know HOLTEC is the one who designs these racks. They've been using Metamic for the past several years for numerous re-rack projects.

MEMBER BLEY: So we'll find out some time.

MR. MORROW: We'll find out. We do have a group on monitoring program for these racks.

MEMBER ARMIJO: I looked at the testing

that was done to qualify the Metamic and it seems like it's very limited. It was 90 day test at a couple of hundred degrees F compared to the lower service temperature water. But it's --

Even Boral would have done just fine with such a test. Now we're having a lot of grief with Boral. I just wonder if you're going to do additional testing so that you don't rely on coupons when you're already made a major commitment to the use of this material.

MR. MORROW: I'm not sure.

MEMBER ARMIJO: The worst that can happen is that you're going to have to take it out if it's -- But I just didn't see a lot of testing that would qualify this material in the material you provided to us.

MR. MORROW: I'm not sure that any additional testing is planned.

MEMBER ARMIJO: Because it's just aluminum boron alloy, right?

MR. MORROW: Right. It's a little bit different. It's a homogenous mixture of the two materials mixed completely through.

MEMBER ARMIJO: Yeah, but you'll pull precipitates. Boron aluminum precipitates in there and then that's exposed to the water and that inside some stainless steel. And that's exposed to the water and unless you have a lot of experience or a good testing program that says we're sure this won't have the same problems the Boral had I just don't understand how you've accepted that as a solution. Maybe your HOLTEC guys could provide more information.

MR. MORROW: Yes, provide more information.

MEMBER ARMIJO: Are they here?

MR. LOZA: I believe we have Chuck Bullard on the phone. If we could have the phone line opened up.

MR. WANG: The phone line is already open to the public.

MR. LOZA: The phone line is open. Chuck Bullard, are you available?

MR. WANG: Maybe he's on mute.

(Off the record comments.)

MR. WANG: The phone line is open.

CHAIRMAN RAY: Speak again, Paul.

MR. LOZA: Chuck Bullard, are you available? We're trying to take you off mute. Stand by.

(Off the record comments.)

MR. LOZA: Come back to this question please.

CHAIRMAN RAY: Sure. We can table it until you get the right guy.

MR. LOZA: Let me get through these questions and see if we can get his answer for us.

The first issue we wanted to talk about was the spent fuel pool criticality. Between DCD 15 and up now to 18, we want to increase the capacity of the spent fuel pool by 50 percent, 619 to 889 locations. We designed and installed -- We designed new racks to handle this. The NRC staff was concerned, however, with the industry issue on the treatment of depletion calculations uncertainties in the spent fuel pool criticality analysis.

We reanalyzed the spent fuel pools as requested. HOLTEC did the analysis for us. And the staff concluded that our methodology and analysis were acceptable. My statement here on the no-burn-up credit in the interim we had designed a checkerboard pattern which would not need a Region II burn up credit. But it would have our spent fuel pool capacity. But we had that as a plan B on the side.

So the staff concluded our methodology and analysis were acceptable and the open item that we have is closed.

MEMBER ARMIJO: So you can go to full capacity.

MR. LOZA: We plan on having full capacity, all assemblies, all locations. We're good to go.

The second issue we wanted to touch on was the fuel rack seismic analysis. Again with the increase in the number of assemblies, 600 to 900, the higher capacity we needed a new rack design and we also had a new SSE spectra. So we had to update our analyses, the structural, dynamic and stress analyses from DCD Rev. 15.

And in addition, we're trying to save our customers some trouble. We wanted to close to two COL information items. One was for the spent fuel rack and the other was for the new fuel rack. We wanted to perform the analysis for them.

We hired HOLTEC again. We had multiple, structural evaluations performed. The 3D seismic and all three dimensions. We handled our fuel drop accident, analyzed the stuck assembly withdrawal and we also look at the rack to wall impact.

As it turns out the new fuel rack as analyzed when it was all said and done, the new fuel rack does not hit the wall. The spent fuel rack they do have impact, but it's within acceptable limits.

We updated our technical reports, TR44 and 54 we refer to them as. We updated them to include the revised and the additional analysis. And we also did sensitivity studies during these studies dealing with friction, the new fuel rack on the floor, a number of the assemblies in the various racks on the gaps between them to make sure that we had covered all the bases.

The staff has concluded these fuel racks are acceptable for both the spent and the new fuel pools. And we closed both COL information items.

(Off the record comments.)

CHAIRMAN RAY: Sorry.

MR. LOZA: That's okay. The third issue we wanted to touch on is zinc injection to the RCS and we've spoken to the staff on this before about a year ago. Zinc addition is shown to be a good thing. It's shown to reduce personnel exposure, surface corrosion and the potential crud induced power shifts. It reduces the amount of crud that you have and if it's released the power doesn't shift by plating out in other areas. The personnel exposure is due to having less nickel and cobalt in the crud.

We wanted to resolve the staff's concerns that they presented in an open item to us. They wanted us to make sure if is our AP1000 core considered High Duty per EPRI standards. At the time, there was not as much High Duty core operating experience to refer to. And they were concerned about the potential for excessive crud deposit on the fuel and the same crud induced power shifts were on the zinc addition started later in the core or fuel life.

MEMBER ARMIJO: I thought that in BWRs it's not the amount of crud but the chemistry of the crud that's favorable when you add zinc. You don't need to increase the amount of crud in the core. But it's you keep the bad stuff in the core and not on your system. So I think it's the same unless you know differently. It shouldn't be a problem.

MR. LOZA: As I understand the zinc provides a thinner crud film and it doesn't -- If you start it early enough in life you don't have the crud problems that plants without zinc have had.

After discussing this with the staff, they concluded our zinc injection design was acceptable. We'll do cycle specific reload analyses to coordinate the addition to minimize our crud thickness. In fact, we're going to start before time zero with the fuel and have addition during hot functional testing.

We want to reduce the corrosion on the RCS and the primary side of the steam generator. We're going to then reduce our level of zinc. Operating levels should be similar to the currently operating plants and we will do the inspect per EPRI's fuel reliability guidelines. And this open item is also closed.

So we chose these three open items to present. I have the remainder of them. If there's questions on any of the others. There were 11 in total.

MEMBER ABDEL-KHALIK: How many were there?

MR. LOZA: Eleven.

MEMBER ABDEL-KHALIK: Eleven. I don't remember what the others were.

MR. LOZA: Any questions?

CHAIRMAN RAY: Okay. Thank you.

Well, would you like him to --

MEMBER ARMIJO: I'd just like to hear if there is --

MR. LOZA: The experience.

MEMBER ARMIJO: Either experience with Metamic or a justification why that testing program that's cited in the materials that were sent to us was adequate. It just seems to me like it's not.

MR. SISK: The subject matter expert we would like to have to address that issue is not readily available right now. But we're going to take an action. We should be able to get you that answer before I'm going to say we're done tomorrow.

MEMBER ARMIJO: Okay. Sure. Thank you.

MR. LOZA: All right. Are there any other questions?

CHAIRMAN RAY: Did you also want to see the complete list of formerly open items?

MEMBER ARMIJO: I just wondered if we missed something.

CHAIRMAN RAY: No.

MEMBER ARMIJO: If they're kind of small or.

MR. LOZA: I have a list of the open items. Here's the first six. We did touch on the criticality. We've got -- We had one on the minimum water shielding height, the storage rack density with respect to cooling, DK heat levels versus the critical time for boil off. We had a discussion on the thermal analysis versus the suction line elevation.

MEMBER ARMIJO: You couldn't drain the pool.

MR. LOZA: Several minor piping diagram changes. Can I scroll down?

MEMBER ARMIJO: Yeah.

MR. LOZA: We've changed our spent fuel pool to be from a single level to a band. We revised the instrumentation for that. We had a question on the spent fuel pool saturation towards boiling and the required operator actions at certain times. A general question on fuel move components. And we talked about the heavy loads handling program. And again at the bottom we've talked about the zinc addition.

We can entertain questions on any of these.

MEMBER ARMIJO: Thank you.

CHAIRMAN RAY: Anybody have anything else on Chapter 9 for the Applicant?

Okay. We have yet to hear from staff on Chapter 9. So that they don't have to wait until after we get back from our break are they ready to go, Eileen?

MS. McKENNA: Yes, they are.

CHAIRMAN RAY: All right.

MR. LOZA: Thank you very much.

CHAIRMAN RAY: Thank you.

(Off the record comments.)

MR. BULLARD: Hi, this is Chuck Bullard at HOLTEC.

CHAIRMAN RAY: Stand by just a second please.

Paul.

MR. LOZA: Good afternoon, Chuck. Paul Loza with Westinghouse.

MR. BULLARD: Hi. Good afternoon, Paul.

MR. LOZA: Thank you for taking the time to come on here.

MR. BULLARD: Yeah. Sorry for the delay or the mix-up. Our email has been down all day.

MR. LOZA: That's okay.

MR. BULLARD: And it's still down.

MR. LOZA: I appreciate you taking the time to do this. We have a question from one of the ACRS members about the valid operating experience with Metamic material.

And, sir, if you want to repeat the question specifically.

MEMBER ARMIJO: Yes. The information that we had to review provided some information on the experience with Metamic and the testing program done to qualify it for use. So that's all the information I read. And all I found was that there was a test performed. I don't know who did it. Maybe it was HOLTEC. A 90 day test with Metamic in water at about 200 degrees F and nothing bad happened. And then an addition, there was some surveillance of this material in other applications.

So my first concern is that the testing that was done was very limited, surprisingly limited. But there may be a lot of experience. What I'm looking for is what's your basis for saying that this stuff will be better than the Boral.

MR. BULLARD: Well, there's a couple important documents. There is an SER from the NRC staff on the use of Metamic in west storage applications. So there was a topical report submitted on the use of Metamic for fuel storage racks. And the NRC issued an SER.

MEMBER ARMIJO: When was that done?

MR. BULLARD: I would have to look it up, but I'm going to say that it was in the 2006-2007 time frame.

MEMBER ARMIJO: Okay.

MR. BULLARD: And then beyond that, I mean that topical report presented a lot of test data, tests that were done both by HOLTEC and independent tests that were done by EPRI and they included the various corrosion tests and thermal aging tests, different temperatures, different lengths of time, I think different pH levels.

MEMBER ARMIJO: Okay.

MR. BULLARD: Simulating a number of different conditions. So there is that information, the EPRI testing, the HOLTEC testing and the SER document as well as the topical report.

And then at least operationally there is Metamic is currently in use at several nuclear plants in their spent fuel pools. Currently I know at Diablo Canyon and Clinton and there's others. But those two.

MEMBER ARMIJO: How many years of operating experience do you think there is out there?

MR. BULLARD: I think Metamic classic has been used in spent fuel rack applications for approximately four or five years. I'd have to check to see when the first racks were installed. But four or five years plus or minus a year.

MEMBER ARMIJO: Okay.

MR. CUMMINS: This is Ed Cummins. I'd maybe like to clarify your question a little bit. I think in the AP1000 application the Metamic is in a sheath of stainless steel. So it never really sees the spent fuel water.

MEMBER ARMIJO: It does because it's got holes in it.

MR. CUMMINS: Oh. The sheath has --

MEMBER ARMIJO: Yes.

MR. BULLARD: It is vented. Yes.

MEMBER ARMIJO: It has to be vented. You know the incubation time for problems with Boral was a long, long time before something happened. And I do recognize a value of accelerated tests and I think HOLTEC tried to accelerate whatever problems might happen by running at a higher temperature albeit for a very short time. So I'd be --

MR. BULLARD: Yes, and there's more testing that's been done beyond that.

MEMBER ARMIJO: Okay.

MR. BULLARD: I mean the fundamental advantage of Metamic over Boral is that it is a homogenous material. It's fabricated based on a powder metallurgy process. So it has very low porosity and good homogeneity in its finished product which you know with Boral because of the fact that it was a layered material.

MEMBER ARMIJO: Low density.

MR. BULLARD: Yes. And higher porosity. You know the water was able to find its way into the

Boral and then eventually you know those gases would expand or blister the Boral.

But Metamic just based on its manufacturing process and characteristics is much less vulnerable to that type of mechanism. And there's a lot of discussion regarding that in the SER at the top of the list board.

MEMBER ARMIJO: Okay. Well, look I appreciate that because the background testing. I wasn't aware of the SER and the supporting information.

MR. BULLARD: I will try and look at that up as well on the phone to give you some references.

MR. SISK: This is Rob Sisk with Westinghouse. And just to help out on the discussion, in Section 9.5.4.3 of the SER for the DCD, References 1 and 2 refer to the HOLTEC report with regard to use of Metamic and fuel pool applications. That includes the ML number to pull it up off the site. But the documentation is referenced there for you to get a hold of.

MEMBER ARMIJO: Okay.

MR. SISK: I can provide it here for you, too, later.

MEMBER ARMIJO: Thanks a lot. Appreciate

that. I'm fine with that.

CHAIRMAN RAY: Anybody else have anything they want to say on this subject?

Okay. Well, with that and the additional -- Thank you, gentlemen.

MR. LOZA: All right. And thank you, Chuck Bullard.

CHAIRMAN RAY: How long do you need?

MS. McKENNA: Well, I think the staff had planned to cover more or less the same three issues that Westinghouse did and it's relatively --

CHAIRMAN RAY: All right. Let's go ahead.

MS. McKENNA: Okay. Thank you.

8 CHAPTER 9 STAFF

MR. BUCKBERG: Good afternoon. My name is Perry Buckberg. I'm a Senior Project Manager in the AP1000 Licensing Branch. The staff will now present the evaluation of AP1000 DCD Chapter 9 Changes.

I list most of the technical staff or some of the technical staff. There is input from many members of the technical staff. Several of those who are joining me today is Chris Van Wert, Eduardo Sastre, Pravin Patel and there are others in the crowd to join in if needed.

Chapter 9 of the SER open items was issued last September 2009 with 11 open items but without the evaluations of the fuel rack seismic analyses, new and spent fuel. I realize you've heard some of this before.

The advanced final SER that was just issued includes these analyses as well as information regarding the closure of the 11 open items. The staff presentation will include the open items, spent fuel pool criticality, zinc addition and the seismic analyses.

And we did choose by some chance the same open items to present that Westinghouse did. We will start with Chris Van Wert with criticality.

MR. VAN WERT: Thank you for the introduction. My name is Chris Van Wert. I'm a Reactor Systems Engineer within the Reactor Systems branch. And my open item is related to the use of burn-up credit within the Region 2 of the spent fuel pool criticality analyses.

This first slide is capturing the history and statuses of the last meeting that we had in November of last year. And that simply was that the original analysis was a fully loaded analysis and did use burn-up credit from Region 2.

And then at that time since there was some ongoing questions that the staff had both within my office as well as NRR on the other side regarding the handling of the depletion calculation uncertainties. There was a plan B that was submitted which was a checkerboard loading pattern to just get us beyond that point. So that was the status as of last year.

And then subsequently the plan's changed. The applicant did return to the original full loading analysis. And this was partially based on recent developments in the review of other analyses that had come in using very similar approaches and methodology and design. After further consideration, the staff agreed and concluded that the applicant met all the current changes using the current guidance. And this conclusion was based on the technical review that we had performed on both the analysis and also review of the current precedences that were available.

MEMBER ARMIJO: Was some degree of burn-up credit included, required, to meet --

MR. VAN WERT: Region 2, yes.

MEMBER ARMIJO: Yes.

MR. VAN WERT: For Region 1, no. And we did review their calculations and methods associated with that calculation.

So we now consider this open item to be

closed and that's pretty much the sum of the review of this open item.

MR. BUCKBERG: Thank you. Questions?

We'll move onto zinc addition, Eduardo.

MR. SASTRE: Good afternoon. My name Eduardo Sastre. I'm a Chemical Engineer in the Company 30 branch in the Office of New Reactor.

Our open item is about the additional zinc to the RCS DCD system. When we presented last year, the only concern that we had was that there wasn't enough operating experience on high duty core. And we sent the applicant with some RAIs about it.

In their response, they stated that they followed EPRI HDCI guidance calculating AP1000 was hydrogen core on the calculations. It came out that it was actually a small to medium duty core. And we performed a complimentary calculation and we had the same results. But for they're going to consider it to be a high duty core to be more conservative.

But they also presented some operating experience that of high duty core reactors that have used zinc additions since 2003 and they haven't had any problems with crud or fuel performance related to the zinc.

The other problem was that we had was the crud induced power shift. The applicant stated that they're going to follow the approach that operating plants are using which is follow the modeling VIPRE BOA is recommended by the EPRI Axial Offset guidelines.

And also to consider the CIPS problem, they presented that they're going to use a fuel surveillance program which is going to take a look at the crud problem in the fuel. And based on this response we find it acceptable and the staff considers this open item closed.

CHAIRMAN RAY: Okay. Questions?

We'll move onto the storage racks seismic analyses with Pravin Patel.

MR. PATEL: Hi. My name is Pravin Patel, Structuring Engineering branch, NRO. I have two gentlemen sitting also Mr. Morante from Brookhaven National Laboratory and Mr. Braverman, also from Brookhaven.

Westinghouse choose to close the core line information item that was in the DCD. Westinghouse Technical Report 54 which is a Spent Fuel Storage Racks Structural and Seismic Analysis.

If you look at the timeline that we started from 2006 to 2010 we'll discuss in slide number 13 why it took so long because a lot of changes the applicant made. Based on the technical evaluation, the staff concludes the core line information item is completely closed and based on TR-54, Rev. 4 and all the other reviews we have done for the calculation and other miscellaneous reviews of the RAIs. The DCD Revision 15 core line information item 9.1-3 is no longer needed.

New fuel storage racks, similar situation for new fuel storage racks. TR-44 was issued and that core line information item was there which is also closed by the similar path that Westinghouse choose to do, submit this design of the new fuel rack.

In the structural evaluation of the fuel racks, the loading conditions analyzed the three directional seismic excitation plus dead weight. The fuel assembly accidental drop over the spent fuel pool there were three conditions that they used it to analyze about this spent fuel pool, the accident of 36 inch height and drop as one on top on the rack, once through the empty shell and the third one is empty shell impact with the base plate. So there are three conditions they analyzed. Staff has concluded that structural assembly during the removal of this rack upward load of 5,000 pounds. We used it for the upward load to analyze how much -- is going to be experience by the assemblies, also racks. Sorry.

Impact load on the spent fuel pool steel liner to concrete fall during the seismic they analyzed and based on that there are bounded conditions. The impact force was 329 kips, K sorry, not kips and 570 kips for the Region 2 fuel racks.

The primary analysis method HOLTEC proprietary computer code DYNARACK for nonlinear dynamic analysis of free-standing fuel racks subject to seismic plus deadweight loading, they used it. Another one is the LS-DYNA nonlinear dynamic analysis for the accidental load drop of a fuel assembly. We already talked about what is a drop, how they consider. LS-DYNA nonlinear analysis for the worst-case rack-to-rack impact loading at the top of the spent fuel rack. There is a -- of that acting on the side at the top. ANSYS using the nonlinear analysis using ANSYS for cell wall compressive loading at the bottom of the new rack and spent fuel racks.

If you guys are interested I can show you the figures -- I have the material available for the figures -- how it looks. We can go over that. Slide number 12.

The staff issued 44 RAIs for TR-44 with

the spent fuel pool racks and 31 RAIs for TR-44 which is new fuel pool racks. The seismic analysis of applicant done with the HOLTEC help and that's Mr. Chuck Bullard on the phone. The coefficient of friction they used 0.2, 0.5 and 0.8 analyzed between the bottom of the fuel rack and the supporting surface. Now the --

DR. WALLIS: Now they're not attached at all. They just rest down there.

MR. PATEL: Yes. And the coefficient friction is in the spent fuel pool is between wet surface stainless steel to stainless steel contact and the mean value they use is 0.5. And the limiting value they use is 0.2 and 0.8. So they bound all the conditions. So they use it for the analysis.

Number of fuel assemblies in the fuel racks at the time of the seismic event, three cases analyzed. And those cases are with the cool VAC --

DR. WALLIS: Now presumably this friction coefficient is uniform. The problem would be if some of them would have a low coefficient and some have a high coefficient so that they move relative to each other. Do they do that or just have a uniform?

MEMBER ARMIJO: They're stainless to stainless.

MR. PATEL: Stainless to stainless.

MEMBER ARMIJO: Probably.

DR. WALLIS: So it shouldn't vary.

MEMBER ARMIJO: It shouldn't.

DR. WALLIS: So why do you have a variation like this, the 0.2 to 0.8.

MEMBER ARMIJO: Probably the uncertainty.

MR. BRAVERMAN: Excuse me.

DR. WALLIS: Yes.

MR. BRAVERMAN: Let me try to answer that question. Based on the actual testing, there's a reference. I forget the reference. They've done testing stainless steel immersed in water on stainless and believe it or not it have a very wide variation and coefficient of friction. And that's been the typical numbers used in the past for fuel rack analysis and design.

The upper bound is 0.8. The lower bound is 0.2 and 0.5 is representative of the medium bounding.

DR. WALLIS: So you assume they're all the same though.

MR. BRAVERMAN: Yes. For each --

DR. WALLIS: Even though you know they vary.

MR. BRAVERMAN: They assume that they're all 0.2. They do another analysis all 0.8 and then 0.5.

MEMBER ARMIJO: Why would you assume that?

MR. BRAVERMAN: The 0.2 maximizing the sliding. The 0.8 maximizes rocking and tipping and impact forces. And ultimately the envelop that results from all three cases for design.

CHAIRMAN RAY: Could you identify yourself please.

MR. BRAVERMAN: I'm sorry. Joseph Braverman.

DR. WALLIS: It does seem possible that some of them could have 0.2 and some could have 0.8.

MR. BRAVERMAN: Theoretically, you could have an infinite number of --

DR. WALLIS: In that case you would have relative motion, wouldn't you? They would hit each other or something.

MR. BRAVERMAN: I'm sorry, sir.

DR. WALLIS: They wouldn't hit each other if they weren't 0.2 and 0.8 here?

MR. BRAVERMAN: Yes, but you could have an infinite number of permutations.

DR. WALLIS: Yes.

MR. BRAVERMAN: And so to bound the problem, the industry typically does all of them at the upper end, all at the bottom and then a medium. But you're right. You could have many permutations.

MEMBER ARMIJO: But I think the question is a bound to assume that they all move the same way or might it be more serious if they're moving relative to each other?

MEMBER BLEY: Well, ones are bound.

MR. BULLARD: If I could add, this is Chuck Bullard at HOLTEC. Each of the racks within the pool are individually modeled. And the fuel within each storage rack is modeled as a separate series of lumped masses with their own degrees of freedom that are free to rattle within the rack.

So in the course of the time history simulation what you see is that the racks they don't move perfectly in phase just because of the rattling of the fuel and the phasing of the three earthquake components. The racks exhibit motions that fall somewhere between perfectly in phase and perfectly out of phase. And in the numerical model we have set up impact springs as we refer to them to track any potential closures of the gaps between racks and monitor if there are any rack-to-rack impacts that occur due to out-of-phase motion that develops.

And Joe was correct. He cited there is a reference. There's a study performed by a professor. I believe that it was at MIT and he concluded that for stainless steel and water there's a mean value. It has a mean value based on a series of tests of around 0.5 and a standard deviation of 0.125. So historically spent fuel rack seismic analyses have been done considering upper and lower bound values of 0.2 and 0.8 which envelopes two standard deviations from the mean.

DR. WALLIS: Now suppose half of them are 0.2 and half of them are 0.8. Does this give you a problem?

MR. BULLARD: I mean if they are all 0.2 again we do -- you tend to see more sliding and less rocking. But it's not as though they all -- All the racks move simultaneously in phase. So we're maximizing the sliding displacement on the low side with 0.8 and potential rocking of 0.2.

I would not -- We would obviously have slightly different set of results if we mixed 0.2 in half the racks and 0.8 in the other. But the conclusions would not change as far as -- At least that's my own opinion. The conclusions would not change in terms of the maximum stress levels within the rack, pedestal forces, etc. It would be within the bounds of the simulations that we've already performed.

DR. WALLIS: But they would be more likely to collide.

MR. BULLARD: Not necessarily. They may or may not.

DR. WALLIS: That's an obvious answer, but it covers everything. It would be interesting to do an analysis where you let some of them have a different coefficient and see how much variability that gives you.

MEMBER ARMIJO: Yes. Randomize.

DR. WALLIS: Well, maybe it's up to the staff to figure out if they want to ask them to do that. It is a possibility since it varies so much that some would slide more than others and there would be more collisions.

CHAIRMAN RAY: Do you have any further comment either from the Applicant or HOLTEC or staff?

MR. PATEL: I think we can ask that question to Westinghouse.

CHAIRMAN RAY: We're not in the business

of asking questions of Westinghouse.

MEMBER ARMIJO: But is this a pretty common design that has been licensed before using this kind of an approach?

MR. BULLARD: Yes, absolutely.

MEMBER ARMIJO: Okay.

DR. WALLIS: But they haven't been shaken by a seismic event.

MR. BRAVERMAN: Folks, also I'd like to add something that I didn't get to. HOLTEC did nine different permutations of other parameters which we'll talk about such as fully loaded, partially loaded, varying the impact spring constants, integration time step. There are nine different runs and the envelope in all of the runs. Now in the real world you're not going to necessarily have all of these conditions occur.

So what we're trying to do with a very highly nonlinear response is to do bounds, less case, sensitivities, and to envelope all the results. So I guess we felt that that should address some of the in-between parameters that you're raising.

DR. WALLIS: Well, just to try and finish this up, when they do a 0.2 the things slide. And when they do a 0.8 they slide with a different amplitude. Are those amplitudes very different?

MR. BULLARD: Yes. When it's 0.8, what you tend to see is that the sliding motion at the base is suppressed but that the rack tends to tip or rock more. So the displacements at the top of the rack --

DR. WALLIS: So you could look at fixing some of them -- slide with 0.2 and seeing if they collided.

MEMBER ARMIJO: But you've got several support points on each rack and each one of us could have a 0.2 or a 0.5 or a 0.8. Who knows what it would be.

DR. WALLIS: Right.

MR. BULLARD: Yes. Each track has four individual pedestals.

DR. WALLIS: It seems to me it's worth investigating by somebody.

CHAIRMAN RAY: Okay. Go ahead.

MR. PATEL: All right. The number of fuel assemblies in the fuel racks at the time of seismic event, three cases analyzed as we talk about that one is possible that rack might be all empty. One is completely full. And one is partially full. So it's those three conditions taken.

In-situ gaps between the adjacent spent

fuel racks and two cases analyzed.

Impact spring value due to the local flexibility of the fuel assembly cell wall, three values analyzed. And the three cases were analyzed to evaluate the sensitivity of the fuel rack response to the variation in the impact spring at the top and the bottom of the racks. Base case is -- One is a base case. One is at 20 percent higher. And one is at 20 percent lower.

Sensitivity of the DYNARACK solution to reduce -- sorry -- reduction of the integration time step by a factor of four in order to convert the solution, the analysis.

Now this is the one I'm coming back to why it took so long, the seismic loading with new and spent fuel racks was re-defined by two times during the course of the staff's review, re-analysis each time the racks.

Staff confirmed that the final analysis loading is consistent with the Auxiliary and Shield Building re-analysis SASSI analysis which was all represented during the Chapter 3 presentation at the ACRS. That all the modeling errors and those related to the buildings and analysis.

Applicant made several design changes to strengthen the rack-to-rack impact loading due to the seismic excitation of spent fuel racks.

The staff determined that the applicant applied methods and procedures contained in the NRC regulatory guidance document and previously accepted by the staff for qualification of fuel racks. In other words, the GDC-2 and GDC-4 per SRP Section 3.84 the staff concluded that the NRR, that design for both spent fuel and new fuel racks, are acceptable.

Currently all technical issue are resolved. Two confirmatory items require revision which will be reviewed in DCD 18. One confirmatory item requires revision of TR-54 and DCD to show the final gap and tolerance dimensions between the racks and the spent fuel pool wall.

And the third one is like a New Fuel Rack Design also contains all the issues are resolved. Five confirmatory items require revisions of the DCD. That's it. Any questions?

CHAIRMAN RAY: Well, yes. I think that there's been a question raised by a consultant for the committee here about whether or not this comment on page 13 concerning rack-to-rack impact loading is sufficient. I mean design changes were made as noted here. But the question is whether or not the variation in this friction factor has been adequately enveloped.

And I guess if you want to say anything more about that, why this is the time to do it. The answer is no. You don't -- You think it's adequately enveloped. Is that the case?

MR. PATEL: Yes. Based on I think Joe's talk about it and HOLTEC, I think this is adequate because all racks are if you look at in a spent fuel pool right now if I can show the figure, one of the figures.

CHAIRMAN RAY: Sure.

MR. PATEL: All racks are very close at the base. So there is no gap. Only the gap is between the -- So I think --

CHAIRMAN RAY: Well, why did they make the modifications that you refer to here?

MR. PATEL: Modifications? What modifications they made? Yes. There are -- I'm sorry. Which page are you talking about?

CHAIRMAN RAY: Third bullet on slide 13.

MR. PATEL: Yes. What they did is there is a buffer plate on the racks. When the original design -- When they started to design, then they made a bumper to stand on this rack because they found out that the new loading change with the seismic because the soil there and they found out that they need to add a small standing to the design. So those are the design changes.

And then during the review we found that it wasn't sufficiently addressed. So they did re-analysis again for some error that they fixed on SASSI analysis on Chapter 3. So those are the design changes they made on the reactor design.

CHAIRMAN RAY: Yes, but the question is whether or not the impact loadings are sufficiently addressed. Your point is I think they made changes. At least that's what you say here.

(Off the record comments.)

MR. BULLARD: This is Chuck Bullard again. The one thing I can add or point out I've got the calc package or the HOLTEC report open. I'm looking at it now. There are among the nine runs that were performed there are three runs that are identical except for the fact that the coefficient of friction in each of those three runs is changed from 0.8 to 0.5 to 0.2.

And when you look at those results specifically in terms of rack-to-rack impacts and rack-to-wall impacts the trend is fairly clear that the maximum rack-to-rack and the rack-to-wall impacts are resulting from run number one which is when the coefficient of friction is highest, 0.8.

Because what happens is that at that coefficient of friction level the base of the rack essentially remains stationary. And all of the racks tend to rock and tip. So you get much larger displacements at the top of the rack than you do in the opposite extreme when the coefficient is 0.2. And that exaggerated rocking at the top of the rack is what is causing the rack-to-rack and rack-to-wall impacts.

DR. WALLIS: Well, it's a rack-to-rack impacts even though they all have the same coefficient. So if some have a coefficient which makes them rock more than the others one it would enhance the rack-to-rack impact, would it not?

MR. BULLARD: Not necessarily because when all of the racks are at 0.8 --

MEMBER ARMIJO: It's worst case.

MR. BULLARD: -- the tendency is that when the coefficient of friction is 0.8 the trend is that the top of rack displacements are at their maximum.

DR. WALLIS: Yes.

MR. BULLARD: So if you take a run and you change one of the racks in that run to 0.2, then the top of rack displacement for that particular rack will be attenuated because it will tend to slide more and the very top of that -- displacement will very likely be less than what it was when the coefficient of friction is 0.8.

DR. WALLIS: So what happens? Does it then hit a neighboring rack or not?

MEMBER BLEY: Depends on whether they're in phase or not. There's a real mix of phases here.

MEMBER REMPE: Is it difficult to do one rack with a different coefficient than the others in the way that the computer model is set up?

MR. BULLARD: It is -- There have been cases run, you know, previous studies that have been done with varying coefficients of friction.

MEMBER REMPE: So it's possible. The model.

MR. BULLARD: It is possible. Yes, it's within the capabilities of the program.

MEMBER REMPE: Okay.

MEMBER BLEY: Any idea what you saw when you did that variability in previous cases?

MR. BULLARD: Usually --

MEMBER BLEY: You vary lots of things so

that the idea that you didn't vary this one just seems a little odd. It could have an impact. I'm sorry. Go ahead.

MR. BULLARD: In my experience in past cases where we've looked at you know variability and the coefficient of friction within a given simulation the results tend to be comparable or slightly less than the 0.8 case. The maximum pedestal loads or the maximum impacts if we were to postulate some random coefficient of friction distribution throughout the layout, my previous experience is that the maximum pedestal loads and the maximum rack impacts will be, you know, the peak loads that is will be comparable of the same general magnitude or order as the constant value 0.8 coefficient of friction case.

DR. WALLIS: But you could do a run where you simply had a random distribution of coefficients of friction and see what happens.

MR. BULLARD: It could be done, yes.

DR. WALLIS: If it were done, then we'd have a quantitative answer instead of speculation.

MR. BULLARD: I can't deny that, yes.

CHAIRMAN RAY: Okay. Anything else?

MEMBER ARMIJO: I have an educational question. What is the big advantage of having these things slide as opposed to locking them down to the floor of the pool? Is that to avoid this banging or be able to pack them tighter or what?

MR. BULLARD: Yes, I mean if you have -- if they're anchored to the floor, then you've got to --

MEMBER ARMIJO: Allow for the banging.

MR. BULLARD: You have other challenges. You have to design an appropriate anchorage to the floor. There might be --

CHAIRMAN RAY: Or chance of leakage.

MR. BULLARD: There might be stresses due to restraint of thermal expansion or thermal growth, those types of things. Our HOLTEC at least has been successful designing and analyzing the racks as freestanding structures because we think it definitely lends itself to if you're re-racking a pool where you're removing all racks and having to install new racks.

MEMBER ARMIJO: Just pick them up.

CHAIRMAN RAY: But it also at the same time has allowed us to maximize the storage capacity within the pool since they're free-standing structures.

MEMBER ARMIJO: Sure. Okay. Thank you.

CHAIRMAN RAY: All right. At this point it seems like there's a clear question that there's no point in us belaboring it further. Anything else?

MR. BUCKBERG: That's it for Chapter 9.

CHAIRMAN RAY: Okay. All right. We'll take a break now until 3:10 p.m. We will try and close as many open items as we can before the end of the day. But at the end of the day we'll go off the record. We'll return to a mode in which we can discuss safeguards information in order to finalize our takeaways from the morning presentation on aircraft impact.

MR. BULLARD: Could I just --

CHAIRMAN RAY: Yes.

MR. BULLARD: If I may before the break, could I just add? I wanted to point out a few numbers relative to rack impacts and the change in coefficient of friction. I think it might help everyone get a little bit better sense of the results.

For the three runs I was mentioning where the coefficient of friction has changed from 0.8 to 0.5 to 0.2, as I mentioned before, there are impact springs throughout the model and we've tracked these springs to see if they close and if they do close what is the magnitude of the impact. And for those three runs I just described, looking specifically at the maximum rack-to-rack impact load, when the coefficient of friction is 0.8 the maximum rack-to-rack impact load is 328 kips. And what we see when the coefficient of friction is reduced from 0.8 to 0.5 maximum impact load drops down to 242 kips. And then further when it reduces to 0.2, the impact load drops down to 89 kips.

So even though you would expect the most sliding when the coefficient of friction is 0.2, that doesn't necessarily correspond to the maximum displacements at the top of the rack which is really the driving force behind these rack-to-rack impacts. I think on the basis of those results there is reason to believe and to expect that if in a postulated and random coefficient of friction distribution that it would still be bounded by the constant 0.8 coefficient of friction case.

CHAIRMAN RAY: Well, reason to believe and a convincing basis for belief are maybe two different things. I mean you know we're faced with the fact that this has been an issue. There were some design changes made as a result of needing to strengthen for rack-to-rack impact loading as at least is what we're told. It's a reasonable question to ask. Isn't it possible that a varying coefficient could affect that in an adverse way? That is to say I think what most people have in mind is something in which things move together with a consistent friction factor but might be out of harmony so to speak with a variable one. It's hard to say.

Intuitively what you suggest sounds plausible. But normally that's not why we find them acceptable. So, in any event, I think we've exhausted the subject right now unless there's something more that you can add. I'd be happy to listen to it.

MR. BULLARD: No, I just wanted to share those results just to put things in a little better perspective.

CHAIRMAN RAY: That's fine. Well, those are substantial loadings. And so not something insignificant.

MR. PATEL: One thing I want to point out that the highest loading that he mentioned, 328 kips, the factor of safety at that point was 1.57. And Region 2, the factor of safety is 1.75. So quite a bit of a factor of safety is there.

CHAIRMAN RAY: Okay. All right. But that having been said, nevertheless it was necessary to strengthen them to achieve that factor of safety I guess. That's what you say anyway.

So with that we will take a break. We'll resume at 3:10 p.m. We will address as many open items as I can persuade my colleagues to do and that we have material available. And the last thing we'll do is return to a safeguards environment and make sure we have identified the takeaways from this morning's meeting. With that, we'll recess for 15 minutes. Off the record.

(Whereupon, the above-entitled matter went off the record at 2:59 p.m. and resumed at 3:13 p.m.)

CHAIRMAN RAY: Okay. We'll go back on the record.

9 ACTION ITEM PRESENTATIONS

CHAIRMAN RAY: We have an action item to resolve and it just so happens it's one that's of interest to one of my colleagues here at the table.

Are you going to be presenting it?

MR. BROCKHOFF: Yes, sir.

CHAIRMAN RAY: All right.

MR. BROCKHOFF: Chuck Brockhoff from Westinghouse System Design. And on the phone I have Andy Gagnon and Dave McDevitt who have done the analysis for us. And I'll go through the presentation and they can answer any questions.

Can you guys hear us, Andy and Dave?

MR. GAGNON: Yes. We're good.

MR. McDEVITT: Yes.

MR. BROCKHOFF: You guys are on hot mike. You don't have to talk loud.

(Off the record comments.)

The issue was a question that came up in the July 8th meeting on Chapter 14 for the test program related to RWSP and the potential for gas intrusion. So we've met and presented to the ACRS in February on our approach for the gas intrusion to address Generic Letter 2008-01 and also the draft ISG that had been issued. And we discussed at that meeting the four high points, the changes, we would put in for the IRWST in some other locations.

We ultimately implemented Change Notice 66 which added four high point locations in the IRWST lines, redundant level indication and hard pipe vents. That's the reactor coolant side of the squib valve basically and I'll show you it in a second.

We also added eight other high point locations and used test connections at several other locations. Primarily this is IRWST and core makeup tank discharge lines.

And there was one open item from the

February meeting. We provided a sensitivity analysis looking at core mixture level and Dr. Wallis asked us to do a heat up calculation which we've done. And I'll show you the results of that. So that's primarily why we came back to give you an update on that.

If you remember, this is a configuration. The IRWST comes down from 103 to about 97 and goes up to 100. Then it drops down to about 93 or so and then DVI is about 100.

So the potential was if you didn't do correct maintenance venting here you could have a voided leg. And that voided leg then would need about 3 psi pressure change that we would have to additional vent before IRWST injection started. This is a fixed elevation head. So you would have to overcome that. So in the event of improper maintenance venting.

Now again our change was to put monitors up here to monitor for gas intrusion there. But the only real mechanism that we would postulate since the change would be improper maintenance venting. So the current safety analysis didn't consider that because we assumed that we would properly vent the system.

And they went back and did an analysis. And really the concern here is for events where there's not a large break that would contribute to the venting and get us depressurized. We turn the IRWST on at about 28 psia roughly.

So the two events we looked at were a two inch cold break and an inadvertent ADS. And we predicted that we would get uncovery but it wasn't substantial and the timing is relatively short. But we went back and looked and we did a peak cladding temperature calculation using SBLOCTA.

And the results of that were beforehand we would initiate RWC injection at about 3200 seconds for a two inch break. An inadvertent ADS obviously starts sooner. As soon as the event starts, it's venting.

With the additional 3.4 psi it takes about another 115 seconds. We get about 2.9 feet of uncovery and PCT temperature was about 650 degree.

For the inadvertent ADS it's a little bit deeper uncovery and a little bit longer uncovery period. And it goes up to about 1300. But the end result is that accounting for these we're well below the 10 CFR limits for this. So that was really the answer to the question was asked of what temperatures we get to.

DR. WALLIS: I thought this void was automatically vented by some alarm system that measured it.

MR. BROCKHOFF: No, what we did is we put a pipe stub on each of these. These actually come down and connect lower. We have four pipe stubs with high point --

DR. WALLIS: But someone has to go and vent them. It doesn't vent by itself.

MR. BROCKHOFF: No, it's not self-venting because there's not a credible postulated mechanism unless you didn't do a vent on start-up properly. And the alarm, it's the same approach as the core makeup tank and PRHR high points. So if there some mechanism that would come up we would get an alarm to indicate the operators to go in.

And that's the reason it's hard pipe so they can just go in. It's an accessible region in containment. They open two manual valves in it and then they're done. And we size the discharge orifice in there to vent.

DR. WALLIS: So there is an alarm and they would go and vent it.

MR. BROCKHOFF: Tech spec alarm.

DR. WALLIS: Right.

MR. BROCKHOFF: Yes, sir.

DR. WALLIS: So they have to have failed

to vent.

MR. BROCKHOFF: You would check for that alarm before you vent. But that's the mechanism that we would have postulated as they were doing maintenance on the squib valve for some reason and didn't vent that properly.

MEMBER ABDEL-KHALIK: So this would be a periodic venting this has to go into the containment.

MR. BROCKHOFF: Only if you did maintenance. If you think about this, once this is -- This is a squib valve here and this is pretty much intact. Once you vent this, we did -- If you recall, we did the accumulator line up here. This was our original sketch.

Now it's moved up here. There's credible maintenance or accident, operations or accident event. Gas is up here. So this is really a deadheaded line. The reactor vessel stays filled as long as you have fuel in there. And even when you defuel you don't drain it. So there's no real mechanism.

That's a big line and there's nothing down there to do anything on. You don't drain it, take it apart and fix anything. The only time you would do it is if you did an inspection of the valves here on some relatively long interval. And then when you're done you put the valve back together and you vent it properly and verify it.

Now the other thing, the Generic Letter 2008-01, requires the utilities to go through a confirmatory inspection program on some periodicity and basically the results if you pick a time that there are no voids in there then you've obviously picked a good interval for your inspection. But that's an operational program.

The current utilities do it for their pump systems. And we would do it for our passive systems.

DR. WALLIS: You have to put the high point there because there's a wall there or something.

MR. BROCKHOFF: We put the -- We needed flexibility in the piping for thermal growth and conditions in containment that would exist potentially in an event if you have flood up and you heat that. So we needed for the pipe stress consideration to put those in. Also routing considerations too.

DR. WALLIS: Routing. I don't know why it has to go up. You could go sideways for the stresses.

MEMBER ARMIJO: What kind of monitor do you use to detect gas accumulation?

MR. BROCKHOFF: The monitor is a heated RTD. I called it a pressure -- a level switch and you guys had asked questions about it. It's really a dual heated RTD.

I actually have it in a backup slide. But there's -- They plug in. They have dual RTDs and one is heated and one is not. So as long as there is water there, there will be a difference. And then if the water goes away it works like a switch. But it's really an RTD and there are matched set of RTDs.

They've been around since the '70s on many, many applications. Probably 25 plants. I've actually brought some sheets with me. But there's a good bit of historical performance on this.

MEMBER ARMIJO: You can rely that they're going to be --

MR. BROCKHOFF: Yes, sir.

DR. WALLIS: So they could actuate a vent, could they? You don't need an operator. You have an automatic venting.

MR. BROCKHOFF: There is no automatic vent. When you get the alarm, we consider the IRWST line inoperable. We have that as tech spec and the operators have an action time to go in and manually vent that which I think is about eight hours, I mean, if I looked at the specs.

DR. WALLIS: So this should really never

happen.

MR. BROCKHOFF: We don't anticipate it. No, sir.

CHAIRMAN RAY: Anything else?

MEMBER BLEY: Once you put a high point in somewhere.

MEMBER ARMIJO: It's a little automatic.

DR. WALLIS: There are all sorts of troubles.

MEMBER BLEY: Yes.

MR. BROCKHOFF: Well, those would be class B valves. And you have to come up with an I&C system and then you have to maintain it for something you really would not need to do only at maintenance periods.

DR. WALLIS: Well, it's just that the devil's in the details, with the pipe if it doesn't show the high point, then you missed something.

MR. BROCKHOFF: Yes, sir.

CHAIRMAN RAY: All right. Action item two will be closed then.

MEMBER ABDEL-KHALIK: There's still a part that deals with the ITAAC.

CHAIRMAN RAY: Oh, I'm sorry. I thought we did that in February.

MR. BROCKHOFF: The last -- I'm sorry. The last question, there was a follow-up. This was not during the meeting but at the end. What ITAAC is needed and change 66 was incorporated by adding a substantial amount of information to 6363 that discussed the ISG approach and how we did and our mitigation features.

So really looked at three things. It committed the ISG in the generic letter. It described our program for gas intrusion and it described the features we put in which I just described. And we added a section that specifically said we need to look at design sloping during design construction and fabrication.

And so based on our discussion with the staff we didn't identify an ITAAC as being required for this. We didn't have one for the high point monitoring, for the core make up tanks or PRHR either because this is a before an accident kind of a function. You make sure that it's not there. It's kind of like an accumulated level before an event. Make sure it's there and it's acceptable performance during the event. So it's not the mitigation feature. It's a preparatory feature.

MEMBER ABDEL-KHALIK: If you had specific lines local requirements how would you verify the as-built condition then?

MR. BROCKHOFF: Well, we're not doing it after the fact. We're doing it -- We designed the module and make the lines sloped to the high point vent in the module. And then in the plant we place module and module correctly. And then we slope the lines while we're fabricating.

The problem is if you do an as-built reconciliation if you find you have a high point you'd have to put a line in and we can't in the module in particular afford to go after the fact and find we had a misconstruction. So we have to verify it while we're building. So the ITAAC if we had a miss, we may not necessarily be able to put a vent in.

So this commitment in 6363.2 says while we constructed in the factory on the module, when we set each module to module and when we run the lines while we're running them, we're doing verification of the slope that specified both in the P&IDs and specified in the isometric drawings. So it's a little bit -- After the fact is too late to solve the problem. Plants that do it after the fact as-built reconciliation end up putting in five or ten or 20 vents maybe and we can't afford to do that in our design. So we have to do it as we build it.

DR. WALLIS: These are very gradual slopes, are they?

MR. BROCKHOFF: They're relatively -- They're horizontal lines, but the manufacturing tolerance can be a little bit one way or the other and we have to make sure that where we drill the hole if there's any slope it's towards the hole. So I don't have a hole here and I ended up building it with a high point.

DR. WALLIS: There is some specification about how steep the slope has to be.

MR. BROCKHOFF: The slope is generally specified as zero but there will be a manufacturing tolerance. And it always says it has to slope uphill to the high point for the line segments of interest only for the specific ones we were interested in.

DR. WALLIS: But does it say by how much it has to slope up?

MR. BROCKHOFF: No. The slope limit -- We design it to be horizontal. But if in the manufacturing when they actually place it, if there's any slope it has to slope towards the vent.

DR. WALLIS: It's very hard to measure zero.

MR. BROCKHOFF: Not with a laser.

DR. WALLIS: It must sit in a tolerance of some.

MR. BROCKHOFF: Well, the tolerance is in the design specs. But when they get it done those specs are specified in like a module drawing or the piping drawing.

DR. WALLIS: I'm not sure that you can measure that slope if it's very small.

CHAIRMAN RAY: But he's saying they don't need a slope, Graham. He's just saying if there is a slope it has to be at the high point.

DR. WALLIS: I don't have to know what that slope is. I'm just saying can you measure that.

CHAIRMAN RAY: What?

MEMBER SHACK: You know the sign of it anyway.

PARTICIPANT: The direction.

CHAIRMAN RAY: Yes, of course.

DR. WALLIS: How do you do that?

MR. BROCKHOFF: Well, they do laser. We have an expert that's actually done the assessment for the current plants, but they do laser leveling of the piping and they have to obviously if there are some different rooms they have to reference a point. But it's that critical. Because if you have a 50 foot segment that's sloped to half inch by the end of it.

DR. WALLIS: That's what I'm getting at.

MR. BROCKHOFF: Yes. So it's very precise and it's during the construction that we would do it, not after the fact you want to measure because it's too late to fix it.

MEMBER SHACK: But why wouldn't you pick something like one inch in 100 just to give yourself --

DR. WALLIS: Just to know what you've got.

MEMBER RYAN: And what is your tolerance for construction?

MR. BROCKHOFF: I don't know the specific ones. It's a field installation policy. I'm not familiar with it.

MEMBER RYAN: Okay. That's fine.

MR. BROCKHOFF: But we place the modules -- Within the module there's a construction tolerance of let's say plus or minus an inch. From module to module it's whatever the installation tolerance is and then the piping has a separate tolerance. But regardless of the tolerance in those, when they lay them out if we have a vent in a location, the line cannot slope uphill any higher than that location. So that becomes an absolute location over the line segment of interest being vented by that location. But we're trying to specify horizontal lines typically except in a few cases like the RHR suction line.

DR. WALLIS: But they're not necessarily straight, are they? I mean 100 foot of line can have wiggles in it.

MR. BROCKHOFF: If it does it can have a high point that can't be vented by the location and that will be an installation tolerance.

MEMBER RYAN: So the highest high point in all these laser measurements is where you would stick the vent.

MR. BROCKHOFF: Well, actually what we do is we specify that to be the high point and everything else has to be downhill. We don't go after --

MEMBER RYAN: Well, I mean I'm picking up on Graham's point.

MR. BROCKHOFF: Yes, sir.

MEMBER RYAN: If you have 100 foot run and there's a few high points relative to the rest of the pipe you would pick the highest of the high points.

MR. BROCKHOFF: We would try to make that the highest of the high points. Yes, sir. We have several locations, but we would want the high point where the vent is to be when we're placing it we make sure. So as we level it if we have a high point as we're going along clamping it we would make sure we adjust that so that it's higher than the other locations.

MEMBER RYAN: All right. So there is a little adjustment capability as you go along.

MR. BROCKHOFF: There has to be.

MEMBER RYAN: There has to be.

MR. BROCKHOFF: If you have two hangars that are off a little bit you have to be able to -- That's why you have to be able to adjust them.

MEMBER RYAN: So you're using something like a rotating laser light or some kind of feature like that to level this up.

MR. BROCKHOFF: Yes.

DR. WALLIS: So you take what you've got and then you fix it.

MEMBER RYAN: Yes.

DR. WALLIS: Rather than saying you're going to make sure that we have one inch in 100 foot design and we make it happen. You take whatever you get and then you fix it.

MR. BROCKHOFF: You adjust it as you're doing it.

CHAIRMAN RAY: Okay. Anything else?

Thank you. We'll close item two.

MS. McKENNA: The next item does contain some proprietary information. So we --

CHAIRMAN RAY: This one does?

MS. McKENNA: Yes.

CHAIRMAN RAY: All right.

MS. McKENNA: So we need to make some appropriate adjustments to the audience.

(Off the record comments.)

CHAIRMAN RAY: We'll close the phone line please and we ask that --

PARTICIPANT: We need Rick Ofstun on the proprietary phone line.

CHAIRMAN RAY: All right. We'll take a minute. Go off the record until we get that set up. Off the record.

(Whereupon, at 3:30 p.m., the above-entitled open meeting was closed to go a closed session.)

AP1000 Design Control Document
Amended Design

Chapter 19
11/02/10

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Chapter 19 Overview

- Probabilistic Risk Assessment
  - Internal Events
  - External Events
- Ex-Vessel Severe Accident Phenomena
- Additional Assessment of AP1000 Design Features
- Equipment Survivability Assessment
- Shutdown Evaluation
- Malevolent Aircraft Impact

- Licensing Lead: Thom Ray
- Technical Lead: Rick Anderson and Andrea Maioli

Chapter 19 Open Items

Five Open Items were identified and subsequently closed:

- OI-SRP19.0-SPLA-07 – More detail of resolved and requantified PRA model and any DCD updates that may be necessary.
- OI-SRP-19.0-SPLA-12 – Maintain acceptable seismic margin for Hard Rock High Frequency sites.
- OI-SRP19.0-SPLA-13 – More detail of the shutdown PRA risk and any DCD updates that may be necessary.
- OI-SRP19.0-SPLA-14 – More information on the containment inventory of radionuclides used for survivability evaluation.
- OI-SRP19F-SPLA-01 – Open Item for review of Appendix 19F, "Malevolent Aircraft Impact." Staff was Awaiting Regulator Guidance for review of Section.

Chapter 19 - OI-SRP19.0-SPLA-07

- **Issue:**
  - More detail of resolved and requantified PRA model and any DCD updates that may be necessary
- Final Resolution
  - DCD Rev. 17 did not reflect the new instrumentation and control (I&C) modeling provided in the PRA model. The PRA was requantified and the results for the at power PRA indicated that the at power CDF and LRF values and top cutsets closely compare with these items documented in the DCD. No further DCD updates were necessary for the at power PRA.

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Chapter 19 - OI-SRP-19.0-SPLA-12

- **Issue:**
  - Maintain acceptable seismic margin for Hard Rock High Frequency sites
- Final Resolution
  - The response provided more information for the Seismic Margin Analysis based on guidance provided in ISG-20. Chapter 19.55 of the DCD (PRA-based Seismic Margin Analysis) was revised to reflect the current site parameters for the standard design of AP1000 and design modifications from DCD Rev. 17 and 18.

Chapter 19 - OI-SRP19.0-SPLA-13

- **Issue:**
  - More detail of the shutdown PRA risk and any DCD updates that may be necessary
- Final Resolution
  - More detail was provided in DCD Chapter 19.59.5 to reflect the results and insights of the requantified low-power/shutdown PRA.

Chapter 19 - OI-SRP19.0-SPLA-14

- **Issue:**
  - More information on the containment inventory of radionuclides used for equipment survivability evaluation.
- Final Resolution
  - Information was provided to give more details on the containment inventory of radionuclides used for the equipment survivability evaluation, inclusion of mechanical hatches and gaskets into the environmental assessment, and additional information by which the licensee COL information item is addressed. The DCD Section 19D.8.2.4 was revised to clarify how the hydrogen monitors are used in severe accident conditions.

Chapter 19 - OI-SRP19F-SPLA-01

- **Issue:**
  - Open Item for review of Appendix 19F, "Malevolent Aircraft Impact."
- Final Resolution
  - NRC performed review in accordance with new guidance provided in DG1176, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts." In response to NRC requests, DCD Section 19F was updated to provide more information on the descriptions of the design features and functional capabilities required by NEI 07-13 "Methodology for Performing Aircraft Impact Assessments for New Plant Designs".

Questions?

AP1000 Design Control Document
Amended Design
Review of Chapter 9 AFSER

November 2-3, 2010

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Chapter 9 - Auxiliary Systems

- Subject Matter Experts
  - Rob Morrow - Components and Materials
  - Chuck Bullard – HOLTEC International
  - Jeff Secker - Core Technologies
  - Phil Mathewson - Turbine Building Layout
  - Mitch Sanders - Auxiliary Equipment
- Licensing – Paul Loza

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Chapter 9 - Auxiliary Systems

- Chapter 9 describes Auxiliary Systems, including
  - **Fuel Storage and Handling**
  - **Water Systems**
  - **Process Auxiliaries**
  - **Air-Conditioning, Heating, Cooling, and Ventilation System**
  - **Fire Protection Analysis**

Chapter 9 – Open Items

- Open Items:
  - Eleven OIs identified in the SER with OIs
  - All are closed
  - Additional RAIs on Fuel Rack Seismic Analysis are closed

Chapter 9 - Discussion Issues

- SFP Criticality (OI-SRP9.1.1-SRSB-08)
- Fuel Racks Seismic Analysis
- Zinc Addition (OI-SRP9.3.6-SRSB-01)

Chapter 9 - SFP Criticality

- AP1000 issue:
  - Increased capacity from 619 storage locations to 889
  - Staff concern with the industry issue on treatment of depletion calculation uncertainties in SFP criticality analysis

Chapter 9 - SFP Criticality

- **Resolved:**
  - SFP criticality reanalyzed using methods of recent similar fuel pools SERs
  - No burnup credit needed for Region 2 (High density)
  - Staff concluded methodology and analysis are acceptable
  - **OI-SRP9.1.1-SRSB-08** is closed

Chapter 9 - Fuel Rack Seismic Analysis

- **AP1000 issue:**
  - Update structural dynamic and stress analyses from DCD R15
    - higher SFP capacity
    - new rack designs
    - new SSE spectra
  - Two COL Information Items desired closed – WEC to perform these analyses for the new and spent fuel racks

Chapter 9 - Fuel Rack Seismic Analysis

- **Resolved:**
  - Multiple structural evaluations performed
    - 3D seismic, fuel drop, stuck assembly, rack/wall impact
    - HOLTEC performed WEC analyses
    - TR-44 and TR-54 were updated to include revised and additional analyses
  - Staff concluded fuel racks are acceptable
  - Two COL Information Items closed

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Chapter 9 – Zinc Injection to RCS

- **AP1000 issue:**
  - Zinc Addition is shown to reduce personnel exposure, surface corrosion, and potential for crud induced power shifts (CIPS)
  - Resolve staff concerns:
    - AP1000 core considered High Duty per EPRI
    - Small High Duty core operating experience
    - Potential for excessive crud/CIPS when zinc addition is started later in core/fuel life

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Chapter 9 – Zinc Injection to RCS

- **Resolved:**
  - Staff concludes AP1000 Zinc injection acceptable:
    - Cycle reload analyses will coordinate zinc addition strategy to minimize crud thickness
    - Addition starts during hot functional testing to reduce corrosion on the RCS and primary side steam generator surfaces.
    - Operating levels similar to operating plants, and inspection to be per EPRI fuel reliability guidelines
    - **OI-SRP9.3.6-SRSB-01** is closed

Questions?

(backup slides)

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Chapter 9 - Open Items

OI-SRP9.1.1-SRSB-08 - Criticality analysis consistent with current burnup credit methodology

OI-SRP9.1.2-SBPA-09 - SFP minimum water shield height

OI-SRP9.1.2-SBPA-14 - SFP storage rack density

OI-SRP9.1.3-SBPA-04 - SFP decay heat levels vs. critical time values

OI-SRP9.1.3-SBPA-08(b) - SFP thermal analysis - suction line elevation

OI-SRP9.1.3-SBPA-10 - SFP piping diagram changes

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Chapter 9 - Open Items (cont.)

OI-SRP9.1.3-SBPA-11 - SFP level alarm changes

OI-SRP9.1.3-SBPA-13 - SFP saturation and required operator actions

OI-SRP9.1.4-SBPA-03 - Fuel Move Components

OI-SRP9.1.5-SBPB-01 - Heavy loads handling program

OI-SRP9.3.6-SRSB-01 - Zinc Addition to RCS during operation

Chapter 9 - OI-SRP9.1.1-SRSB-08

- **Issue:**
  - Potential restricted SFP loading pattern due to Fission Product and Actinide Inventory Uncertainties
- **Final Resolution: Issue closed**
  - Burnup credit methodology revised to match currently operating reactors / Kopp memo
  - No burnup credit needed for Region 2 (High density)
  - Meets the requirements of GDC 62 / 10 CFR 50.68

Chapter 9 - OI-SRP9.1.2-SBPA-09

- **Issue:**
  - SFP minimum water shield height
- **Final Resolution: Issue closed**
  - Adjustments made to maximum lift height and SFP water level maintain the dose rate to the bridge operator within safe limits

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Chapter 9 - OI-SRP9.1.2-SBPA-14

- **Issue:**
  - SFP cooling with high density storage racks
- **Final Resolution: Issue closed**
  - AP1000 SFP cooling removes decay heat during all plant operation modes, regardless of location
  - Satisfies GDC 61 requirements

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Chapter 9 - OI-SRP9.1.3-SBPA-04

- **Issue:**
  - SFP decay heat levels vs. critical time values
- **Final Resolution: Issue closed**
  - Clarified conditions and assumptions of each calculated range of decay heat levels
  - Specified each refueling off-load condition as representative or limiting
  - Now a Confirmatory Item

Chapter 9 - OI-SRP9.1.3-SBPA-08(b)

- **Issue:**
  - SFP Thermal Analysis – Suction Line Elevation
- **Final Resolution: Issue closed**
  - SFP boiloff calculation revised to correct the draindown height
  - SFP level is changed to a normal operation band
  - Now a Confirmatory Item

Chapter 9 - OI-SRP9.1.3-SBPA-10

- **Issue:**
  - SFP piping diagram changes
- **Final Resolution: Issue closed**
  - Several corrections were made to represent the actual SFS on DCD Figure 9.1-5
  - None of these corrections change the safety conclusions

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Chapter 9 - OI-SRP9.1.3-SBPA-11

- **Issue:**
  - SFP level alarm changes re: level is changed to a normal operation band
- **Final Resolution: Issue closed**
  - High and Low SF Pool level alarms are moved from safety related sensors to a non-safety related level transmitter, allowing accurate level maintenance
  - The Low-Low safety-related setpoint remains on the safety-related sensors. No safety evaluation are affected.

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Chapter 9 - OI-SRP9.1.3-SBPA-13

- **Issue:**
  - SFP saturation and required operator actions
- **Final Resolution: Issue closed**
  - Description and TS reflect assumed water sources and operator actions for several offload scenarios
  - Maximum 140F temperature clarified regarding available equipment and ambient wet bulb temperatures

Chapter 9 - OI-SRP9.3.6-SRSB-01

- **Issue:**
  - Zinc Addition to RCS during operation
- **Final Resolution: Issue closed**
  - Cycle specific reload analyses will coordinate zinc addition strategy with the plant and core design to minimize crud thickness
  - Zinc to be added during hot functional testing to reduce corrosion on the RCS and steam generator surfaces. Zinc levels are lowered on fuel load similar to operating plants
  - Fuel inspection to be per EPRI fuel reliability guidelines

Chapter 9 - OI-SRP9.1.4-SBPA-03

- **Issue:**
  - Fuel Move Components
- **Final Resolution: Issue closed**
  - Clarified the use of and the restrictions on each Fuel Handling Machine (FHM) hoist
  - FHM hoists have mechanical stops to limit height of fuel lift within safe bounds
  - Add New Fuel Elevator to Figure 9.1-4

Chapter 9 - OI-SRP9.1.5-SBPB-01

- **Issue:**
  - Evaluate Equipment Hatch Hoist Loads on Containment Vessel
- **Final Resolution: Issue closed**
  - The analyzed load set on Containment Vessel is acceptable for all conditions and service levels, including seismic

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Presentation to the ACRS Subcommittee

AFSER Chapter 9
Auxiliary Systems

Westinghouse AP1000 Design Certification Amendment Application Review

November 3, 2010

Staff Review Team

- Technical Staff
  - Pravin Patel—Structural Engineering
  - Chris Van Wert—Reactor Systems
  - Raul Hernandez—Balance of Plant
  - Gordon Curran—Balance of Plant
  - Larry Wheeler—Balance of Plant
  - Thinh Dinh—Balance of Plant
  - Brookhaven National Laboratory
    - (R. Morante, J. Braverman)
- Project Management
  - Perry Buckberg

Overview

- Chapter 9 of the SER with Open Items (OIs) included 11 Open Items
- Fuel Rack Seismic Analyses Sections Were Not Issued Until the AFSER
  - Several RAIs were Resolved Summer 2010
- All Open Items & RAIs are now Resolved
- OI Resolutions Being Presented
  - OI-SRP9.1.1-SRSB-01
  - OI-SRP9.3.6-SRSB-01
- Fuel Rack Seismic topics will be presented

OI-SRP9.1.1-SRSB-01

- OI-SRP9.1.1-SRSB-01 tracks an issue related to the use of burnup credit in the spent fuel pool criticality analysis.
  - Original analysis assumed full rack loading and included burnup credit for Region 2 storage.
  - Staff questioned the handling of uncertainties related to depletion calculations.
  - To resolve the issue, the applicant proposed a checkerboard pattern limitation so that burnup credit was not necessary.

OI-SRP9.1.1-SRSB-01 (cont.)

- The applicant subsequently returned to the original fully loaded analysis.
  - Recent LAR approvals of similar designs/methods.
- Based on the staff’s technical review and recent precedents, the staff finds that the applicant meets all current regulations regarding spent fuel pool criticality.

OI-SRP9.3.6-SRSB-01

- Option to Inject Zinc Added to DCD
  - For Dose Reduction; Not Credited For PWSCC Mitigation
  - No Adverse Effects on RCS Pressure Boundary Materials or Chemistry (Operating or Post- Accident)
- Insufficient High Duty Core Industry Experience
  - To Rule Out Excessive Crud, or Crud Induced Power Shift (CIPS)
  - OI-SRP 9.3.6-SRSB-01 Related to Effects on Fuel

OI-SRP9.3.6-SRSB-01

- OI Related to Effects on Fuel
  - AP1000 core design classified as a low to medium duty plant.
    - Confirmed by staff calculation
  - High duty plants have successfully operated with zinc addition
  - CIPS risk analysis is performed using EPRI guidelines(VIPRE BOA)
  - Fuel inspection program will look at crud build-up
- Staff finds the Response Acceptable
  - AP1000 CIPS risk is bounded by current OE
  - Modeling plus fuel inspection provides additional assurance CIPS risk is minimized

Spent Fuel Storage Racks

- Westinghouse Technical Report TR-54 (APP-GW-GLR-033), "Spent Fuel Storage Racks Structural/Seismic Analysis", addresses DCD Revision 15 COL Information Item 9.1-3:

  > *Perform a confirmatory structural dynamic and stress analysis for the spent fuel rack, as described in subsection 9.1.2.2.1. This includes reconciliation of loads imposed by the spent fuel rack on the spent fuel pool structure described in subsection 3.8.4.*

- TR-54, Revision 0, was submitted in July 2006.

- TR-54, Revision 4, was submitted in May 2010.

- Based on its technical evaluation, the staff concludes that the substance of the COL Information Item is completely addressed by TR-54, Revision 4.

- DCD Revision 15 COL Information Item 9.1-3 is no longer needed.

New Fuel Storage Racks

- Westinghouse Technical Report TR-44 , (APP-GW-GLR-026) “New Fuel Storage Rack Structural/Seismic Analysis”, addresses DCD Revision 15 COL Information Item 9.1-1:

  Perform a confirmatory structural dynamic and stress analysis for the new fuel rack, as described in AP 1000 DCD subsection 9.1.1.2.1. This includes the structural adequacy of the proposed AP 1000 New Fuel Storage Rack under postulated loading conditions and effects on the structure described in subsection 3.8.4.

- TR-44, Revision 0, was submitted in May 2006.

- TR-44, Revision 5, was submitted in August 2010.

- Based on its technical evaluation, the staff concludes that the substance of the COL Information Item is completely addressed by TR-44, Revision 5

- DCD Revision 15 COL Information Item 9.1-1 is no longer needed.

Fuel Racks Structural Evaluation

- Loading Conditions Analyzed
  - 3 Directions of Seismic Excitation + Dead Weight
  - Fuel Assembly Accidental Drop over the Spent Fuel Pool
  - Stuck Fuel Assembly, during removal from rack
  - Impact Load on the Spent Fuel Pool Steel Liner/Concrete Wall

Fuel Racks Structural Evaluation

- Primary Analysis Methods

  - HOLTEC proprietary computer code DYNARACK, for nonlinear dynamic analysis of free-standing fuel racks subject to seismic plus deadweight loading

  - LS-DYNA nonlinear dynamic analysis, for accidental drop of a fuel assembly over the spent fuel pool. Two scenarios: drop on top of a fuel rack and drop through a cell to the rack bottom plate.

  - LS-DYNA nonlinear analysis, for worst-case rack-to-rack impact loading at the top of a spent fuel rack

  - ANSYS nonlinear analysis, for cell wall compressive loading at the bottom of the new and spent fuel racks.

Fuel Racks Structural Evaluation

- The staff issued forty-four (44) RAIs for TR-54, and thirty-one (31) RAIs for TR-44.
- For the seismic analysis, the applicant's contractor (HOLTEC) conducted the following sensitivity studies, several in response to staff RAIs:
    - friction coefficient between the bottom of the fuel racks and the supporting surface; 0.2, 0.5, 0.8 analyzed.
    - number of fuel assemblies in the fuel racks at the time of a seismic event; three cases analyzed.
    - in-situ gaps between adjacent spent fuel racks; two cases analyzed.
    - impact spring value due to local flexibility of the fuel assembly cell wall; three values analyzed.
    - sensitivity of the DYNARACK solution to reduction of the integration time step, by a factor of 4.

Fuel Racks Structural Evaluation

- Seismic loading on the new and spent fuel racks was re-defined two (2) times during the course of the staff's review; re-analysis each time.
- The staff confirmed that final seismic loading is consistent with the Auxiliary and Shield Building (ASB) re-analysis (SASSI modeling errors and SB design changes).
- Applicant made several design changes, to strengthen for rack-to-rack impact loading, due to seismic excitation of the spent fuel racks.
- The staff determined that the applicant applied methods and procedures contained in NRC regulatory guidance documents, and previously accepted by the staff for qualification of fuel racks.
- Based on the staff's in-depth review of the applicant's detailed calculations, during a series of audits, and the results of the applicant's sensitivity studies, the staff concluded that the spent and new fuel rack designs are adequate to withstand the postulated loading

Fuel Racks Structural Evaluation

- SER Section 9.1.2.2.1 “Spent Fuel Rack Design Change” documents the staff’s evaluation of TR-54.
  - All Technical Issues are Resolved.
  - Two (2) Confirmatory Items require revision of the DCD.
  - One (1) Confirmatory Item requires revision of TR-54 and the DCD, to show the final gap and tolerance dimensions between the racks and between the racks and the spent fuel pool wall.

- SER Section 9.1.1.2.1 “New Fuel Rack Design Change” documents the staff’s evaluation of TR-44.
  - All Technical Issues are Resolved.
  - Five (5) Confirmatory Items require revision of the DCD.

ACRS Meeting

Impact of Gas Intrusion on IRWST Makeup Water Injection in the AP1000

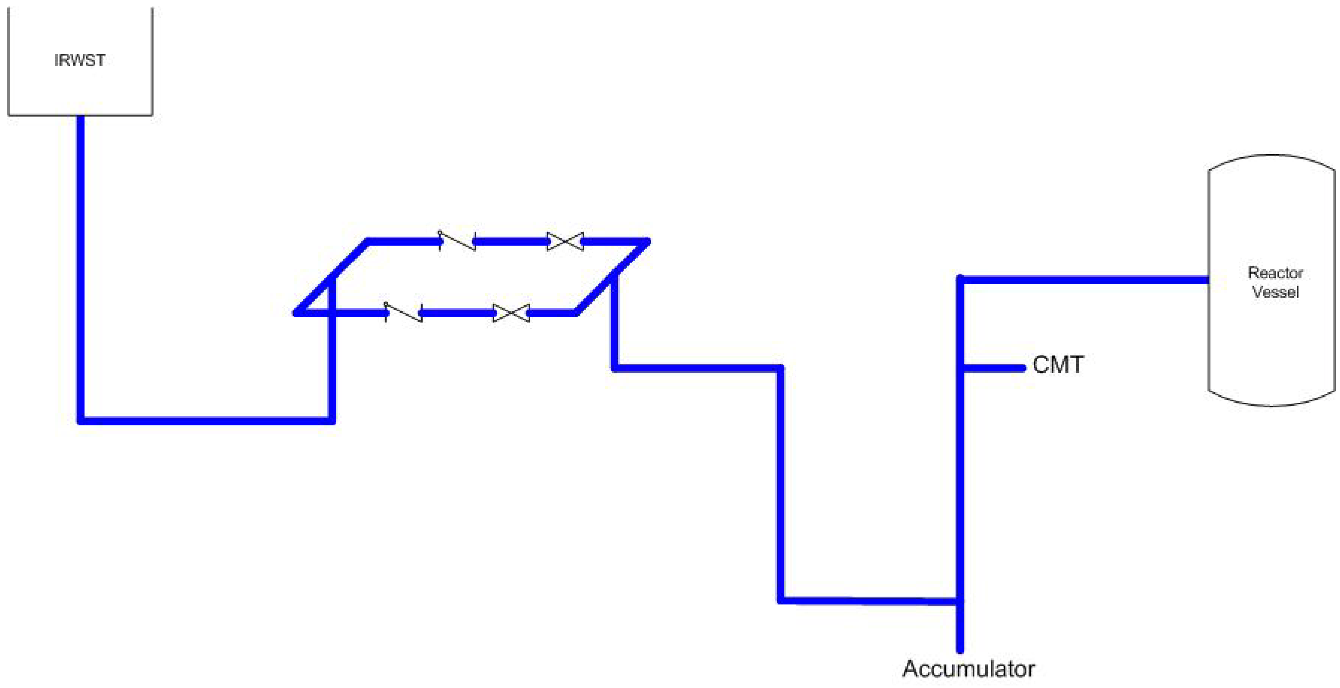
November 2010

Chuck Brockhoff — Nuclear Systems Design
David McDevitt — Nuclear Safety Analyses

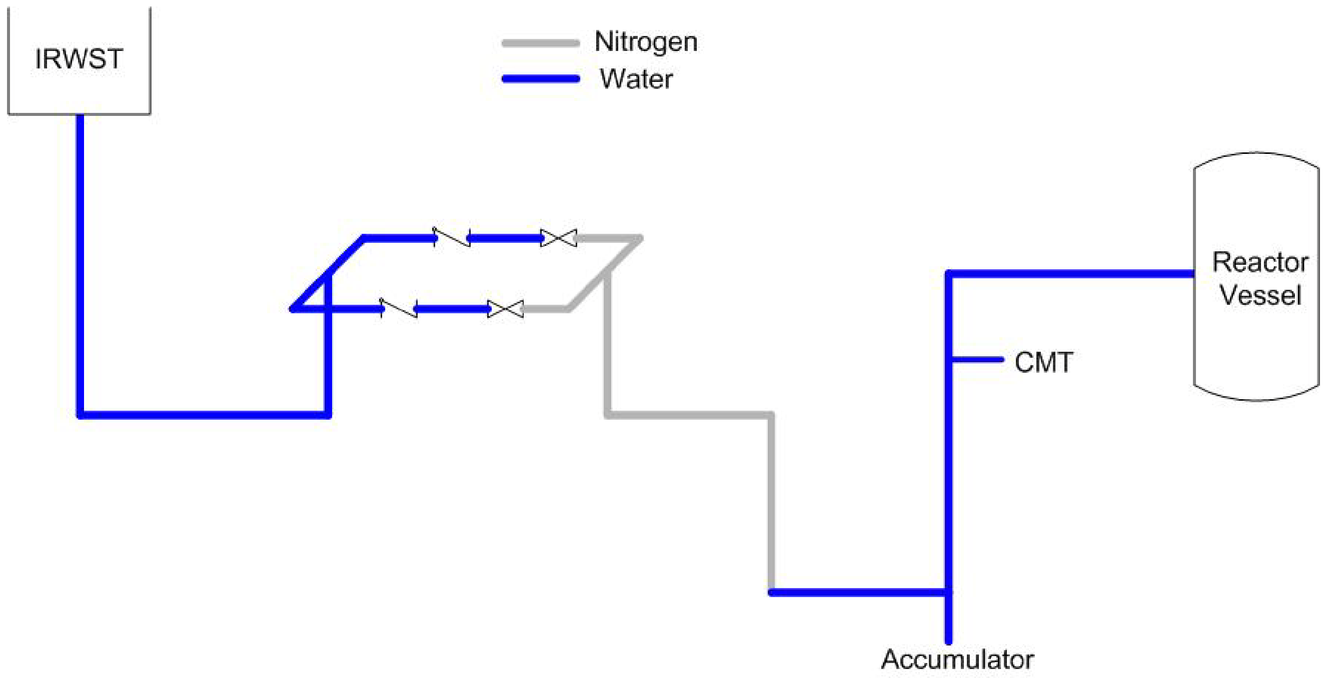
AP1000 Gas Intrusion Assessment

- A question on the potential for gas intrusion during In-Containment Refueling Water Storage Tank (IRWST) passive injection was asked during the July 2009 ACRS Meeting discussion on Chapter 14 (Initial Test Program)
- Westinghouse provided an update to the ACRS in February 2010 on the AP1000 gas intrusion assessment following the operating plant guidance in NEI 09-10 to address GL 2008-01 considerations (now required for advanced plants per draft ISG-019)
- Resulted in three design changes initiated by CN66
  - Added 4 high point pipe stub locations / redundant level indications / hard piped vents
  - Added 8 other high-point vent valves (and used existing test connections at 9 other locations)
  - Moved the accumulator discharge line connection to the direct vessel injection line
- One Open Item (2b) from the February 2010 ACRS meeting was to supplement the sensitivity analysis (core mixture level) provided with a core heatup calculation

IRWST Injection Path - No Void Present



IRWST Injection Path - Void Present



[NOTE: (IRWST Valve Elevation – IRWST Injection Tee Elevation) * Density of IRWST Fluid ≈3.4 psi]

SBLOCA Gas Intrusion Simulations

- Current Safety Analysis NOTRUMP Small Break LOCA Evaluation Model (EM) does not explicitly consider gas intrusion
  - Potential delay in onset of IRWST injection

- During February meeting preliminary NOTRUMP simulations were discussed
  - IRWST injection delayed to simulate non-condensable gas accumulation
  - Impact is most significant for smaller breaks and no-break simulations (Inadvertent ADS, INADS)
    - Break in RCS assists in depressurization characteristics
    - 2 inch cold leg break and INADS examined
  - Core uncovery predicted

- Peak Cladding Temperature (PCT) response requested
    - SBLOCTA code utilized

NOTRUMP Simulation Results

- Simulations indicate base model IRWST injection begins with a DVI line pressure of approximately 28 psia
    - 2-inch indicates IRWST Injection at ~3197 seconds
    - INADS indicates IRWST Injection at ~2474 seconds
- Accounting for gas intrusion requires additional depressurization to achieve IRWST injection
  - With maximum IRWST line void (~7.9 ft) assumed an additional ~3.4 psia depressurization required
    - 2-inch indicates ~2.9 ft uncovery over ~115 seconds
      - 654°F PCT
    - INADS indicates ~4.3 ft uncovery over ~346 seconds
      - 1305°F PCT
- Accounting for gas void with DCD modeling assumptions results in partial core uncovery
  - PCTs well below 10 CFR 50.46 limit w/ maximum IRWST line void considered

Response to ACRS Question 2a What ITAAC is Needed?

- CN66 changes evaluated as part of SER Chapter 23
- CN66 SER inputs are complete – No further action
- Added DCD Subsection 6.3.6.3 (discusses Mitigation of Gas Accumulation)
  - Includes a discussion of the ISG-019 / GL 2008-01 gas intrusion assessment
  - Summarizes the gas mitigation design features
- DCD Subsection 6.3.6.3.2 (System Design Features to Mitigate Gas Intrusion) includes specific line sloping design / construction / fabrication requirements
- A new ITAAC is not required