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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

ABWR SUBCOMMITTEE MEETING

OPEN SESSION

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TUESDAY

MARCH 8, 2011

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Said Abdel-Khalik, Chairman, presiding.

COMMITTEE MEMBERS:

SAID ABDEL-KHALIK, Chairman

JOHN W. STETKAR, Member-at-Large

J. SAM ARMIJO, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, Member

MICHAEL L. CORRADINI, Member

MICHAEL T. RYAN, Member

ACRS CONSULTANT PRESENT:

GRAHAM B. WALLIS

NRC STAFF PRESENT:

JOE DONOGHUE, NRO/DSRA/SRSB

JAMES GILMER, NRO/DSRA/SRSB

STACY JOSEPH, NRO/DNRL/BWR

CHANG-YANG LI, NRO/DSRA/SBPB

GREGORY MAKAR, NRO/DE/CIB1

JOHN McKIRGAN, NRO/DSRA

MICHAEL NORATO, NRO/DE/CIB2

NEIL RAY, NRO/DE/CIB2

THOMAS SCARBROUGH, NRO/DE/CIB2

GEORGE THOMAS, NRO/DSRA/SRSB

MARK TONACCI, NRO/DNRL/BWR

HANRY WAGAGE, NRO/SBCV

GEORGE WUNDER, NRO, DNRL/NGE2

MAITRI BANERJEE, Designated Federal Official

ALSO PRESENT:

TIM ANDREYCHEK, Westinghouse

KENJI ARAI, Toshiba

COLEY CHAPPELL, STPNOC

THOMAS DALEY, NINA Engineering, STP 3&4

SCOTT HEAD, NINA Manager, Regulatory Affairs,
STP 3&4
NIRMAL JAIN, Westinghouse
JEREMY KING, Westinghouse
ROBERT QUINN, Westinghouse
MARY RICHMOND, Bechtel
CAROLINE SCHLASEMAN, MPR Associates/TANE Licensing
JAMES TOMKINS, NINA Licensing, STP 3&4
MARTIN VAN HALTERN, Westinghouse

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

8:30 a.m.

CHAIRMAN ABDEL-KHALIK: The meeting will now come to order. This is a meeting of the ABWR Subcommittee of the Advisory Committee on Reactor Safeguards.

I am Said Abdel-Khalik, Chairman of the Subcommittee. ACRS members in attendance today are Mike Ryan, Sam Armijo, John Stetkar and Dennis Bley. Members Brown and Corradini will join us at a later point today.

Dr. Graham Wallis, ACRS consultant, is also in attendance. Ms. Maitri Banerjee is the Designated Federal Official for this meeting.

The Committee wrote an interim letter to the NRC chairman last year after several briefings of the Subcommittee and a briefing of the full committee by STP, the applicant, and the NRC staff, regarding the South Texas Project Combined License Application and the corresponding Safety Evaluation Reports with open items prepared by the staff.

In today's meeting, we are scheduled to discuss Chapters 4, 5 and 6 of the staff Safety Evaluation where the open items have been closed.

The applicant and the staff will discuss the COL application and resolution of the open items, together with the action items that resulted from previous ABWR Subcommittee meetings.

In addition to the SER chapters, today's discussion is expected to specifically address long-term cooling of the plant following a design-basis accident.

In a 2008 SRM, the Commission mandated that the ACRS advise the staff and Commission on the adequacy of the design-basis long-term cooling approach for each new reactor design base as appropriate on either its review of the design certification or the first license application referencing the reactor design.

Today's meeting will continue into tomorrow when we will discuss three more chapters of the SER, namely Chapters 11, 13 and 16.

The rules for participation in today's meeting were announced in the Federal Register on March 2nd, 2011, for an open/closed meeting.

Parts of this meeting may need to be closed to the public to protect information proprietary to the applicant or other parties.

I'm asking the NRC staff and the applicant to identify the need for closing the meeting before we enter into such discussion, and to verify that only people with the required clearance and need to know are present.

We have a telephone bridge line for the public and stakeholders to hear the deliberations. This line will not carry any signal from this end during the closed portion of the meeting.

Also, to minimize disturbance, the line will be kept in listen-only mode until the last 15 minutes of the meeting.

At that time, we will provide an opportunity for any member of the public attending this meeting in person or through the bridge line, to make a statement or provide comments.

As the meeting is being transcribed, I request that participants in this meeting use the microphones located throughout this room when addressing the Subcommittee.

Participants should first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

Before we proceed to the meeting, there is a minor change in the agenda, where on the agenda that you have in front of you it says between 8:45 and 9:45

both the applicant and the staff will discuss Chapter 5. And then after the break, both the staff and the applicant will discuss Chapter 4.

Just to minimize the back-and-forth, the applicant will discuss both Chapters 4 and 5 before the break, and the staff will discuss Chapters 4 and 5 after the break.

So, with that, we will proceed to the meeting. And I ask Mr. Tonacci if there are any opening comments.

MR. TONACCI: Thank you, Mr. Chairman, and members of the Committee. I appreciate your accommodating our request for an agenda change.

I also look forward to today's discussion as it represents a culmination of many months of work surrounding the reactor system cooling and long-term core cooling as well.

Much of the long-term core cooling presentation this afternoon is going to focus on portions of the design that were certified by regulation way back in March of 1997, 14 years ago.

These presentations are being made as the Chairman mentioned moments ago, to allow the Committee to address the 2008 SRM from the Commission on the adequacy of the design of long-term core cooling for the ABWR.

Since portions of the ABWR long-term cooling design are being modified by STP, it makes sense to present the COL application and the related Safety Evaluation at the same meeting as the presentation for the long-term core cooling so we can adjust the SRM.

Thank you in advance for your time today, and I look forward to an engaging discussion.

CHAIRMAN ABDEL-KHALIK: Please proceed.

MR. HEAD: Okay. Thank you, and we appreciate the opportunity to brief the ACRS on Chapters 4, 5, 6 and long-term cooling, and the opportunity again tomorrow.

One just slight nuance. We're going to go ahead and do Chapter 5 first during this first session, and then we'll do Chapter 4. So, we'll go ahead and get started.

The agenda, as alluded to, this is a relatively short presentation at least content-wise. We'll go over the Chapter 5 contents and discuss departures and COL items, and then a quick Chapter 5 summary.

And our participants, myself, Tom Daley is with us today from NINA and Coley Chappell. And I'm going to turn it over to Coley at this point.

MR. CHAPPELL: My name is Coley Chappell with NINA Licensing for STP 3 and 4. And what I'd like to do is briefly recap the contents of Chapter 5, which is the reactor coolant system and connected systems, which was discussed on March 18th of last year.

We discussed primarily that a Tier 1 Departure for the reactor core isolation cooling turbine pump design change that simplified the design, reduced some components. And we went through some action items that followed up that discussion as well and closed those in subsequent meetings.

We also discussed the number of Tier 2 Departures that were in that section. These Tier 2 Departures primarily dealt with component changes or code changes, code adjustments.

In summary for Chapter 5, there are no open items that are identified in the SER. All license information items to be addressed by the COL applicant, have been addressed. And the Pressure Temperature Limits Report was submitted and also is documented in the SER.

There are no outstanding requests for information in this section. And all action items as

I mentioned before, have been addressed in previous meetings.

CHAIRMAN ABDEL-KHALIK: Now, I know this is not an open item, but the unidentified leakage rate was increased from 3.785 liters from one gpm to 19 liters from it.

And if one were to just take the hypothetical situation that is allowed by tech specs of having a plant operating for 18 months with an unidentified leak of 19 liters per minute, that adds up to 1.5 times 10 to the seventh liters, which is 3.7 times 10 to the six gallons. 3.7 million gallons.

Is there something in tech specs that prevents that from happening?

MR. CHAPPELL: When the system is in operation and unidentified leakages accumulated in the drywell, the limit is, as you mentioned, 19 liters or five gallons per minute.

Those inputs are monitored. They're monitored continuously and they have alarms. As you mentioned, they also have tech spec limits.

So, if there's a change in that, it's identified in a corrective program and it's aggressively pursued. So, we would not operate at that limit, and we would not allow operation to continue with a rising trend over that period of time.

CHAIRMAN ABDEL-KHALIK: But what is there formally in tech specs that limits the cumulative amount of unidentified leakage?

MR. CHAPPELL: The rate. The rate that is coming into the system.

CHAIRMAN ABDEL-KHALIK: But the rate, I mean, we'll stick with the 19 liters per minute.

Is there something on the integrated cumulative leak?

MR. CHAPPELL: On a rate basis, you have the unidentified and the identified leakage.

CHAIRMAN ABDEL-KHALIK: I'm only focused on unidentified.

MR. HEAD: I guess my experience in One and Two is that, you know, accumulative is not as important as the existence of the leak itself.

That's the fact that you've got a question regarding the reactor, you know, the boundary itself at the time identified. Very small leaks capable of being identified now get significant reaction on the part of the staff.

It's, I guess, my view that that rate defines significance with respect to a plant shutdown, but that doesn't mean that the plant is not reacting significantly to any.

And so, you're right. In the theoretical if we operated that length of time for a year, maybe that's what tech spec says, but that clearly the regulatory regime and the corrective action program, just a number of different other aspects of our, you know, would be insisting that we be focusing on that leak.

And so, I think it's more of a, you know, at what point in time is it severe enough that you should be shutting the plant down versus envisioning operating that period for the whole cycle.

CHAIRMAN ABDEL-KHALIK: And don't you think the integrated cumulative amount that had leaked so far would matter significantly in that decision as to whether or not to shut the plant down?

MR. HEAD: No, sir, I don't see that as important as the fact that the leak exists itself, and that we need to embark upon finding out what it is.

Because the integration, for example, if it's stable, then, you know, I think the future threat that it represents would be something that, you know, from a, you know, what you're ultimately after is the potential for unidentified leading to some sort of LOCA -

CHAIRMAN ABDEL-KHALIK: Right.

MR. HEAD: - which is your ultimate concern there, that that would not play into your - cumulative, I do not think, would play into your decision as the fact to say, as again, the fact that it exists at all.

So, I've never -

MR. CHAPPELL: It's a significant operational -

CHAIRMAN ABDEL-KHALIK: Right.

MR. CHAPPELL: A significant operational aspect of -

CHAIRMAN ABDEL-KHALIK: I mean, I just can't see a plant accumulating 3.7 million gallons and saying we'll continue operating because we're within tech specs.

MR. HEAD: Well, that just would not happen.

CHAIRMAN ABDEL-KHALIK: Go ahead.

MR. CHAPPELL: I mean, you have the liquid waste management system. And it's capable of maintaining other inputs as well and processing these inputs and returning the water to plant operation.

And there are a number of things that could potentially challenge that system operation. If you're not able to process water, maintain the water, then that's a threat to continued plant operation. And that will be addressed. Very high priority to address those activities.

That's why we have a large number in redundant tanks to handle that type of -

MR. TOMKINS: And leaks like that are addressed long before you're anywhere close to that type of -

MEMBER BLEY: Well, I think you also said you wouldn't accumulate -

MR. CHAPPELL: That's correct. We would continue to process all of our waste and try to reduce that and return it to service.

MR. HEAD: Our ops manager will be here tomorrow, and that would be an interesting question to ask him and get his perspective. Because, you know, tech specs, you know, define limits for shutting the plant down, but he'll tell you he defines limits also.

CHAIRMAN ABDEL-KHALIK: That's what I was waiting to hear.

MR. HEAD: Okay.

CHAIRMAN ABDEL-KHALIK: Thank you. Let's proceed.

DR. WALLIS: Well, I was listening to this.

So, 7,000 gallons a day you're talking about has to go somewhere.

MR. CHAPPELL: Yes, sir.

DR. WALLIS: So, I would imagine you're not doing something within a day. No waiting for --

MR. HEAD: Actually, the experience at STP where --

CHAIRMAN ABDEL-KHALIK: But that's not what tech spec says.

MR. WALLIS: I know. It seems very odd.

MR. HEAD: Well, like I say, that represents an official place where you would have to address the plant from shutting down. But way before that, the entire station has embraced this as an issue and will be reacting to it. That's the experience at One and Two, and I know it will be the experience at Three and Four.

MR. WALLIS: What is the reaction?

You just pump the water away and put more in --

MR. HEAD: No, sir, no, in terms of identifying it. Now, at that point in time, yes, you have people that have a water management issue, but everyone else is focused on where is the leak and what do we have to do to address the leak.

Because, you know, if it is the wrong type of leak, obviously we have to shut down. If it's pressure boundary leakage, we may have to shut the plant down.

MR. CHAPPELL: I would also add to that that five gallons per minute limit in tech specs is consistent with BWRs in operation and has been successful in handling this type of situation.

CHAIRMAN ABDEL-KHALIK: Thank you.

MEMBER STETKAR: Coley, I'd like to --

MR. LI: Excuse me. This is Chang Li of staff review on RCS leakage detection. I have some comments to add.

CHAIRMAN ABDEL-KHALIK: Yes, sir.

MR. LI: Maybe I can clarify the questions the Committee asks.

Before they reach the tech spec limit, there is an alarm set point which has a rate. I think it's two gallons per minute over a period of four hours.

That would trigger the alarm and trigger the following procedures. There's a procedure that's going to take care to trigger - let the operator have follow-up actions.

So, the procedure would prevent the

situation that now you're running the five gallon per minute for many, many days.

CHAIRMAN ABDEL-KHALIK: Thank you.

MEMBER STETKAR: Coley, I was thinking about - I was reading Chapter 5, and I got confused. There's a calculation in Table 54-1A of net positive suction head for the RCIC pump.

MR. CHAPPELL: Yes.

MEMBER STETKAR: I'm really confused about that calculation. And I'm going to ask the staff about this. So, make sure you have after the break, your person who reviewed this available, please.

In the table, it says that the maximum suppression pool temperature is 77 degrees C. However, for conservatism, a hundred degrees C is used to calculate the following values.

Well, in fact, it's not because the net positive suction head that's calculated actually uses 77 degrees C for the temperature of the suppression pool water. So, there seems to be a misstatement there in that table.

The vapor pressure that's used is 4.39 meters, which was changed a bit from 4.33 meters, but I'm not going to split hairs. That's basically the saturation pressure for 77 degrees C, not a hundred degrees C.

If you actually use a hundred degrees C, there's no way that you can meet the net positive suction head requirements for that pump as there stated. Which means you either have to take credit for containment accident pressure in the suppression pool to operate the RCIC system, or I'm really confused.

So, I'd like some clarification on how that net positive suction head calculation was really done, what assumptions were made, and if indeed you do require active suppression pool cooling to keep the water temperature at 77 degrees C or somewhere.

We'll talk about strainer plugging later. I know you changed a little bit of the assumptions in strainer plugging, but that would only reduce the available net positive suction head.

So, maybe you can do a little bit of homework. You probably can't answer this off the top of your head, but I'd appreciate -

MR. CHAPPELL: Unfortunately not.

MEMBER STETKAR: I'd appreciate a little bit of clarification on that.

The other thing is the staff had some questions the last time that we were around, the RCIC turbine pump, the bearings are lubricated by the RCIC flow themselves.

And I looked at - there's a Technical Report that shows a little more detail of how that's accomplished.

And I looked at that Technical Report and there's a - let's see if I can get the right terminology here. There's a little strainer in that line and a - oh, I forgot the terminology.

There are a couple little things that can filter that water from the suction volume of the pump before it's actually transmitted to the bearings.

I was thinking about when RCIC is operating with suction from the suppression pool during a post-LOCA response - this would be a small LOCA, obviously - there's going to be some amount of suspended fine particulates and solids in that suppression pool water.

Now, they're going to pass through the big suction strainer. And the question is, what happens, you know?

Have you done evaluations to show that indeed the pump can continue to operate under those conditions for the nominal eight hour - whatever the eight-hour mission time is, I think.

The two concerns are, will the particulates get through the little filters in the bearing lubrication water system? And if they do get through, you know, are they fine enough where they actually hurt the bearings?

More concerned about those little filters getting plugged than you having no bearing lubrication flow.

And the test program, I looked up the test program, and the test program - the qualification test program is pretty vague. It just says the pump will be qualified to operate under the assumed water quality conditions for qualifying the pump, or something like that, which is sort of a self-serving statement.

So, I was curious whether you've thought about that condition, especially because during the long-term cooling analysis there's so much attention paid to those very small fines and where they go now.

In that analysis, you know, the concern is where do they go in terms of plugging the fuel, but I'm a little concerned about the pump.

So, I'm curious if you can do a little bit of homework and perhaps -

MR. TOMKINS: Well, I can address that.

There is - and you'll hear about this a little bit later during the Chapter 6 presentation, but, you know, one of the things we worry about is debris getting through the strainers and affecting the fuel. And you'll hear a lot of discussion today about that.

But there's also a commitment we've made and there's an evaluation we have to go through of debris getting through the strainers and getting into small clearances, exactly what you're talking about --

MEMBER STETKAR: Yes.

MR. TOMKINS: -- and that evaluation is done according to a WCAP. It's been approved by the NRC, and that's something we will do in the future.

MEMBER STETKAR: I haven't read that WCAP. But all of the discussion that I read about the WCAP talks about erosion of valve internals and erosion of pump impellers.

It doesn't talk about water-lubricated pumps and whether or not - so, if you can tell me that indeed that evaluation that's performed according to that WCAP will indeed confirm that, you know, the water lubrication system for the RCIC pump will be evaluated, I'll be pretty happy.

MR. TOMKINS: Okay.

MEMBER STETKAR: But I didn't really see that sort of nuance addressed in that analysis.

MR. TOMKINS: Okay. We'll get back to you on that.

MEMBER STETKAR: Okay. Thanks.

CHAIRMAN ABDEL-KHALIK: Any additional questions regarding Chapter 5? Please continue.

Okay. So, we have two follow-up items from Chapter 5. Okay. Now, we will go with Chapter 4.

MR. HEAD: I was going to mention in that last statement that all ACRS action items have been closed.

(Laughter.)

CHAIRMAN ABDEL-KHALIK: Two items. Hopefully, you will get back to us later today or, if not, tomorrow, or we'll add them to the list.

MR. HEAD: Absolutely.

CHAIRMAN ABDEL-KHALIK: Okay. We're on to Chapter 4.

MR. TOMKINS: Okay. Good morning. My name is Jim Tomkins, NINA Licensing. So, I'm going to talk a little bit about Chapter 4 and we'll go over recent topics, cover ACRS action items.

In attendance in addition to some folks

who have already been introduced, John Price who is the senior licensing engineer on this is in the audience. And Nirmal Jain from Westinghouse is also in the audience.

Chapter 4 was discussed at the ACRS meeting in March 2nd of 2010. There was a couple of topics that we have worked on between that meeting and now.

There was an inconsistency between the DCD referenced figures and the COLA figures we submitted, and that was resolved by responses to RAIs 04.03-1 and 04.03-2 where we corrected the numbers that were in the figures. And that change has been put in the COLA.

The next item was provide a verifiable acceptance criteria for downstream fuel testing. You're going to hear a lot about that in the Chapter 6 presentation.

That issue is tied to Chapter 4 because of the tie to fuel, obviously. But that issue has been resolved with the submittal of RAI 04.04-4 - actually, Supplement 1 is the final one that we responded to with the NRC, and we have closed that out. That will be put into COLA Rev 6.

And then the last item was there was an

RPV purge flow transcription error that got into the COLA, and we have responded at the NRC as to what that correction is, and we will make that correction in Revision 6. So, all of those are, we think, closed.

There were a couple of action items that I'd like to discuss. ACRS was interested in a briefing on the Fuel Amendment Topical Reports. We did that in October of last year.

There was an issue about Part 21 reports for stability. We addressed that through a commitment in the COLA that when we change fuel, we will do it to the most recent stability methodology.

In fact, we've actually already submitted the topical for that as part of the fuel amendment topicals to support that.

And then there was an ACRS action item on Part 21 process. And my understanding is at that point that that is now something that the NRC has an action and they're working on.

So, from our perspective, we think that item is closed for us, but there's still work to be done.

CHAIRMAN ABDEL-KHALIK: There is one COL information item on the CRD inspection program that is -

MR. TOMKINS: Right.

CHAIRMAN ABDEL-KHALIK: - in this chapter.

Are you aware of the Part 21 that was issued February 15th by GEH on the CRD cracking?

MR. TOMKINS: Yes.

CHAIRMAN ABDEL-KHALIK: Has that been evaluated as to the impact on STP?

MR. CHAPPELL: We're in the process of doing that.

CHAIRMAN ABDEL-KHALIK: Is the CRD design comparable to the design that's impacted by the Part 21?

MR. CHAPPELL: I don't think we've made that determination yet.

MEMBER ARMIJO: Well, designs are different, but the phenomena of irradiation-assisted stress corrosion cracking applies to both plants. So, it has to be evaluated.

MR. DALEY: That's correct. The design is a sealless design, and ours does not incorporate that characteristic. But the phenomenon is applicable to both designs, so we're still in the process of reviewing that.

CHAIRMAN ABDEL-KHALIK: So, this is something that you will respond to us at a later time as to whether or not this Part 21 has an impact on STP 3 and 4?

MR. HEAD: We will.

CHAIRMAN ABDEL-KHALIK: Okay. So, as far as CRDs are concerned, a lot of plants have a problem with the so-called double-notching of control rod drives.

Has that been evaluated for STP?

MR. CHAPPELL: We don't have hydraulic controls. So, we use a fine-motion control rod drive.

CHAIRMAN ABDEL-KHALIK: Okay.

MR. CHAPPELL: So, that negates those concerns.

CHAIRMAN ABDEL-KHALIK: Okay. So, it probably doesn't impact you. All right. Good. I guess we'll add this Part 21 to our list.

MR. CHAPPELL: Okay.

CHAIRMAN ABDEL-KHALIK: Are there any additional questions to STP on -

MEMBER ARMIJO: Yes, just when you do respond to that Part 21 on your control rod drive design, you know, I'd appreciate just a little detail, some detail of what's different about the design and why you think your design may or may not be more or less susceptible to this problem.

MR. CHAPPELL: Okay.

CHAIRMAN ABDEL-KHALIK: Any additional questions?

Okay. We'll move on to the staff. I know we're way ahead of schedule, but we'll move on with the presentation of the staff for Chapters 4 and 5.

MR. WUNDER: Mr. Chairman, Tekia Govan was scheduled to be here for Chapter 5, but she is not here today and she'll - the project will be presented by Stacy Joseph.

CHAIRMAN ABDEL-KHALIK: Okay. Thank you.

MS. JOSEPH: All right.

CHAIRMAN ABDEL-KHALIK: Stacy, go ahead.

MS. JOSEPH: Good morning. My name is Stacy Joseph, and I'm filling in for Tekia Govan, as George said, who's sick today. She's the project manager for Chapters 4 and 5.

During the subcommittee meeting for Chapter 5 reactor coolant system and connected systems, there were four areas reviewed that had open items remaining.

Those sections were P-T limits, compliance with 10 CFR 50.55a, applicable code cases and RCIC turbine design change.

With that, I'm going to turn this over to

Neil Ray and Tom Scarbrough and George Thomas who will discuss these open items.

MR. RAY: Good morning. My name is Neil Ray with the NRO Division of Engineering.

In terms of ABWR DCD COL Item 5.6, they are supposed to submit P-T limits. Plant-specific P-T limits.

So, in this case, what they did instead of P-T limits, they prepared and submitted a PTLR, Pressure-Temperature Limits Report, which we have reviewed and approved it.

In terms of P-T limits, as you know, plant-specific P-T limits cannot be given at this point because there is no -- there is no clearance, all those things.

So, based on the projected materials that we will develop the PTLRs, and, yes, they will provide the plant-specific P-T limits as far as it says generic pressure temperature PTLR. We approved it. Open item is closed.

And resolution of COL item is acceptable because it is a condition that they are going to provide the plant-specific P-T limits upon receipt of vessel and related information.

MS. JOSEPH: Okay. Tom.

MR. SCARBROUGH: Okay. Hello. I'm Tom Scarbrough. I'm in the Division of Engineering in the Component Branch with NRO. And I'm going to talk about Sections 5.2.

The first, Section 5.2.1.1 relates to compliance with 10 CFR 50.55a. And the South Texas FSAR incorporates, by reference, the DCD Section 5.2.1.1. for the use of ASME code consistent with 55a.

We had an RAI with confirmatory item where Revision 4 for the South Texas Table 1.8-21 alpha includes the ASME OM code, operation and maintenance code, 2004 edition. And that update was included in Revision 4 to the STP FSAR.

And so, that resolved that confirmatory item, and that was the only item we had for 5.2.1.1. So, 5.2.1.1. is now closed and acceptable.

Now, 5.2.1.2 relates to applicable code cases. And once again the STP FSAR incorporates by reference DCD 5.2.1.2 for the use of ASME code cases related to the reactor coolant pressure boundary.

Standard Departure 1.8-1 in the STP FSAR relates to standard departure Tier 2* code cases because they're listed as Tier 2*. And Tables 5.2-1 and 5.2-1 alpha relates to reactor coolant pressure boundary code cases.

5.2-1 relates to boiler pressure vessel code cases in Reg Guide 1.84 and Reg Guide 1.147. And there was an RAI which related to there were some superseded code cases that were still listed in those tables. N-71-15 and N-3319 were both outdated code cases. And Revision 4 deleted those code cases and replaced them with the more recent versions N-7118 and N-319-3. And so, that resolved that particular item and that was closed as well.

We had a couple of place keeper open items in 5.2.1.2. Just to make sure we didn't lose track, because 5.2.1.2 included code cases related to ISI, in-service inspection and in-service testing.

So, we kept a couple of open items there for those two. But as we moved toward closure/completion of those in-service inspection and in-service testing sections, we decided we couldn't close those open items and track them through their applicable FSAR sections, 5.2.4 for ISI and 3.9.6 for IST. So, those place keepers were closed out administratively.

Then moving on to jumping a few sections to the reactor core isolation cooling system, RCIC, 5.4.6, there's a standard departure that relates to new design, which you all were just talking about.

And there's a proprietary Toshiba Technical Report which describes that pump and design qualification process.

We did perform an audit of the documentation back in November of 2009. And the primary finding was that the function of qualification was not clearly addressed in the Topical Report. So, they revised the Topical Report and resubmitted it, which we've reviewed.

Just as a reminder of what's in the new RCIC turbine pump design, it's a monoblock design with the pump, impeller and turbine attached to a common shaft. There's no shaft seal.

There's no barometric condenser required because there's no steam leakage from the staff. There's no oil lubrication because the RCIC process water cools the bearings in the pump. And there's no steam bypass for this system. There's a single control valve that's self-adjusting.

And so, it results in a less complex auxiliary system. There's no external electrical power or control devices. So, it's a much more simple design than currently in the plan.

MEMBER ARMIJO: Those are nice features, but could you fill me in is there any experience in the Japanese ABWRs with this kind of pump?

MR. SCARBROUGH: Yes, actually, there's quite a bit. In the Technical Report they say - they did list some of the plants that had been using this new design. And there were a number of them, if I can find the place where they are, but there are a number of places where this - they're used in other plants.

It says there's 50 years of experience - oh, here's the list.

MEMBER ARMIJO: Specifically, the original ABWRs, Kashiwazaki, I think, 6 and 7 - well, I forget which ones they were, but did they use those functions?

MR. SCARBROUGH: I don't know if they're in those. I don't know which plants. There's a Ko Ri 1, Quinshan 2, Ringhals 2, 3 and 4, Sizewell B.

MEMBER ARMIJO: I don't know if Ko Ri is - those are not BWRs.

MR. SCARBROUGH: I don't know if they were - yes, it says pressurized water reactors.

I do not know if they've been used in the ABWRs or not.

MEMBER STETKAR: They're not used in the original. All these plants, I mean, like Sizewell B uses them for their turbine-driven auxiliary feedwater pump.

MEMBER ARMIJO: Okay.

MR. SCARBROUGH: Right. That's what it lists here. So, I don't know. I would have thought they probably would --

MEMBER STETKAR: Quinshan 2 is also a PWR.

MEMBER ARMIJO: Right.

MEMBER STETKAR: Turbine-driven auxiliary feedwater pump.

MEMBER ARMIJO: Right, right. Because I don't remember them being used in the original.

MR. HEAD: And the answer is that in Japan, they're not at this point.

MEMBER ARMIJO: They're not used in Japan?

MR. HEAD: Right. In our briefing, though, you know, Mr. Stillwell did discuss his discussions and experience with the people from the Ko Ri plants. And so, you know, we've - even though they're not the ABWR as a pump and how it functions, we are getting, you know, feedback on that for us to be able to apply to our plant. This was Scott Head.

MR. SCARBROUGH: We had a couple of open items in the SER for Section 05.04.06. Open Item 1 related to revising the Topical Report to address the functional qualification of the RCIC turbine pump.

And the second part of that was describe the function of the RCIC turbine pump drain leak-off line pump.

And then we had an open item numbered Number 3, which had to do with a perform pump calculation showing available net positive suction head margin. And so, those were our two open items we had.

In terms of resolution of Open Item 1, the Topical Report was revised to specify that the RCIC turbine pump will be qualified using ASME standard QME-1-2007. And that's been accepted in Revision 3 of to Reg Guide 1.100.

It also clarifies that the QA program will be following Appendix B to Part 50 for the RCIC turbine pump. The RCIC turbine pump is going to be part of the IST program in Section 3.9.6.

It also clarifies that the RCIC turbine drain leak-off line pump had no safety-related function. The bearings are cooled by the RCIC water itself by gravity feed. And then the drain pump just returns water back to the pump suction to prevent tank overflow. So, there's no safety-related function for that pump.

It also clarified that the vibration will be addressed as part of testing, and that's Chapter

14. So, they're going to monitor vibration of the turbine pump during startup. And with that, we are able to close out Open Item Number 1 for the process.

MEMBER STETKAR: Tom, in the Subcommittee meeting we talked a little bit about the change in the design.

One of the changes to the design is that the previous pump had a small bypass valve in the steam admission line that opened first. And then there was the ten-second delay on the main steam admission valve.

And the whole purpose of that is to more gently start up the turbine rather than giving it a slug of steam when the steam admission valve opens.

Those have been removed. And we talked a little bit about the reliability - the starting reliability of this design compared to the former design with this modified steam admission system.

And at that time, I think my notes at least say that you were going to make sure that the ITAAC programs functionally verified that the RCIC system would operate under its design-basis loading requirements.

I looked at the ITAAC in Rev 4 of Tier 1, and they don't seem to require a cyclic - a confirmation of cyclic operation. They require that the pump - you verify that the pumps start from low level. You require that the pump trip from high level. And they require that the pump restart from a low-level signal, but that's a single trip and restart.

I think when during our discussion, NINA indicated that under design-basis conditions it would be expected to cycle on and off about four times.

So, I was curious as a COL license information item 5.8 that says a best estimate analysis will be performed to confirm that the system will meet its design-basis operating requirements, but there doesn't seem to be a requirement for a test.

MR. SCARBROUGH: Right.

MEMBER STETKAR: Could you clarify how we're going to confirm that indeed the RCIC system will cycle on and off four times?

MR. SCARBROUGH: Yes, sir. QME-1-2007 contains the latest requirements for qualifying various equipment, including pumps.

MEMBER STETKAR: Yes.

MR. SCARBROUGH: And in it, it specifies that it does have to deal with the startup and operating time based on plant conditions, the transients. It has a list of the various aspects it has to be able to start and stop, operating modes, startup.

In terms of the qualification process when they go and they point to their QME-1 qualification program very similar to the way we're doing with valves, the inspectors will be looking to see that they follow through on all the requirements in QME-1, including all these transients.

And so, that's part of how we're going to make sure that they do it. Because, yes, a lot of times the ITAAC -

MEMBER STETKAR: But, you know, I'm left a little bit cold with an analysis. I can analyze the fact that a valve will work pretty doggone well when I put it in the plant that doesn't.

MR. SCARBROUGH: Right. Yes, and we would - in QME-1, we would expect them to be performing these by test. I mean, that's part of the concept. And also with valves as well.

QME-1 is a test-driven - they do a lot of analysis, but you have to demonstrate where you use analysis. It's really a test-driven -

MEMBER STETKAR: So, you're pretty confident that they indeed will perform functional tests that run that turbine through -

MR. SCARBROUGH: Yes, sir.

MEMBER STETKAR: - a number of cycles.

MR. SCARBROUGH: Yes.

MEMBER STETKAR: Three, four or five or something like that.

MR. SCARBROUGH: Especially since it's a new application for the U.S. power plant.

MEMBER STETKAR: Well, and it's explicitly designed to cycle. I mean, this system automatically will cycle.

MR. SCARBROUGH: Right.

MEMBER STETKAR: So, this is not, you know, some beyond normal design. This is the way the system is designed to work.

MR. SCARBROUGH: So, all these cyclings will be part of the QME-1 process.

MEMBER STETKAR: Okay.

MR. SCARBROUGH: And relating to the question about the filter that process fluid -

MEMBER STETKAR: Yes.

MR. SCARBROUGH: - one of the requirements in QME-1 is they must demonstrate that the process fluid, you have to demonstrate the pump will operate for the process fluid conditions. And then in the checklist, it does include that you have the pump flow and entrained material for which the pump is designed for under normal and abnormal conditions.

So, all of that has to be part of the qualification process for this pump.

MEMBER STETKAR: Okay. As long as that, you know, normally this thing is lined up, I believe, to the condensate storage tank, which is pretty doggone clean water.

And when it switches over to the suppression pool, the water there might be pretty clean when it initially switches over.

The question is, what water quality has to be assumed to satisfy those qualifications under realistic conditions, which is post-LOCA blowdown. Small LOCA.

MR. SCARBROUGH: Right. So, they will have to specify in the qualification, the type of - the level of debris or -

MEMBER STETKAR: Okay. They will.

MR. SCARBROUGH: -- entrained material. And then they will have to - the plant will have to support that.

MEMBER STETKAR: Okay.

CHAIRMAN ABDEL-KHALIK: How would you go

about doing that?

MR. SCARBROUGH: Well, when they do the testing, they're going to have to show how much debris or clean water they have as part of the qualification process. And then the plant is going to have to be able to support that.

CHAIRMAN ABDEL-KHALIK: And how would they do that? Through tech specs?

MR. SCARBROUGH: Well, in terms of the GSI-191 whole program of making sure that the water coming through the system is adequately at a level that can support the qualification of the pump.

So, they're going to have to qualify the pump for what level of debris or whatever different type of suspended material they're going to have to qualify that pump for.

And so, they're going to have to coordinate with the individuals working with the sump issue and making sure that the amount of debris and -- that comes through and the filter system for the RCIC turbine pump is adequate.

So, there's going to have to be some coordination there between qualifications.

MEMBER STETKAR: It's going to be tricky.

CHAIRMAN ABDEL-KHALIK: Yes. So, perhaps

as part of the applicant's response to our follow-up item, you may want to address how you're going to handle this QME-1 requirement.

MEMBER STETKAR: Thanks, Tom.

MR. SCARBROUGH: And then Item Number 3 George Thomas is going to talk about.

MR. THOMAS: Yes, my name is George Thomas, and I am from the Reactor Systems Branch. And I review this calculation for NPSH. And there was a question about the temperature in the pool.

Table 5.4-1 of FSAR, they say the maximum pool temperature is 77 degrees, but for conservatism, a hundred degrees is used to calculate this NPSH.

MEMBER STETKAR: I know the words say that, but the actual numbers in the calculation don't correspond to that.

Saturation vapor pressure, the last I checked, for a hundred degrees C is one atmosphere, which is 10.77 meters.

And if you use that vapor pressure in that calculation, you get a maximum available - maximum available net positive suction head of 3.46 meters, which is about 3.54 meters less than what is required before you subtract off the losses from the suction and the strainer. In other words, you don't meet it at a hundred degrees C, unless I can't add.

So, I'm curious how your review of this calculation confirm that they - in the FSAR, you state they have a margin a 2.84 meters, which is not true because they have a margin of 2.84 meters less the losses in the suction line, less the losses in the suction strainer.

So, the 2.84 meters that's calculated in that table, is the maximum available net positive suction head margin assuming 77 degrees C water and no losses in the suction line.

And that statement in the FSAR - or, I'm sorry, the SER, also makes mention that they assume 50 percent blockage, which they don't.

So, I'm curious how you drew the conclusion that they're okay.

MR. THOMAS: Okay. This whole calculation was based on our Japanese plant. Okay. The ITAAC - okay. The ITAAC, that is, the provision for doing the calculation and verifying this pump will be as such.

So, however, basic conclusion is based on the ITAAC, actually. If you look at the ITAAC, there is a requirement that they have to verify this pump NPSH as built. Okay.

And here, you know, they are using Reg

Guide 1.1, that the strainer is 50 percent blockage.

MEMBER STETKAR: They can't do that though, sir.

MR. THOMAS: So they are using very conservative assumptions here.

MEMBER STETKAR: They did not assume 50 percent blockage. They changed that assumption to say that they will use realistic analyses of the blockage based on plant-specific conditions.

So, they did not assume 50 percent blockage. They changed that. They explicitly say they changed that. And indeed it's documented that they changed that.

So, the statement about 50 percent blockage is not relevant.

MR. DONOGHUE: Dr. Stetkar, this is Joe Donoghue from the Reactor Systems Branch. I'm going to ask George to - we'll come back to you.

MEMBER STETKAR: Go back and take a look at that calculation.

MR. THOMAS: Okay.

MR. DONOGHUE: Yes, yes. We're going to take your points during the break and make sure we understand them.

MEMBER STETKAR: Yes.

MR. DONOGHUE: Then we'll come back to you and explain what we said in the SER, to you. George can get back to you.

MEMBER STETKAR: Because my concern is that if indeed - if indeed the required net positive suction head for that pump is seven meters as stated here, and that does not seem to have changed, it's bounced around between 7.3 or seven meters, but it's something on the order of seven meters as the required net positive suction head, and if the static head is only three-and-a-half meters, you're not going to meet it at saturation temperature. You're just not going to meet it.

You can't do an ITAAC to show it's going to meet it, unless you take credit for accident pressure or require that the water must be at some sub-cooling origin.

MR. DONOGHUE: We'll take a look at the calculation details.

MEMBER STETKAR: I mean, that's the basic concern that I have.

MR. DONOGHUE: We'll try to get back to you today.

MEMBER STETKAR: Yes, that would be great. Thanks.

DR. WALLIS: Another concern, they're going to do tests with cold water and they're going to apply these results to the first drop across the strainer with hot water.

Now, if indeed it's a hundred degrees C, you have to worry about possible flashing. And as far as I know, there's no tests that test the strainer with flashing going on through the debris bed. And in some cases, plants have had to ask for containment over-pressure to allow for that.

Now, I don't know this is an issue or not. But if it really is a hundred degree water, you may have to worry about flashing in the debris bed.

MEMBER STETKAR: They're assuming a hundred degrees for the RHR and the high-pressure core -

DR. WALLIS: They're assuming they can use the results of tests -

MEMBER STETKAR: Yes.

DR. WALLIS: - at lower temperature and extrapolate them in some way without taking account of possible flashing.

So, I think flashing in the debris bed needs also to be addressed when you revisit this problem.

I was really astounded by this 50 percent blockage statement up here. I thought that was completely discredited and out of date and gone.

MEMBER STETKAR: It is if you look at the - if you look at the Rev 4 of the FSAR, they removed all of that assumption and they just have -

DR. WALLIS: I'm astounded it appears in the slide.

MEMBER STETKAR: Yes. Well, it also appears in the SER, but the - right now the FSAR calculation just says a head NPSH minus a couple of factors that are not specified right now that will have to be determined later, I guess, you know, when they do the actual flow test through the strainers and suction lines.

It's pretty clear that 50 percent is out.

DR. WALLIS: So, when do we get a new analysis which is better? Is this something we have to wait for?

MS. JOSEPH: I think we'll have to get back to you after we discuss after the break.

MR. THOMAS: You know, when the piping is installed, there will be isometrics. And if you know the piping layout, then you can do -

DR. WALLIS: But everything seems to be put off to a later date. It would be good to have some assurance now that things are going to work.

CHAIRMAN ABDUL-KHALIK: Well, we'll just wait to hear back from them. Both the staff and the applicant will have to respond to this issue.

DR. WALLIS: Okay.

CHAIRMAN ABDUL-KHALIK: Please proceed.

MS. JOSEPH: All right. I'm moving on to Chapter 4 reactor.

I think as we discussed in the last meeting, most of Chapter 4 was incorporated by reference.

During the last Subcommittee meeting for STP Chapter 4, downstream fuel effects is the only open item that was discussed during the presentation.

The staff determined, and the applicant agreed, that they needed a license condition requiring testing of the fuel that would be loaded into the core for downstream effect.

The applicant responded to this open item with the license condition that's been reviewed and evaluated by technical staff. And we're going to be discussing that as part of the Chapter 6 and long-term cooling presentation that the STP is going to present shortly.

We were able to close this open item, and there were no ACRS open items associated with Chapter 4 during the last Subcommittee meeting.

DR. WALLIS: So, later in the day you will justify accepting the acceptance criteria?

MS. JOSEPH: Yes.

DR. WALLIS: And the test plan?

MS. JOSEPH: Yes.

DR. WALLIS: Okay.

CHAIRMAN ABDUL-KHALIK: And the staff will also follow up on the February 15 Part 21 as far as the CRD is concerned?

MS. JOSEPH: Yes.

CHAIRMAN ABDUL-KHALIK: The applicant will. So, I assume you must as well.

MS. JOSEPH: Yes.

MR. DONOGHUE: This is Joe Donoghue from the staff again.

We did look at that Part 21. The reviewer is not immediately available. But if you want some more details, we can look at that.

But, basically, my understanding was there were design differences that we concluded did not apply to the ABWR, but I can get that reviewer to come talk to you about what that -

CHAIRMAN ABDEL-KHALIK: I think, you know, if the applicant is going to respond to that request, we'd like the staff to comment on the applicant response at that time.

MR. DONOGHUE: We can do that.

CHAIRMAN ABDEL-KHALIK: Thank you.

MS. JOSEPH: And that's it for Chapters 4 and 5.

CHAIRMAN ABDEL-KHALIK: Thank you. Okay. We are way ahead of schedule. Wow. And that is fine. At this time, perhaps we should take a break and we'll come back and we'll start Chapter 6. Okay?

So, we will take a 15-minute break. We will reconvene at 9:45.

(Whereupon, the proceedings went off the record at 9:27 a.m. and resumed at 9:46 a.m.)

CHAIRMAN ABDEL-KHALIK: We're back in session. This time we'll go to Chapter 6 and the applicant will make a presentation.

MR. HEAD: Sir, before we do Chapter 6, if we could, I just want to offer a perspective on the Part 21 question -

CHAIRMAN ABDEL-KHALIK: Yes, sir.

MR. HEAD: - that you had asked us. And so, I'm going to ask to offer a personal reaction that I had in fact read about that. And the way the process works is if it had been applicable, I would have, I think, got some pretty much immediate feedback. That's the way it typically works for an operating plant.

So, I'm going to ask Jeremy King with Westinghouse to provide the ACRS with a perspective.

MR. KING: Hi. I'm Jeremy King. I'm the BWR fuel product manager of - we've taken a look at GE-Hitachi's response that was dated February 15th.

And in that report, it shows that the defect is only applicable to S and D plants. However, we've also looked at some of the common causes that were in there listed such as irradiation-assisted stress corrosion cracking and also boron swelling, and we compared that to our design which from a power regulation standpoint design it would be CR 99 product.

And we looked at some differences such as our differences in material, as well as versus boron carbide powder. We use a boron carbide pin which we have dated as should accurately predict how much that pin swells.

And looking at our design life, we've shown that our delay design is not affected by this issue.

MEMBER ARMIJO: Well, I recall when the GE blades were first introduced, this particular design was made of the best material available; nuclear grade 316, the stresses and, you know, a lot of welds in that design.

And the - everything known about IASCC was addressed, but apparently still not sufficient to prevent that problem from happening.

And I think it's a fundamental problem, and it's kind of hard to tell on your - I've looked at your control blade design reports, a limited amount of stuff, but I think, you know, the phenomenon of boron carbide swelling is not closed. Even those high-density pins can swell.

So, you know, I think it's a potential problem for any stainless steel control blade design in the core of a reactor with salt.

It's kind of hard to say without experience, because the - those particular GE blades were designed for long life taking into account that IASCC phenomenon. And they still are not meeting their life expectations.

MR. KING: Yes, sir. If there's one further point I could make in our design, we have data where we've measured the boron swelling at nuclear end of life. And we factor that into our - into our design - or beginning of life.

MEMBER ARMIJO: Yes. Okay. Well, I've looked at your reports and I didn't see too much data. So, maybe I got to look again.

MR. HEAD: Mr. Chairman, you know, obviously we're aware of the problem.

CHAIRMAN ABDEL-KHALIK: Yes.

MR. HEAD: And, you know, Westinghouse has been evaluating it for us. So, I mean, I don't know if that closes the issue for you from our perspective on the Part 21 aspect of it.

MEMBER ARMIJO: I don't know how much more you can do. Because, you know, first of all, the exact mechanism of what's going on is not yet settled, you know.

GE-H has their understanding and they presented it. It's not clear that that's completely the story.

But as far as from a design standpoint, material standpoint, I don't know how - what anybody can do other than limit the life of the blades to make sure that this cracking doesn't occur.

MR. HEAD: Obviously, you know, something for us to consider also as we move forward.

MEMBER ARMIJO: Yes.

CHAIRMAN ABDEL-KHALIK: As far as I'm concerned, this follow-up item is closed.

MR. HEAD: Okay.

CHAIRMAN ABDEL-KHALIK: Thank you.

MR. HEAD: Okay. So, we'll move on into Chapter 6. This is a relatively long discussion we'll have today regarding these topics. We'll go over some ACRS action items.

We'll cover strainers again. As in our previous meetings, we told you we would give you some more detail on our downstream fuel effects, you know, testing and the license condition. We're certainly prepared to have that discussion today. And then, obviously, a discussion on long-term cooling.

There is a portion of the presentation that we're going to ask to be closed not because of anything that's actually in the material, but we believe the discussion will just naturally go to, you know, a place that could be proprietary.

CHAIRMAN ABDEL-KHALIK: Just let us know at that point.

MR. HEAD: We have a place keeper in the presentation to notify everyone of that.

CHAIRMAN ABDEL-KHALIK: Good.

MR. HEAD: Okay. Attendees, myself, Jim Tomkins. You've met Tom Daley. Caroline Schlaseman who has briefed you before on the strainers.

We have Mr. Arai-san from Toshiba who has joined us today. Marty Van Haltern is going to be discussing, you know, long-term cooling and the fuel aspect.

Nirmal Jain is with us today. He's briefed you before. Tim Andreychek has helped us with a number of issues related to this topic. And Mary Richmond is here today to help if we need to discuss any detail of the toxic gas analysis.

I'm just going to get up just to - today's going to be a rather lengthy discussion today, but I'm going to just do a couple of introductory remarks with respect to the overall topic.

With respect to core cooling, something that struck me throughout all of the discussions we've been having in all the review is the certified design. That the fact that the large, you know, the LOCA, the issues, you know, the piping is located above the core, and that immediately makes some of the accidents and some of the scenarios much different than, you know, the current BWRs.

I'm impressed - coming from a three-train plant, 1 and 2, I've always been impressed with amount of water sources that are available. And as you're aware as part of the licensing process for 3 and 4, we have, in fact, additional water sources that are now available to us.

Today we'll talk about some of the cooling paths for the fuel. Obviously, there's the direct flow, but we're going to introduce some discussion on bypass blow, and then also the impact of the core flutter with respect to any potential, you know, blockage issues that we might have.

And each of these blow paths, in fact, provide adequate core cooling. And we'll discuss that today as part of our defense in depth discussions that we'll be having.

With respect to the decisions that STP has made to address these issues, and we've discussed these before, fiber and aluminum have been precluded from containment by design, you know. The insulation is going to be the stainless steel and there won't be any fiber inside the containment. And so, that's something that will be reflected both in the testing and the license condition that you'll see. And then we've minimized zinc to the extent we can at this point.

Based on that, based on all of the work that we've done -

MEMBER BLEY: Does the programs in that bullet mean anything, programs in zinc minimized? I don't understand it.

DR. WALLIS: No, it is not part of the zinc. It's precluded by design on programs.

MR. TOMKINS: Yes, but we have a program, a suppression core cleanliness program that we added as a COL item. And that's really what that's referring to.

MEMBER BLEY: Okay. Thank you.

MR. TOMKINS: It's an operational program. So, it's a good program.

MR. HEAD: So, based on everything we've done, and as you're aware, we are going to be embarking upon licensing a different fuel after COL, but at this point in time we believe we have reasonable assurance that the licensed fuel will meet the downstream effects. And we'll have some discussion -

DR. WALLIS: Well, if it will meet them, will it overcome them?

(Laughter.)

MR. HEAD: Absolutely. "Overcome" is not

a word we normally put on a slide.

DR. WALLIS: English is a bit - I mean, obviously it's going to meet them. Is it going to handle them successfully or -

MR. HEAD: Yes, sir. I think at the end of the day you will be able to understand our perspective on that bullet.

DR. WALLIS: Okay.

MR. HEAD: And then as we indicated, we have committed to a license condition to test the specific fuel to be used in the first cycle. And we'll have detailed discussion on how that was arrived at and the testing program that we expect to be doing.

And in that you'll see that we've developed a conservative fuel test acceptance criteria to be in place as we do that testing.

Okay. I'm going to turn it over to Jim for -

CHAIRMAN ABDEL-KHALIK: But just to be clear, the task before us today is to assure that GE7 fuel -

MR. HEAD: Yes, sir. We understand that.

CHAIRMAN ABDEL-KHALIK: - will meet the - okay. Thank you.

MR. TOMKINS: Okay. Just a quick overview of Chapter 6. There's a number of Chapter 6-based departures in this chapter, but there's two that are really significant.

Containment analysis we discussed extensively at the last ACRS meeting. We won't really discuss containment analysis as part of this presentation. We don't plan to.

ECCS suction strainers were discussed extensively at the last meeting. And as Scott said, we're going to discuss them in detail again. We have some follow-up items and some action items. And some of our positions on ECCS suction strainers have changed since the last meeting, so we'll cover all of that in detail.

All the COL items in Chapter 6 have been completed. There's no DAC in Chapter 6. And all the open items, we believe, are closed at this point.

Just some acronyms that we're going to use throughout the presentation. So, I don't really need to go over those, but that's a tool. We do use quite a few action items in the presentation.

So, recent topics, things that we've worked on since the last meeting, the containment analysis was done making some assumptions about the feedwater design of the plant. And we haven't completed that design yet.

And we made a commitment in our application that we would confirm when the design was finalized, that it still support the containment analysis.

The NRC asked an RAI on that. They wanted a little more detail. And I think they wanted something a little more solid than a commitment.

And so, it turns out that there's also - and this has been there from Day 1. There's an ITAAC in the DCD that says when you complete the as-built containment, you will confirm that the as-built containment meets the containment analysis.

So, we agreed with the NRC that as part of that same effort, we would confirm that the containment analysis when we look at the as-built containment, we'll also look at the as-built feedwater design and make that affirmation. And the NRC accepted that.

Vacuum breaker shield design was an item we worked on. We provided a sketch and some details on the design.

We're going to talk about that. That's also an ACRS action item that will be coming up shortly.

Toxic gas, there was a COL item that we addressed by performing an assessment of toxic gas impacts on STP 3 and 4. And long story short, our assessment indicated that there were on threats to the units. And that we didn't need to add any detection or alarming capability for toxic gas on Units 3 and 4.

The NRC had a number of RAIs they asked on that, and they did some confirmatory analyses which at least initially came to a different conclusion than we - some of their calculations indicated that there might be an issue with toxic gas.

We had an audit. Last fall, I believe it was. And in that audit, we went over the calculation that was performed for us by Bechtel. And ultimately came to resolution after we went through all the assumptions and the NRC was comfortable, that we have a conservative analysis of toxic gas.

MR. HEAD: So, Jim, let me just say that a little differently. We all agree there's some threats. There are some plants in the area.

MR. TOMKINS: Right.

MR. HEAD: But the analysis has demonstrated that they don't affect it.

MR. TOMKINS: Right.

And then the last item is -

CHAIRMAN ABDEL-KHALIK: Is the difference between the original conclusion and the staff's assessment sort of was a result of some inappropriate application of the code used by the staff?

MR. TOMKINS: No, it really came down to assumptions that were used. And all the tanks that - there's a chemical plant about four-and-a-half miles away and there's some very large tanks there.

All those tanks have containments, have berms and have containments and the NRC wasn't aware of the size of those.

And so that made - when you fill that tank, if you don't have a berm, that makes the puddle or the pool much, much larger than was appropriate.

CHAIRMAN ABDEL-KHALIK: Okay.

MR. TOMKINS: I think that was much of the difference. Mary Richmond actually did the analysis.

MS. RICHMOND: Mary Richmond from Bechtel.

That was the main difference. There were some different models missed by both, but we were able to reconcile them and some different assumptions.

MR. TOMKINS: NRC used a different code. So, we used the ALOHA code, and NRC used the HABIT.

CHAIRMAN ABDEL-KHALIK: Right.

MR. TOMKINS: There were some minor

administrative corrections due to the containment analysis. Those are in RAI C 15, 16 and 18. And those were made. And those are now in COLA.

CHAIRMAN ABDEL-KHALIK: Were any of these toxic gases considered heavy gases for which the code used by the NRC is not really qualified?

MS. RICHMOND: Right. The five identified chemicals that we would come to resolution, most of them were heavy gases. So, we had used the ALOHA code. The used HABIT.

Part of it was the puddle size. But, yes, that had something to do with it too running the heavy gas versus the gas in -

MR. TOMKINS: And the gases we looked at were -

MS. RICHMOND: They were heavy.

MR. TOMKINS: - toxic.

MS. RICHMOND: The five that we analyzed were acetic acid, and we did that in two locations. The river transport, and then OXEA plant offsite.

We also looked at gasoline as water transport. Sodium hypochlorite stored onsite. One hexene stored at the OXEA plant. And acetic acid stored at the OXED plant, too.

So, those were the five scenarios that we worked on together at the NRC to come to resolution on, and they were the - they're all heavy gases.

CHAIRMAN ABDEL-KHALIK: The ALOHA code is qualified to do the heavy gas analysis.

MS. RICHMOND: Right. And there's a DEGADIS program that - it will run DEGADIS, which is a dense gas model, when it's a heavy gas.

MR. McKIRGAN: Mr. Chairman, if I could, John McKirgan, chief of the Containment and Ventilation Branch. I do just want to correct something that's been said.

The staff did use both ALOHA and HABIT -

CHAIRMAN ABDEL-KHALIK: Okay.

MR. McKIRGAN: - in our confirmatory analysis. We are very sensitive to the issues with HABIT that have been discussed in other meetings, and so we did use both.

The licensing basis of course for the plant as Mr. Tomkins has indicated, is based on ALOHA, which we all have some confidence in.

CHAIRMAN ABDEL-KHALIK: Thank you.

MR. McKIRGAN: Thank you.

MR. TOMKINS: ACRS Action Items. So, I'm going to go through a couple of these.

There was an ACRS Action Item that was

actually a question from Dr. Shack regarding the concentration in the standby liquid control tank.

And so, there's the answer. It kind of depends. There's a tech spec that controls it, but it has to be between 13.4 percent and 23.2 percent based on temperature. So, it was actually a curve in the tech spec and that's the value.

And the time that question was asked, we had a slightly different position on chemical effects. And I think it was a more critical question, if you will, but that's at least the answer to the question.

DR. WALLIS: You're not concerned about pH effects on the concrete?

MR. TOMKINS: We're going to talk about that, I think, a little later.

DR. WALLIS: It's not just aluminum they're worried about. The pH affects the concrete as well.

MS. SCHLASEMAN: This is Caroline Schlaseman with TANE licensing and Toshiba licensing, and we have no exposed concrete. Essentially no exposed concrete. All the concrete surfaces are covered either by carbon steel or stainless steel.

There is a small amount of exposed concrete that's considered for qualified coatings within the zone of influence of the break. And that number is - we have a bounding number of 300 square feet of exposed concrete.

DR. WALLIS: Because the coatings come off.

MS. SCHLASEMAN: Because the coating has come off. And so, now we just have exposed concrete.

We've also evaluated it for whether or not the break is close enough that you would actually get concrete swelling or erosion. And our break is not located close enough to cause any damage to the concrete.

So, the 300 square feet is a bounding number, and that's included in our aluminum corrosion calculation. Later on that affect will be discussed.

DR. WALLIS: Okay.

MS. SCHLASEMAN: This was specifically to solubility. And we were taking credit for aluminum solubility last June when we discussed this. And that's why Dr. Shack asked the question about how applicable his report would be to our situation for the solubility.

MR. TOMKINS: Yes, and we aren't just considering aluminum. You'll hear about other chemicals later.

Action Item 47 was to provide -

CHAIRMAN ABDEL-KHALIK: So, this issue sort of disappeared from your perspective because of the last statement in the second bullet?

MR. TOMKINS: Right.

MS. SCHLASEMAN: Right - well, we don't -

MR. TOMKINS: Didn't disappear.

MS. SCHLASEMAN: We don't -

MR. TOMKINS: Here's the answer.

MS. SCHLASEMAN: We answered. At the time he asked what our concentration was, I did not know off the top of my head. We came back with this concentration.

But because in our mind it's a moot point, we haven't gone back to reconcile whether the aluminum solubility and boron report, the Argonne report that we had used for solubility, whether or not the boron concentrations that we have match up with that report, because we don't use that report anymore.

MR. HEAD: No credit is taken for the solubility.

CHAIRMAN ABDEL-KHALIK: I understand. Okay.

DR. WALLIS: So, it does not dissolve. You assume it does not dissolve.

MR. TOMKINS: We assume it does not dissolve.

MS. SCHLASEMAN: Correct - well, we don't assume it stays in solution. That is correct. It does not precipitate - we assume it precipitates. We assume that now, yes.

DR. WALLIS: Right. Thank you.

MR. TOMKINS: Action Item 47 was to provide a future briefing on downstream testing analysis. We will do that in quite a bit of detail shortly.

There was a misalignment between what we were saying and the staff was saying on the amount of fiber that will bypass the strainers.

We have resolved that. We're now considering that all of the fiber, all of the one cubic foot will bypass the strainer. And that will be reflected in our analysis and in our testing.

DR. WALLIS: So, the only function of the strainer seems to be to hold back the reflected metal.

MS. SCHLASEMAN: Correct.

MR. TOMKINS: One could interpret it that way.

MS. SCHLASEMAN: You could interpret it that way.

MR. TOMKINS: Yes.

MS. SCHLASEMAN: That is correct.

MR. TOMKINS: And then the other item that the ACRS asked for was a future briefing on the vacuum breaker shield. So, I'm going to do that right now.

Vacuum breakers are an important safety component in the plant. And I'm going to skip ahead here just to show you in the containment design - of course yours is obviously the reactor, the lower dry well - here's the suppression pool and the wetwell air space, and this is where the vacuum breakers are located.

So, the purpose of the vacuum breakers is to make sure you don't get a negative pressure in the containment. And negative in that context, is to find the wetwell pressure is actually greater than the dry well pressure and you could get backflow of water.

And the structures internally there are not - they're designed to a pressure of about 13.7 kilopascals, about two psi. So, you have to make sure that the vacuum breakers open to protect those structures.

So, one of the things we need to do is protect those vacuum breakers. As I know you are aware, our revised containment analysis put more energy in the pool.

And as a result of putting more energy into the pool, the pool swell is more energetic. It goes higher and it's faster.

So, what Toshiba has designed are some V-shaped plates that sit just under the vacuum breaker and protect that slug of water that at least in the analytical space, comes up very fast.

It's about 30 feet per second, and it does that in several seconds. So, it's going to hit those plates pretty hard.

And the plates will protect the -

DR. WALLIS: That is solid water. It has no bubbles in it. It's just water.

MR. TOMKINS: Probably has some bubbles, but, yes, it's going to be a lot of water.

DR. WALLIS: Mostly you assume it's water.

MR. TOMKINS: And it's getting pushed up by the bubble.

So, these shields are - V-shaped shields are welded to the RTV pedestal wall. Each of - there's eight vacuum breakers in the design. Each one has its own shield.

And as I indicated, the V shape sort of pushes the water away from directly impacting the vacuum breaker itself.

We looked at the loads from fallback of the water after the pool swell, and the decision was that that was not significant.

The swell goes maybe four or five feet above the vacuum breaker. So, there will be some water splashing against the vacuum breakers. But at that point, the slug is not solid. It's been broken up and it's strictly a freefall of water compared to a really rapid rise in the actual -

DR. WALLIS: By the time you've got rapid condensation, the pool level is below these vacuum breakers?

MR. TOMKINS: Yes, the pool - the swell goes up and it goes above the vacuum breakers. And then very shortly after that, 20, 30 seconds after that, it goes back down. Yes, goes back underneath then.

DR. WALLIS: So, there's no load on these from condensation bubbles collapsing in the later stages?

MR. TOMKINS: No, because that's all happening down below.

DR. WALLIS: Happening below.

MR. TOMKINS: Right.

DR. WALLIS: You're sure there's not swell above the vacuum breakers at that time?

MR. TOMKINS: I don't believe so.

DR. WALLIS: Because that would be the big loads if you have a bubble collapsing there.

MR. TOMKINS: Right, right. Nirmal, do you want to -

MR. JAIN: This is Nirmal Jain.

Yes, for condensation oscillation or checking the pool swell, the water level is very below the vacuum breaker.

CHAIRMAN ABDEL-KHALIK: I'm sorry. Could you repeat that?

MR. JAIN: The water level is very below the vacuum breaker.

CHAIRMAN ABDEL-KHALIK: Okay. Thank you.

MR. TOMKINS: The other point is the vacuum breaker operation is not required until well into the transient. The pool swell happens in the first two, three seconds. The vacuum breakers are predicted to be needed at about 1200 seconds. So, quite a bit later in the event.

CHAIRMAN ABDEL-KHALIK: They have to be there.

MR. TOMKINS: They're going to be there, yes, sir. Right.

The vacuum breakers are designed to operate in a water-rich environment. Containment sprays are above the vacuum breakers. So, they will presumably see some water from actuation and containment sprays.

They're Seismic Category 1. They're not directly attached to the vacuum - the shields are not directly attached to the breaker itself, as I said.

They're coated carbon steel. And I've got a little drawing here. This is -

MEMBER ARMIJO: What are they coated with? Is that an epoxy-type coating?

MR. TOMKINS: I think they would be coated with the same -

MS. SCHLASEMAN: Oh, they would have the same qualified coating, which is an inorganic zinc primer with epoxy topcoat.

MEMBER ARMIJO: So, it's zinc with epoxy overcoat?

MS. SCHLASEMAN: Yes, the epoxy is over the inorganic zinc primer. That would be the qualified coating system for all steel, all carbon steel that's within the primary container.

MEMBER ARMIJO: So, it would be the same that's on the, let's say, the pedestal, the RPV pedestal?

MS. SCHLASEMAN: On the outside of the

pedestal?

MEMBER ARMIJO: Yes.

MS. SCHLASEMAN: Well, in the suppression pool, that's all stainless steel. Below the water line it's all stainless steel. Above the water line it's all carbon steel, and that would be coated with qualified coatings.

MEMBER ARMIJO: Okay.

DR. WALLIS: I'm sorry. I wasn't in on where the - where is the actual part of the vacuum breaker that operates in that tube?

MR. TOMKINS: I'll show you that in just a second.

DR. WALLIS: You will show us that?

MR. TOMKINS: Well, I've going to -- I'll show it by --

So, this is a - this is the pipe that goes from the wetwell air space into the lower dry well. And it's about a 20-inch pipe. There's eight of them.

And then this is the shield. And this is welded all -

DR. WALLIS: There's 30 inches here, right?

MR. TOMKINS: I think the vacuum breaker valve itself is 20 inches.

DR. WALLIS: Oh, it's in the 30-inch pipe though.

MR. TOMKINS: Where does it say that?

MEMBER STETKAR: On the right side of your slide.

MR. TOMKINS: Okay. All right. The pipe is sum D.

So, as I said, this shield is welded all along here to the pedestal. This is a side view of it. So, you can see the pipe going through to the lower dry - this is the lower dry well. This is the wetwell. This is the side view of the shield.

So, the valve is basically a gate valve with a small spring on it. And the valve is hinged here. And so it sort of opens this way.

And when that -

MEMBER BLEY: Well, it's not a gate valve. It's a swing check valve.

MR. TOMKINS: Excuse me. It's a swing check valve, yes.

And it opens at .1 psi, and is fully open at .5 psi.

MEMBER BLEY: Is there a detail of the valve? I didn't look hard enough to find it. Detailed drawing of the valve?

MR. TOMKINS: I don't have one. I don't

think there's on in the DCD.

MEMBER BLEY: Is it an angle check valve? Is it offset on an angle that keeps it normally closed?

MR. TOMKINS: I don't know that. I don't know the answer to that.

MR. HEAD: Jim, I thought yesterday I saw a picture of a drawing that -

MR. TOMKINS: Well, yes, I have a picture of one at another plant, but I don't have it on - the capability to show it on the screen.

MEMBER BLEY: Maybe at a break we can look at it -

MR. TOMKINS: Yes, yes.

MEMBER BLEY: - because I didn't find it and I didn't look hard enough for it, but I would like to see -

MR. TOMKINS: It didn't look to me like it was angled, but -

MEMBER STETKAR: Jim, you said these valves are qualified to operate in a - you characterized it as a water-rich environment.

During this slug, is there some chance that the slug itself, you know, pops the valve open?

You said it opens with - I forgot what you said the psi differential pressure is. Pretty small.

MR. TOMKINS: Very unlikely. Because at the time that slug comes up there, the pressure on the other side of this is like 90 kilopascals, but the delta is a huge delta P.

MEMBER STETKAR: Okay.

MR. TOMKINS: So, because the pressure hasn't got into the suppression pool -

MEMBER STETKAR: Okay.

MR. TOMKINS: - yes, it's still much larger there.

MEMBER STETKAR: All right.

MR. TOMKINS: So, I don't think it opened.

MEMBER STETKAR: Okay. Thanks.

MEMBER BLEY: And when they need to open, how many of them have to open?

MR. TOMKINS: Well, it's designed for - there's eight. Seven is what's needed. So, it's assumed that one could fail.

MEMBER BLEY: Could tolerate one fail?

MR. TOMKINS: One could fail, yes.

DR. WALLIS: So, what happens in the wake of this V-shaped plate?

MR. TOMKINS: Well, you get water that would splash in the air. There would probably be a little water in here, and then it would presumably run out.

DR. WALLIS: You assume it just sort of all diverts away, but some of it's going to splash on this.

MR. TOMKINS: Oh, yes. I'm sure, yes.

CHAIRMAN ABDEL-KHALIK: But you had just - this is just to try to avoid the direct impact of the -

DR. WALLIS: I understand. I'm just trying to imagine what else happens.

CHAIRMAN ABDEL-KHALIK: Right.

DR. WALLIS: Is this just to sort of - sort of a rough idea of what happens, or have you actually tried to analyze a bit more what happens with this V-shaped plate in place? Do you just assume it's okay?

MR. TOMKINS: Well, no. There's an analysis done of the force caused by that slug of water at that speed and -

DR. WALLIS: And if it comes around, it doesn't do anything?

MR. TOMKINS: I don't know if there was an analysis done on that. I think there was a judgment that -

DR. WALLIS: A judgment.

MR. TOMKINS: Yes. Bob.

MR. QUINN: Hi, yes. My name is Bob Quinn. I'm with Westinghouse.

The V-shaped plate design you see here is very similar to the V-shaped plates that were installed in the Mark I containments underneath the primary header for the exact same purpose of the pool swell deflection.

So, what it actually does is it splits the flow of the pool around the plate, and basically you get no water above there except for froth that appears once the bubble breaks through.

So, the only water impact, if you will, on this vacuum breaker will be the fallback of the froth, which is insignificant.

Does that answer the question?

DR. WALLIS: Well, it certainly cuts the water that's directly going up to the thing, but I just wonder what happens to the other water that's - something has to come around and hit that strainer. It's not going to stay dry forever.

MR. TOMKINS: No, I think there will be some water that will -

DR. WALLIS: Some assessment of what that force would be.

MR. TOMKINS: - spill over and hit it, but far, far less than the -

DR. WALLIS: It won't break the pipe, but it might damage the strainer.

MR. TOMKINS: Strainer?

MS. SCHLASEMAN: What strainer?

DR. WALLIS: Isn't there a strainer on the top there?

MR. TOMKINS: No, that's not -

MS. SCHLASEMAN: No.

MR. TOMKINS: There's no strainer there.

DR. WALLIS: I thought you said there was a strainer on top of the -

MR. TOMKINS: No, the strainer is way down -

DR. WALLIS: Oh, on the end of the pipe there? What's that thing there that's on the end of the pipe? The double-dash thing. What is that?

MR. TOMKINS: That's a flange, and the vacuum breaker sits there.

DR. WALLIS: There's something on top of the - I thought you said there was a strainer there.

MR. TOMKINS: No, no, no. There's no strainer. The strainers are down near the bottom.

DR. WALLIS: Just an open end?

MEMBER BLEY: Well, the valve gets -

DR. WALLIS: The valve is there?

MR. TOMKINS: Looks like this.

DR. WALLIS: I thought it was inside the pipe. It's bolted right on the end?

MEMBER BLEY: It's a valve.

MR. TOMKINS: Well, it's right on the - you'll see when I show you this drawing. It's right on the -

DR. WALLIS: Oh, okay.

MR. TOMKINS: Right on the end.

MEMBER BLEY: After they've relieved, broken in the vacuum, do they all have to recede? What's the receding criterion for these?

MR. TOMKINS: Well, that - there is indication of receding, I know, in the control room.

MEMBER BLEY: That's just the VPR, sensing --

MR. TOMKINS: Yes, yes.

MEMBER BLEY: But in some designs, you have to get an almost perfect receding, and I just wonder if that's true here. Maybe we'll get that in Chapter 15.

MR. TOMKINS: Nirmal, would you -

MR. JAIN: Yes. This is Nirmal Jain.

Even if it doesn't recede completely, operator can still control the driver pressure by starting this phase.

So, complete receding is desirable, but it's probably - it can be mitigated if some valves were to stick open with this phase.

MEMBER BLEY: Thanks.

CHAIRMAN ABDEL-KHALIK: I guess there is just one follow-up item. You'll show us some details of the design of these valves?

MR. HEAD: Right. It's not our design.

CHAIRMAN ABDEL-KHALIK: Okay. Thanks.

MR. TOMKINS: And with that, I will transition to Caroline who will take us through ECCS suction strainers.

MS. SCHLASEMAN: Okay. Good morning. I'm Caroline Schlaseman. I'm an engineer with NPR Associates, and I support TANE and Toshiba licensing.

And last June I gave a presentation to the Subcommittee on the suction strainer design. Dr. Wallis was not with us then. So, I am going to cover a little bit of the previous ground that I've covered in the past. That will include a little bit about strainer sizing, chemical effects.

As Jim mentioned the chemical effects, we have made some changes from our position from what we reported last June to the Committee, and so I'll highlight that. And then I'll provide a summary with where we stand as far as the suction strainers.

As I said, last June we met with the Subcommittee and we explained how South Texas Project, the STP Units 3 and 4 suction strainers. We have taken a departure, a Tier 2 departure, to upgrade from the DCD strainers to achieve the regulatory positions that are described in Reg Guide 1.82 Rev 3.

We do that - the primary method of achieving that is that we've referenced the - we are using the same strainer designs and sizes that have previously been installed in 2005 at a Reference Japanese ABWR.

The difference between what was done for the Japanese plant and what we have for South Texas with using Rev 3 of Reg Guide 1.82, is that the downstream effects and chemical effects were not addressed in the Japanese plant. So, that was an additional thing.

And to meet the Rev 3 regulatory positions, we're relying obviously on the design and using the reference plant strainer sizing.

In addition, we are minimizing materials within the primary containment that are known to challenge ECCS strainers or sumps in BWRs, and the downstream components.

Here's a cross-section of the ABWR. As you all are aware, the break - the large-break LOCA is assume to occur in the upper drywell.

Jim was pointing out the main steam line, that our postulated worst-case LOCA is a break in the main steam line.

The debris from the break, which would include the RMI and destroyed qualified coatings that are within the zone of influence, would be washed down. They first come to the trash rack, which is a course grate, and then they would enter the ten drywell connecting vents and come down and discharge out the horizontal vents - there's a stack of three of them there that you can see - into the suppression pool.

The other feature of interest that the little hand is on right now is the SRV - the x-quenchers, the discharge piping, also is located in the suppression pool.

on the lower right-hand side, the strainers of course are on the perimeter of the suppression pool in six locations. And our next figure will show you in a plan view, the - most of this slide is taken up with the x-quenchers. But around the perimeter at about the one o'clock position, you have the first of the RHR sections. then the RCIC section, the first of the two high-pressure core flooder, and then another RHR, RHR for the third time, and then the high-pressure core flooder.

So, we have three low-pressure suctions from our suppression pool, the three RHR trains. We have three high-pressure - the two high-pressure core flooder, and the RCIC, but the RCIC is not credited for the large-break LOCA because its missing time is -

DR. WALLIS: So, what are --

MS. SCHLASEMAN: This is going to depressurize and RCIC is not going to -

DR. WALLIS: What are the loads on these strainers due to condensation in the suppression pool?

MS. SCHLASEMAN: I'm sorry. Could you repeat the question?

DR. WALLIS: What are the loads?

MS. SCHLASEMAN: Condensation oscillation?

DR. WALLIS: When you inject steam, there are two things from the quenchers, and also from the vents.

MS. SCHLASEMAN: Right.

DR. WALLIS: There are steam comes in.

MS. SCHLASEMAN: Correct.

DR. WALLIS: And those bubbles collapse.

MS. SCHLASEMAN: Correct.

DR. WALLIS: And as they collapse, they send out pressure waves, right?

MS. SCHLASEMAN: Correct.

DR. WALLIS: I'm asking what are the effects on the strainers of the pressure waves generated by rapid condensation in the pool?

MS. SCHLASEMAN: Are you talking about the structural issue or the -

DR. WALLIS: Yes.

MS. SCHLASEMAN: Yes, okay. These strainers have been evaluated in the reference plant for the hydrodynamic loads that the BWR sees. That includes vent clearing, pool swell -

DR. WALLIS: How do you do that?

MS. SCHLASEMAN: I beg your pardon?

DR. WALLIS: Are these all done experimentally?

MS. SCHLASEMAN: The definition of the loads which is described in Chapter 3 - it's actually in Appendix B, bravo, 3B.

The pool swell load, the methodology is based originally on testing that was done by GE, and Toshiba, Hitachi all were involved in the development of the loads for horizontal discharge vents.

So, the pool swell, the condensation oscillation, the chugging, there is empirical test basis for those methodologies. And they are defined in 3 bravo.

SRV discharge, similarly there was testing of these x-quenchers and the discharge associated with them.

So, the design, the ASME design specification for the structural evaluation and design of these strainers, includes all of the hydrodynamic loads, the seismic load, the loads coming from the reactor building back in through the tees, through the penetrations.

DR. WALLIS: ASME tells you how to design strainers for these loads?

MS. SCHLASEMAN: ASME tells you what the stress limits are for the -

DR. WALLIS: Yes, but then you have to calculate.

MS. SCHLASEMAN: Correct. Yes. When I say the ASME design specification, what I mean is that the

EPC team, Sargent Lundy, in this case, has put together the design specification to go to CCI, who's the vendor.

DR. WALLIS: Okay.

MS. SCHLASEMAN: And they receive from Toshiba, the actual strainer loads for each of the different hydrodynamic loads specific for STP.

DR. WALLIS: So, CCI, then, has done calculations?

MS. SCHLASEMAN: They're in the process of doing the calculations.

DR. WALLIS: Process.

MS. SCHLASEMAN: Structural calculations.

DR. WALLIS: So, we don't yet know if these strainers will meet the loads?

MS. SCHLASEMAN: We have high confidence because for the reference plant, the reference plant did a similar evaluation and had to evaluate higher-dynamic loads because that's also an ABWR suppression pool almost identical, very close to what we have.

And so - and we are using the same size RHR and high-pressure core flooder strainers so the inertial load, the drag load, you know, all the geometry-specific - it's all geometry-specific, I guess, basically, for the strainers, has been evaluated for the reference Japanese ABWR.

We're doing it again, of course, because our loads are not identical. They're similar. And then that was done - the acceptance criteria were JSME code stress limits. We're using ASME code stress limits.

The Japanese code actually is slightly more conservative in their stress limits compared to our code.

DR. WALLIS: So, there's going to be, then, something submitted by CCI?

MS. SCHLASEMAN: Correct.

DR. WALLIS: Which will be reviewed by the staff?

MS. SCHLASEMAN: Well, that's covered by an ITAAC because these are ASME code components.

DR. WALLIS: ITAAC.

MS. SCHLASEMAN: Oh.

DR. WALLIS: Yes, I'm not worried about the ASME code. I'm just worried about the ability of someone to analyze the complicated geometry of a strainer -

MS. SCHLASEMAN: Yes.

DR. WALLIS: - and how it responds to these loads.

MS. SCHLASEMAN: Yes. And we have shown the staff the sections as part of Chapter 3. We have shown the - I guess it was the Engineering Mechanics Branch. We provided for review, the JSME - excuse me - the stress reports that were done for the reference Japanese plant.

So, they were able to see how CCI did that evaluation. And we will be providing for review purposes, the ASME design stress report for these components.

And the staff in January, we had an audit at Sargent Lundy of all of the ASME component design specifications. And so, the Engineering Mechanics Branch staff conducted that audit. And the ECCS strainer design specifications were included in that audit.

DR. WALLIS: Well, I assume that someone has done this work. I'm just a little puzzled about - there's no experiment done with this loading of this actual strainer, right?

So, it's all based on someone's ability to analyze this complex geometry with this load that's imposed on it. It's all based on some computer model of this complex geometry, presumably.

MS. SCHLASEMAN: There is - they prepare a fine-element analysis of the strainer. And they looked at the - well, you want to skip ahead to the picture? Because Dr. Wallis is already on the picture.

So, this is what the typical strainer looks like. Like I said, CCI is the vendor. This is referred to as a cassette-type strainer.

These strainers are about - the photo is actually from functional testing, you know, strainer performance as far as catching debris and head loss that was done at the EPRI Charlotte facility quite a while ago.

But this is - and this is only a single strainer. We have pairs of strainers on each -

DR. WALLIS: Well, I guess I'm coming in way late in the game. Presumably if you blew out one of these pockets or several pockets, then the debris would just go right through. It would have nothing to stop it, right?

MS. SCHLASEMAN: That would be correct.

DR. WALLIS: So, you want to be sure that every pocket -

MS. SCHLASEMAN: Right.

DR. WALLIS: - stays integral.

MS. SCHLASEMAN: That is correct.

DR. WALLIS: Okay. And I assume someone's looked into all this. So, it's too late for me to do it now, right?

MS. SCHLASEMAN: You would be welcome to go ahead and look at the stress reports that we have for the Japanese plant.

Like I said, we -

DR. WALLIS: If the Committee wants me to do that. I'm not sure. I'm so late in the process here. I'm not sure if I'm raising a question that's been resolved.

CHAIRMAN ABDEL-KHALIK: We'll talk about this offline. Thank you.

DR. WALLIS: Thank you.

CHAIRMAN ABDEL-KHALIK: The question in my mind, really, is not the mechanical response of the components, but how the loads are calculated. That's -

MS. SCHLASEMAN: Right. And the load definition, like I said, that's - Chapter 3 will end up having a lot more discussion about that, because Appendix 3 bravo is where the detailed load definition is.

And then I said Toshiba has - and we do not have the safety analysis experts from Toshiba with us today for that discussion, but we will when we do Chapter 3.

But they, like I said, the methodology, the definition of the load is in the certified design. And then that approved methodology is obviously implemented by Toshiba to calculate specifically then what the impact is on the strainers. Like what's the impact on the x-quenchers also, which are sitting there also in the suppression pool. In fact, they're closer to where the vents are than the strainers are.

DR. WALLIS: They're also creating loads at one time.

MS. SCHLASEMAN: At some point, yes, that is correct. That is correct.

DR. WALLIS: Repetitive load. It's not just a bang, it's a repetitive -

MS. SCHLASEMAN: For condensation oscillation, that is correct. It's a response spectrum. I mean, Toshiba provides a response spectrum for condensation oscillation, for chugging, to CCI for them to analyze the response of the strainers.

DR. WALLIS: The whole thing rings, presumably. If you hit this complicated thing, everything is going to shake. And then it's going to be hit again.

MS. SCHLASEMAN: Yes.

DR. WALLIS: It doesn't sound to me that easy an analysis. That's all.

MS. SCHLASEMAN: Okay. Well, there's - the jacket frame and the flanges and the - are all analyzed for the stresses. And then the pocket as you - oh, in the lower right-hand corner, that's without the jacket over it, but looking down into one of the pockets.

Obviously this is, you know, perf plate. It's, you know, relatively thing gauge material. And its thickness is stressed out to meet ASME code.

So, I've given a little - overall dimension is about four feet. Diameter - the high-pressure core flooder and the RHR strainers are different sizes. RHR is slightly larger. That's closer to about a three-foot diameter strainer. And the high-pressure core flooder is closer to about two-and-a-half feet diameter. I think that's it for that.

From a functional standpoint, the cassette-type strainer, the CCI design, you know, the chief advantage is that you can end up with a large filter surface area in a compact volume, which minimizes the structural loads, which is a good thing.

And then the second bullet, if we had more than an insignificant amount of fiber, you know, if you have an amount of fiber that's larger than what we have, but is smaller enough to be a thin bed effect that the disruptive surface of a cassette-type strainer ends up having - it minimizes the thin bed effect that's been identified.

DR. WALLIS: Now, how do you know that?

MS. SCHLASEMAN: I beg your pardon?

DR. WALLIS: How do you know that? I mean, no one understands thin bed effect anyway.

MS. SCHLASEMAN: Oh, that's based on CCI testing, and I don't have details of that.

DR. WALLIS: Thin bed usually appears as a surprise.

MS. SCHLASEMAN: That's correct.

DR. WALLIS: Rather than something you know how to create or predict.

MS. SCHLASEMAN: But it was first identified on the flatter, perforated plate stacked-disk type strainers. And the stacked-disk type strainer, you have much larger surface area of perf plate.

And this is - it's CCI brochure material. And for us, it ends up being a non-effect. So, I probably should have taken that bullet off.

DR. WALLIS: In a convoluted surface. I see a lot of flat surfaces, so I don't know what you mean by convoluted suction surface.

MS. SCHLASEMAN: Actually, you're drawing the water in through four sideways surfaces, and then down through the bottom on the pocket.

DR. WALLIS: The pocket. It's a pocket with flat sides that are perforated.

MS. SCHLASEMAN: That's correct. That is correct.

DR. WALLIS: They're all flat.

MS. SCHLASEMAN: That's correct.

DR. WALLIS: So, they could make a thin bed.

MS. SCHLASEMAN: That is correct.

DR. WALLIS: There's nothing convoluted about them.

MS. SCHLASEMAN: That is correct.

DR. WALLIS: So, I just wonder if this isn't a statement based on faith.

MS. SCHLASEMAN: I think that it is based on the - I am - this is speculation because I'm not CCI and I have not specifically asked how they came up with it.

My guess is that compared to other perforated plate strainers, CCI had a smaller thin bed effect - smaller head loss due to thin bed effect than other vendors. But, again -

DR. WALLIS: I think what happened was -

MS. SCHLASEMAN: - this is a vendor claim.

DR. WALLIS: They didn't notice that. They did tests, and they didn't get it.

MS. SCHLASEMAN: No, they have thin bed effects.

DR. WALLIS: They have seen thin bed?

MS. SCHLASEMAN: Oh, yes.

DR. WALLIS: Really?

MS. SCHLASEMAN: I thought so, yes. I mean, or at least we do the correlation.

For the Japanese plant where we have fiber, the strainer sizing report is based on fiber at the, you know, the max fiber condition. And then it's also evaluated for a thin bed effect.

And so, those correlations and those analyses were done to ensure that there wasn't a surprise thin bed effect for the Japanese plant.

DR. WALLIS: Well, I tend not to believe any predictions about thin bed effects because -

MS. SCHLASEMAN: That's fair.

DR. WALLIS: - no one knows how to predict them.

MS. SCHLASEMAN: Yes.

DR. WALLIS: And if they ever happen, it's usually a surprise.

MS. SCHLASEMAN: And it could be just a quirk of the testing. Like I said, this is a vendor claim. And based on that, I probably shouldn't have put it in here because it's not - it's not germane to us because we have no fiber.

DR. WALLIS: So, little fiber.

MS. SCHLASEMAN: Yes, so little fiber that -

DR. WALLIS: It all goes through anyway.

MS. SCHLASEMAN: It will all go through. That is correct.

DR. WALLIS: No, it doesn't. It doesn't all go through.

MS. SCHLASEMAN: It does not contribute to -

DR. WALLIS: So, you have calculated the fiber loading per unit area and determined that's so low that nothing could happen?

Is that what you've done?

MS. SCHLASEMAN: For the STP. Our

strainers, though, were sized for the Japanese plant.

DR. WALLIS: Yes.

MS. SCHLASEMAN: The Japanese plant has fiber.

DR. WALLIS: Yes.

MS. SCHLASEMAN: And that strainer sizing evaluation goes through both the analytical sizing analysis in accordance with Utility Resolution Guideline and the NUREG-6808 correlation for head loss.

And then it was confirmed by small-scale testing of a couple of - well, for pockets at CCI. And the analytical result was more conservative than the small-scale testing.

So, that's how the size was determined.

DR. WALLIS: Is there some rationale that I could find here, I don't want to prolong this, but where you've convinced yourselves that you will not have a thin bed effect?

I just want to see what that rationale is. Is it written down somewhere?

MS. SCHLASEMAN: It's based on the one cubit foot of latent fiber -

DR. WALLIS: There's so little fiber.

MS. SCHLASEMAN: - over the - if I - more than - I'm trying to avoid proprietary information here.

The overall strainer surface area of operating strainers post-LOCA, is over a hundred square meters.

DR. WALLIS: So, this is spread over all the strainers?

MS. SCHLASEMAN: Yes.

DR. WALLIS: Do some of the operate first?

MS. SCHLASEMAN: Of the operating strainers.

DR. WALLIS: Some of them operate first, don't they?

MS. SCHLASEMAN: Um -

DR. WALLIS: They don't all operate together, do they?

MS. SCHLASEMAN: That's two RHR strainers, and one high-pressure core flooder strainer.

DR. WALLIS: But spread over those first?

MS. SCHLASEMAN: Those six - well, those three pairs of strainers, yes.

DR. WALLIS: I just want to see it. There is a rationale written up somewhere.

MS. SCHLASEMAN: That's with a large-break LOCA.

DR. WALLIS: There is a rationale written up somewhere. That's all I want.

MS. SCHLASEMAN: Yes.

DR. WALLIS: Rather than just words, I'd like to see some numbers.

MS. SCHLASEMAN: We have docketed the proprietary reports for the strainer sizing. And the staff has reviewed that and we've been through that in considerable detail.

DR. WALLIS: The staff could just dig it out and let me have it?

MS. BANERJEE: It was in the CD.

DR. WALLIS: It's in this?

MS. BANERJEE: Yes. Those Toshiba reports I forwarded you.

DR. WALLIS: You've got so much stuff in it. I didn't know what to look at.

MS. BANERJEE: I can show it to you.

DR. WALLIS: You can direct me to it.

MS. BANERJEE: I will.

MS. SCHLASEMAN: Yes, there are three Toshiba proprietary reports that have been docketed. And the first two are directly associated with the strainer sizing and why those strainers were adequately sized in accordance with the URG methodology for the reference Japanese plant.

DR. WALLIS: Okay.

CHAIRMAN ABDUL-KHALIK: But our case, I guess, you know, the problem is so much reduced that -

MS. SCHLASEMAN: We have less fiber.

CHAIRMAN ABDUL-KHALIK: But, nevertheless, if you can point Dr. Wallis to the rationale for this statement that there is no thin bed effect -

MS. SCHLASEMAN: No, no, no.

CHAIRMAN ABDUL-KHALIK: - for this particular case -

MS. SCHLASEMAN: This is not an absolute statement. This is the deeply-regretted vendor statement from their website about why the CCI cassette-type strainer is superior to other vendors' perforated plate-type strainers, and we do not take any credit for this.

DR. WALLIS: But they're saying it cannot happen in their strainer?

MS. SCHLASEMAN: No, I don't think so. They're saying it disrupts it.

DR. WALLIS: Well, if it's just a qualitative statement, that's not good enough.

MS. SCHLASEMAN: no, no, no. In the - you will see the thin bed effects evaluation and the testing that supports that in the reports, in the Toshiba reports.

CHAIRMAN ABDEL-KHALIK: But that's for the reference plant.

MS. SCHLASEMAN: It is for the reference plant and it's not applicable to us.

DR. WALLIS: Well, that's the problem. If your conditions are different -

MS. SCHLASEMAN: It bounds us.

DR. WALLIS: If your conditions are different from the reference plant -

MS. SCHLASEMAN: Right.

DR. WALLIS: - how do we assess them?

MR. VAN HALTERN: It bounds us though.

MS. SCHLASEMAN: Because -

DR. WALLIS: Doesn't necessarily bound you because less fiber can be worse under some circumstances.

MS. SCHLASEMAN: We have one cubic foot spread over more than a hundred square -

DR. WALLIS: It seems good. It seems good, but just -

MS. SCHLASEMAN: Well, and I have more discussion on latent fiber, which I will explain in more detail when I get to that slide.

DR. WALLIS: Well, just give me something definite. That's all I need.

MR. HEAD: So, Mr. Chairman, I suggest that we -

MS. SCHLASEMAN: Skip to latent fiber?

MR. HEAD: - declare this an action item that if you -

CHAIRMAN ABDEL-KHALIK: Just provide the rationale.

MR. HEAD: If you encounter the information at a future moment, we'll come armed to provide more detail on that in case you haven't seen it.

DR. WALLIS: It may be very convincing.

MR. HEAD: Yes, sir, I think you'll find it's very convincing. So - but we'll just declare it as an action item. And if we don't have to address it because we've seen the information, then we'll be done, but -

DR. WALLIS: Fair enough.

MR. HEAD: Okay.

MR. TONACCI: Excuse me. This is Mark Tonacci.

So, what exactly is the action item? To provide the three reports to Dr. Wallis?

CHAIRMAN ABDEL-KHALIK: No, I guess the

action item is to find out whether the analysis done for the Japanese reference plant with regard to thin bed effects really the STP case where the amount of fiber is considerably less.

MR. TONACCI: Thank you. That's what I wanted to hear. Thank you.

CHAIRMAN ABDEL-KHALIK: Is that correct, Graham?

DR. WALLIS: I want to see whatever the rationale is.

CHAIRMAN ABDEL-KHALIK: Right.

DR. WALLIS: That's it.

CHAIRMAN ABDEL-KHALIK: Please continue.

MS. SCHLASEMAN: Okay. And the last bullet is that we have decreased the hole size from the original DCD value of 2.4 millimeters. It's now the maximum hole size for any of the strainers, all the strainers is 2.1 millimeters.

There are several US PWRs that are using the CCI cassette-type strainer to resolve GSI-191. This list is from the NRC's inspection of CCI several years ago - well, about three or four years ago at this point - over in Winterthur. And at that point, these are the PWRs that were using CCI cassette-type strainers.

As I think I've already mentioned, the reference Japanese plant replaced the original RHR strainers and high-pressure core flooder strainers with the CCI cassette-type strainers in 2005.

They used - the sizing methodology is based on the BWR Owners Group Utility Resolution Guidance. That was issued in the mid-1990s.

There are actually three reports that we were just talking about. But the two that are on strainer sizing directly are the two that are referred to here. What we refer to as Reports 1 and 2.

Report 1 was a report that was submitted by Toshiba on behalf of the utility to the Japanese regulator on that change from the original strainers in the ABWR to the CCI cassette-type strainers.

And the second report is a supplemental report that provides additional detail beyond what was in the summary report to the Japanese regulator. So, those are the two reports that I'm referring to here.

Fiber, this is, as we all know, the hot topic. Latent fiber - well, actually let me back up. I think that I had mentioned that we - our primary method of achieving compliance with all the requirements for suction strainers is by prohibiting the use of fiber aluminum inside primary containment, and minimizing the use of zinc to only the inorganic zinc primer in the qualified coating system.

DR. WALLIS: So, what is the area of the strainer surface?

MS. SCHLASEMAN: I would have to - we'd have to go proprietary if I give you a precise number.

DR. WALLIS: Okay.

CHAIRMAN ABDEL-KHALIK: We are planning a closed session. Maybe at that time, you can provide that information.

DR. WALLIS: I mean, if it's a thousand square feet, we can say something about how thick the bed might be and -

MS. SCHLASEMAN: Well, I can tell you it's more than a hundred square meters.

DR. WALLIS: More than a hundred square meters.

MS. SCHLASEMAN: Right off the top of my head I can tell you more than -

DR. WALLIS: So, you've got meters for area and foot-cubes for volume. Okay. That's all right.

MS. SCHLASEMAN: Well, that's where I need to explain the basis for the fiber and what the fiber really is.

Fibrous insulation, fibrous materials are prohibited from STP by design. By design, by process, by procedure, it's, you know, it's prohibited.

However, we agreed with the staff that zero was a very hard number to prove. And so, to address the concern that potentially there is some fiber even though we prohibit and obviously have controls to not have it by design, that we would develop an amount of latent fiber, a quantity of latent fiber and we agreed with the staff of one cubic foot.

And we did that based on the experience, the containment cleanliness experience at TEPCO, who is the utility that has the two oldest ABWRs, Kashiwazaki-Kariwa Units 6 and 7.

And, you know, one other - well, okay. So, the TEPCO experience, we got from them a report of their inspection five years after operation, both Unites 6 and 7. And the types of material that they found in their suppression pool were very small quantities less than a cubic foot total, and it was primarily things like bits of metal and bits of tape. But the materials that you could possibly say were fibrous, were bits of rope.

We've also postulated, well, maybe there would be a cloth or a rag, but TEPCO actually didn't have any cloth or rag. They had bits of rope, and that was kind of the only fibrous-type thing.

DR. WALLIS: Most of those fibers comes from clothing debris, doesn't it? Just wear.

MS. SCHLASEMAN: And -

DR. WALLIS: It's like dusting a house. It's there.

MS. SCHLASEMAN: And that's what this number is supposed to represent. It would bound that because the actual bits of material that could be left behind, we believe is minimal. So, we have agreed that you could potentially have a cubic foot of fibrous material.

Last summer we were - and actually we still believe this, but the types of latent material that we were talking about where it didn't seem to be the type that would be capable of passing through the strainer openings, which are .083 inches or 2.1 millimeters, but we had to have something to test for downstream effects.

And, you know, we couldn't prove that, you know, a stray thread or whisker or whatever, you know, would get through.

So, what we had decided that we would go ahead and just assume for test purposes, that ten percent of it was destroyed fibrous insulation. And there's no physical basis for that. It's just because we don't have fibrous insulation materials. They are prohibited.

We have changed our position because there - again, there was really no way to prove the ten percent number was a number intended as a surrogate for the one cubic foot of fibrous material, latent fibrous material, but we've since decided we would just go ahead and assume that the one cubic foot of fibrous material was all destroyed fibrous insulation.

DR. WALLIS: What kind of latent debris is actually found in the containments?

MS. SCHLASEMAN: It's a rope.

DR. WALLIS: No, it's blue jean dust, isn't it? It's dust from clothing. That's what you find in the containments.

MS. SCHLASEMAN: Well, dust is a different particulate degree. I mean, we have -

DR. WALLIS: It's cotton. My concern here, I'm just saying, is since most debris found in containment is not fibrous insulation, it's hairs and clothing debris and so on, that would seem the right thing to model because cotton doesn't behave the same as fiberglass.

MS. SCHLASEMAN: Right.

DR. WALLIS: But this is an old story, and I'll just raise the point now.

MR. HEAD: Well, the URG has -

MS. SCHLASEMAN: The URG requires dust.

MR. HEAD: Right.

DR. WALLIS: I know, but it's all - cotton doesn't lay the same as fiberglass, but this is an old story. GSI-191 is going to look at all this stuff again, I guess.

It just seems odd to say it's fiberglass when it isn't.

MS. SCHLASEMAN: I agree, but that was the only way we could come up with something small enough to pass through our strainers. I mean, that's what we were -

DR. WALLIS: I think it should be based on what's actually found in containments as latent debris.

CHAIRMAN ABDEL-KHALIK: When we get to the test protocols, maybe we can discuss this issue.

MS. SCHLASEMAN: Okay. All right. I'm going to keep going, and then I'll go back to the point.

Okay. So, our next material of concern

for chemical effects is aluminum. And, again, aluminum is prohibited from the South Texas primary containment.

So, about a year ago we went ahead to address the question of, well, what if you had some latent aluminum, what if you had some material that was aluminum that was inadvertently left inside containment, you know, how large a quantity could you get?

Our approach for coming up with a number for latent aluminum, a quantity, was to calculate the maximum amount of aluminum that will corrode over 30 days based on a worst-case pH and temperature profile, and not come out of solution.

And we used the Westinghouse WCAP methodology to run that correlation. And our number for our worst-case, was that we could have four-and-a-half square feet of aluminum surface area that could be accidentally left inside containment, corrode for 30 days in the worst post-LOCA conditions, and would not come out of solution because we - not precipitate because -

DR. WALLIS: But it's thick enough so it doesn't all disappear. I mean, the surface area doesn't tell you how much aluminum -

MS. SCHLASEMAN: Well, it's run with a large - it's very thick.

DR. WALLIS: So, it's not candy wrappers or something?

MS. SCHLASEMAN: Oh, no, no, no.

DR. WALLIS: It's ladders or something.

MS. SCHLASEMAN: Right. And Westinghouse ran that calculation so it had an infinite - the surface area kept replenishing.

DR. WALLIS: Okay.

MS. SCHLASEMAN: So, it corroded and corroded and corroded.

MR. ANDREYCHEK: Can I answer that question? This is Tim Andreychek.

We did assume an extremely thick slice of aluminum plate, and there was plate remaining after the corrosion calculations were run at the end of 30 days. So, we did not consume all the aluminum that could be available to the corrosion process, Dr. Wallis.

So, we did have excess aluminum at the end of 30 days that had we run the calculations longer, would have calculated additional dissolution.

DR. WALLIS: Thank you.

MS. SCHLASEMAN: We also considered the

four-and-a-half square feet of aluminum was within our foreign materials exclusion and containment cleanliness programs to detect. We would - if it was bigger than, you know, we would know if we had something that large or in our containment.

Next slide. Since June, we've changed our position and we've decided to go ahead and conservatively assume that all of the corrosion products from the latent aluminum do come out of solution. And so, we would consider them for chemical effects testing.

There are two forms of corrosion products predicted. The larger amount is the aluminum oxy-hydroxide. And then there's also a smaller quantity of sodium aluminum silicate. That's the exposure to the - it's the assumed exposure to concrete, the 300 square feet I mentioned earlier, that's under the destroyed qualified coatings within the zone of influence.

then for the test, for the planned downstream fuel effect test, we have agreed with the staff to use aluminum oxy-hydroxide as a surrogate for sodium aluminum silicate on the basis of the GSI-191 chemical effects testing that basically showed that aluminum oxy-hydroxide had a higher head loss than sodium aluminum silicate.

Okay. For chemical effects, zinc is our last material of concern. That's because we don't have sodium phosphate and - I don't know what else PWRs have that we don't, but, anyway, phosphate is not a concern for us. And calcium silicate was also prohibited from our design. So, zinc was our last material of concern.

The 300 square feet that was assumed to come off of the concrete, is actually doubled in the URG. The total quantity of destroyed coatings is postulated to be 604 square feet.

The 604 square feet of qualified coatings, a fraction of that - it turns out URG uses 85 pounds of destroyed coatings. 47 of that is the inorganic zinc primer.

The inorganic zinc primer is assumed to be entirely zinc metal as opposed to inorganic zinc primer. It's mostly zinc metal. And we assume all of it is.

And then that 47 pounds is assumed because it's within the zone of influence, to be destroyed into ten micron-size spheres to create a really huge surface area, over 20,000 square feet of surface area of zinc, that's then corroded over the 30 days.

Again, worst-case pH limits.

And the 30 days, that correlates with the WCAP methodology. Basically corrodes all of it.

MEMBER ARMIJO: So, you convert all the zinc into zinc oxide? Is that the -

MS. SCHLASEMAN: Yes.

MEMBER ARMIJO: All the zinc, that 58.6 pounds you just said by whatever mechanism, will turn it all into zinc oxide particles?

MS. SCHLASEMAN: Right.

MEMBER ARMIJO: Small particles of zinc oxide.

MS. SCHLASEMAN: Right.

MEMBER ARMIJO: And what happens with the silicate binder in the inorganic zinc coating?

MS. SCHLASEMAN: It was all assumed to be zinc metal. I mean, the binder, it was substituted -

MEMBER ARMIJO: Well, there's not a lot of it, but there is some.

MS. SCHLASEMAN: Well, wait until you see what we do with it. I mean, we then go ahead and we assume that our 58.6 pounds of zinc oxide is aluminum oxy-hydroxide.

So, aluminum oxy-hydroxide is actually going to be the material used as the surrogate for the test. So, we believe we're using the worst-case gelatinous goo as far as head loss goes as a surrogate for the corroded -

MEMBER ARMIJO: But based on your understanding of the chemistry, what is the form of the zinc that you actually expect will be there?

Will it be zinc oxide or will it actually be in some complicated oxy-hydroxide material?

MR. ANDREYCHEK: If I may, this is Tim Andreychek, and I'll respond to that question.

MEMBER ARMIJO: Yes.

MR. ANDREYCHEK: Zinc oxide is the material that we would expect based on our -

MEMBER ARMIJO: So, normally you would expect that stuff to go right through everything. I mean, it's small particles.

MR. ANDREYCHEK: Normally, again, we're dealing with ten-micron balls of zinc, which is the constituent material that makes up the inorganic zinc primer. And, now, we're corroding it away. So, we're going to expect even smaller, finer materials.

However, as Caroline indicated for the purposes of conservatism in the test, we're assuming it's aluminum oxy-hydroxide. So, that gives us a conservative chemical mix that we would use in the test looking for head loss.

MEMBER ARMIJO: Okay.

DR. WALLIS: Now, Tim, you said to expect this to be balls of zinc oxide.

Is there any basis for that experimentally or analytically?

MR. ANDREYCHEK: The work that we did on that, we did do a background search. And what our chemists have determined was is that that was the most plausible, most likely form of zinc corrosion product that we would expect to see.

We did do some zinc corrosion testing for the PWR Owners Group in WCAP 16530-N. And zinc oxide was the material that we were looking at at that point in time. That's what we had seen and observed.

So, if you take a look at a thermodynamic chemical equilibrium code to calculate things, you might end up with several different possible forms, but zinc oxide was the dominant form, the predominant form that we saw in the testing that we did.

DR. WALLIS: Well, the reason I'm asking you is because I think the aluminum experience was that we didn't anticipate aluminum oxy-hydroxide in the form in which it appeared in the Argonne tests and it was a big surprise that we got such a huge pressure drop.

And so, I'm a bit concerned about assumptions about zinc which are not backed up by similar experience. That's why I'm asking the question. I guess that's why my colleague was asking a question too.

There seem to be assumptions about what the zinc is doing. Are they really backed up by solid analysis and experience?

MEMBER ARMIJO: I believe you did experiments, right?

MR. ANDREYCHEK: As part of WCAP 16530, yes.

MEMBER ARMIJO: In this temperature range, this pH range. And you found that zinc oxide was the chemical form that resulted?

MR. ANDREYCHEK: That is correct.

MEMBER ARMIJO: Okay.

MR. ANDREYCHEK: And the temperature range we looked at in WCAP 16530 ranged from approximately 80 degrees Fahrenheit up to about 180 or so degrees Fahrenheit. So, we were in that ballpark, yes.

MEMBER ARMIJO: But then you just say, okay, we know it's going to be zinc oxide, but we're going to assume it's aluminum oxy-hydroxide.

MR. ANDREYCHEK: For the purposes of testing, yes.

DR. WALLIS: Well, I think I read - was it in the SER or something - that it sounded just like an assumption because it was stated there had been no experiments with - no tests for zinc oxide.

But that's not true. There were experiments with zinc oxide, right?

MR. ANDREYCHEK: Yes, but it was not specific for STP. It was part of the PWR Owners Group program.

DR. WALLIS: Well, maybe in order to be more convincing, it's the SER which should display this background because it comes across as just a big assumption that you can assume zinc's like aluminum without any basis. And that seemed to be not adequate.

So, maybe the SER needs to be a bit more explicit about the evidence, and then it would be okay.

MR. HEAD: Caroline, let me just ask. I mean, we say zinc is like aluminum, but wasn't that assumption really to basically use the hydroxide to create the most challenging test in terms of the aluminum?

MS. SCHLASEMAN: Well, that's the intent, right, but Dr. Wallis is questioning whether or not we know that. Whether or not we -

DR. WALLIS: Whether we know that the aluminum oxy-hydroxide is more challenging than something that might be made by the zinc. Correct.

MS. SCHLASEMAN: Right. And, again, that was based on Westinghouse's experience with the -

DR. WALLIS: Yes, it's got to be based on something more substantial than an assumption, right?

MS. SCHLASEMAN: Right.

DR. WALLIS: Right.

CHAIRMAN ABDEL-KHALIK: So, how are we going to resolve this question? You're going to provide a reference to that test data that shows that that's indeed the case?

MR. ANDREYCHEK: We did not compare the zinc oxide to the aluminum oxy-hydroxide. That was not part of what we had done, but we had demonstrated that we did get aluminum oxy-hydroxide.

Based on conversations that we have had and literature that we found, best we could say is that the aluminum oxy-hydroxide was a limiting material for head loss.

DR. WALLIS: Well, you didn't actually test

-

MR. ANDREYCHEK: And the aluminum oxy-hydroxide is made up for the Owners Group, PWR Owners Group formula mix to come up with the material used in the head loss testing that we would -

DR. WALLIS: But there wasn't a test with the zinc.

MR. ANDREYCHEK: Say again, sir?

DR. WALLIS: You didn't have a test that showed aluminum was worse than the zinc product for head loss.

MR. ANDREYCHEK: We did not, no.

DR. WALLIS: So, the rationale is a little bit more shaky than it would be if there had been a direct comparison.

There's no direct comparison, but you're assuming - you go through some argument, but the form of the zinc oxide is such that you wouldn't expect it to clog the strainers as much as the aluminum oxy-hydroxide.

MR. ANDREYCHEK: That's correct, sir.

DR. WALLIS: And the problem with GSI-191 is everything we've been assured of before about what you'd expect, comes to be destroyed by experiment.

You see the problem I have, Tim?

MR. ANDREYCHEK: Yes, I do.

DR. WALLIS: All right.

MEMBER ARMIJO: The only glitch I see is that when you did your zinc oxide corrosion, you didn't do it at the same time you did your aluminum oxide.

And so that you don't know that zinc - if you had a concurrent oxidation of the aluminum and the zinc oxide in the same temperature range and the same pH range, would you form a different type of aluminum oxy-hydroxide enriched in zinc that acted differently?

It's just a straight chemistry thing, you know. Because these things are going to be happening at about at the same time.

MS. SCHLASEMAN: I guess one observation about that is there's like two orders of magnitude different in quantity of these materials.

The zinc is huge quantity compared to the very small quantity of a latent aluminum that we have. And you'll see in -

MEMBER ARMIJO: But be the dominant form.

MS. SCHLASEMAN: You'll see in a subsequent slide, that the mass of aluminum corrosion products is a tenth of a pound compared to, you know, almost sixty pounds.

MEMBER ARMIJO: That's a good point.

MS. SCHLASEMAN: So, I'm not sure that there's - it's so far apart that there may not be any interaction.

DR. WALLIS: You're assuming they're independent.

MS. SCHLASEMAN: That's correct.

DR. WALLIS: And it's conceivable there are chemical reactions involving zinc and aluminum, which make some think. I mean, it could be that the aluminum oxy-hydroxide form is modified in some way by interacting with all these little zinc particles.

And until you do a test or something, I don't really know how you resolve that.

MS. SCHLASEMAN: I agree that that's true. But I think that for the quantities of material we're talking about, that - well, when we get a little bit further on, I think it - it's worth keeping in mind the quantities of materials that we're talking about before thinking that we should test. We'll see.

Should I move to the next slide?

DR. WALLIS: I'm trying to check this.

How much aluminum is there? How many pounds of aluminum?

MEMBER BROWN: .11 pounds, according to the

Slide 32.

MS. SCHLASEMAN: Right.

DR. WALLIS: How many?

MEMBER BROWN: 1.00 pounds.

DR. WALLIS: A tiny amount.

MS. SCHLASEMAN: Correct.

MEMBER BROWN: A test tube.

MS. SCHLASEMAN: That was my point about two orders of magnitude different relationship between zinc and aluminum.

CHAIRMAN ABDUL-KHALIK: Almost three.

MS. SCHLASEMAN: Yes.

MEMBER BROWN: Right.

DR. WALLIS: Which is an argument for why you should get the zinc behavior right.

MR. HEAD: Well, it was certainly our intent to get the zinc behavior conservative from a testing standpoint.

MS. SCHLASEMAN: Yes.

MR. HEAD: And we felt like the aluminum hydroxide was the most challenging material from a testing standpoint. And so that was -

DR. WALLIS: Well, I feel that way too, but my feelings, I've learned, are not a very good predictor of reality always.

MR. HEAD: Well, it was more than feelings. I mean, we have done some literature, you know, research and we felt like that that would, you know, bound what would be challenging in the field with.

And so, that was our basis because, I guess, every time, you know, you've heard some of our discussions about we've changed our position. Well, a lot of that was based on what you could envision a different test or a different pH or a different - so, there's a lot of different things that we're involved with and are changing our position that we could never come up with something that says, well, this is a definitive -

DR. WALLIS: I'm puzzled by this because I think GSI-191 has gone on for years and I think zinc was considered early on. Zinc's been in the literature for years, and then it disappeared for some reason.

When is it suddenly appearing again? There's an issue.

MR. ANDREYCHEK: Well, the reason it disappeared from the PWR side was that it was totally overwhelmed by aluminum.

DR. WALLIS: Ah. Now, in this case it's not.

MR. ANDREYCHEK: Because the aluminum was so small, the zinc rises to the top. It's kind of like whack-a-mole, you know. We knock the aluminum way down. And now the zinc which stayed relatively constant, rose to the top, so to speak, because the aluminum went way down.

DR. WALLIS: But you didn't have this amount of zinc oxide with PWRs, did you?

This is a huge amount of zinc oxide.

MR. ANDREYCHEK: Actually, again, the zinc was so overwhelmed by the aluminum oxy-hydroxide that it was all assumed to be aluminum oxy-hydroxide.

DR. WALLIS: I see.

MS. SCHLASEMAN: Yes, I would expect you have destroyed coatings.

MR. ANDREYCHEK: You do have destroyed coatings.

MS. SCHLASEMAN: Destroyed coatings too.

DR. WALLIS: We don't really have a good technical basis for evaluating the effects of zinc.

MEMBER ARMIJO: Well, you may other than intuition, wouldn't you?

DR. WALLIS: Yes, but that's not that good.

MEMBER ARMIJO: May be over-conservative. Way over-conservative and you may regret that.

MS. SCHLASEMAN: I think everything is conservative.

MR. TOMKINS: I think the amount's over-conservative and -

MS. SCHLASEMAN: Let's stay here. I'm going to do this one first, and then go back to 31. I think it makes more sense to point out that - so, here's the roll-up of all of the debris that is assumed to be in the suppression pool and reached the strainer.

We assume that everything that gets into the suppression pool gets to the strainers, and onto the strainers.

And the epoxy coating is the fraction of the 85 pounds that wasn't in inorganic zinc primer. So, that's, you know, where the 38 comes from.

That's a URG value. And, like I said, we've evaluated whether that's bounding for us. We've convinced ourselves that it is bounding.

Then the URG also prescribes using 195 pounds of sludge, 150 pounds of dust and dirt, 50 pounds of rust flakes.

The stainless steel RMI shards is specific to the South Texas plant. And this is - as you can see, you know, it's a huge - seems like a pretty huge number.

DR. WALLIS: I'm sorry. Slide 31, you said that these quantities are very small.

MS. SCHLASEMAN: Well, I'm going to go back to that one.

DR. WALLIS: Go back to that one.

MS. SCHLASEMAN: I thought it made more sense to - on the spur of the moment, it occurred to me that if we talk about this one first, it would make more sense -

DR. WALLIS: I see. You're going to go back. Okay.

MS. SCHLASEMAN: - to back up and then -

DR. WALLIS: Sorry.

MS. SCHLASEMAN: - do Slide 31.

DR. WALLIS: I thought you bypassed it.

MS. SCHLASEMAN: No, I'm going to go back to it. Yes, because 31 has my key summary points and - yes.

But I thought first we should, again, set the stage about where are the materials, you know? What do we really have?

And then the latent fiber we're assuming to be destroyed fibrous insulation now of one cubic foot.

Aluminum precipitate, we've just been talking about how it is -

DR. WALLIS: What is this dust and dirt? What is that?

MS. SCHLASEMAN: That is from the Utility Resolution Guideline from the BWR Owners Group NETO number -

DR. WALLIS: But that's dust which is not fiber, correct?

MR. ANDREYCHEK: That's correct.

MS. SCHLASEMAN: That is correct. That is particulate. That is dust and dirt.

DR. WALLIS: Particulate dust. Okay.

MEMBER ARMIJO: And what is the sludge? Is it iron oxide or is it -

MS. SCHLASEMAN: Yes. It's the junk from the suppression pool corrosion -

MEMBER ARMIJO: Okay.

MS. SCHLASEMAN: - which stainless steel lined - we've evaluated whether or not that sludge number is bounded for us based again on TEPCO Kashiwazaki-Kariwa experience and their suppression pool cleaning and what - their rate of sludge accumulating in the condensate polishers.

So, that number, we validated that as

being a conservative number for us. A bounding number for us based on the -

DR. WALLIS: Now, the thin bed effect was discovered, because I remember, from a Swedish PWR in which the effects of sludge on the strainers were much bigger than expected. I think that's the history.

Years ago there was an event. I think it was a Swedish PWR. I think this is when the thin bed effect was discovered. It was a surprise and turned out the dirt in the suppression pool was enough to clog the strainer.

MS. SCHLASEMAN: Not without having the fiber.

DR. WALLIS: Well, it did.

MS. SCHLASEMAN: I mean, you have to have fiber -

DR. WALLIS: It happened in the plant.

MS. SCHLASEMAN: - for the interstices -

DR. WALLIS: It happened in the plant.

MS. SCHLASEMAN: Well, right. But they had fiber.

MEMBER STETKAR: But it's Barseback by fibrous insulation.

MR. HEAD: You have to rip the insulation apart. A lot of it.

DR. WALLIS: So, the fibers came in as well with the sludge.

MR. HEAD: Yes.

MS. SCHLASEMAN: The fiber creates a mat, and then the interstices are blocked by the particulate and because the sludge by itself is particulate and it just passes through the strainers.

DR. WALLIS: So, examination of what was on the strainers revealed that fibers are built in.

MR. HEAD: Yes.

MS. SCHLASEMAN: Yes.

DR. WALLIS: I'm trying to remember.

MS. SCHLASEMAN: That's actually in our DCD. There's discussion about Barseback, and then Perry.

DR. WALLIS: But the sludge certainly played a role at Barseback.

MS. SCHLASEMAN: Oh, it will play a role in any of the fiber mats. I mean, that's - I mean, any particulate will block the interstices of -

DR. WALLIS: But it's not as bad as aluminum?

MS. SCHLASEMAN: I beg your pardon?

DR. WALLIS: It's not as bad as aluminum?

MS. SCHLASEMAN: What? The sludge?

DR. WALLIS: It's overwhelming, what I'm hearing.

MS. SCHLASEMAN: Well, the sludge is particulate. And the aluminum precipitate we have to assume is gelatinous.

DR. WALLIS: It's iron.

MS. SCHLASEMAN: I beg your pardon?

DR. WALLIS: The sludge is iron oxide?

MS. SCHLASEMAN: Yes, yes. Basically, it's rust that came out of the suppression pool as opposed to rust that came out of the drywell and got -

CHAIRMAN ABDEL-KHALIK: You said this was validated by actual experience from the Japanese plant.

Did they actually also have a stainless steel suppression pool?

MS. SCHLASEMAN: Yes, they have a stainless steel suppression pool.

CHAIRMAN ABDEL-KHALIK: And yet they had - they still had that much -

MS. SCHLASEMAN: No, they had less than that much. It's about the URG value.

CHAIRMAN ABDEL-KHALIK: Where does this number come from?

MS. SCHLASEMAN: This comes from the

Utility Resolution Guidance. So, this is a mid-`90s developed number by the BWR Owners Group. And what the reference Japanese plant in the strainer sizing evaluation did, is they went back and used these numbers. And then we re-validated whether or not we agreed that these numbers were applicable for us.

MR. HEAD: But for licensing purposes, we didn't see any reason to make it any smaller.

MS. SCHLASEMAN: Right.

MEMBER ARMIJO: The Japanese plant data was at, you know, fifty pounds of sludge. That seems like a lot for a stainless steel system.

MS. SCHLASEMAN: I have the - well, the sludge may also include dirt. I mean, I don't know how to define that.

That is the particulate quantity that they identified in their report as coming out of the suppression pool cleanup system.

And I have the TEPCO report with me. It's in my bag. I could show it to you on the break. I probably could run and get it, but - I don't remember the exact number, but we concluded that we were - this was a bounding number. So, this is what we used.

CHAIRMAN ABDEL-KHALIK: Is there a specified frequency by which the suppression pool is cleaned?

MS. SCHLASEMAN: Each outage. It's during the refueling outages was the frequency they were doing. And I believe that's what we committed to do too.

MR. TOMKINS: Right. We committed, but the cleanup system runs -

MS. SCHLASEMAN: Theirs doesn't.

MR. TOMKINS: Can run frequently.

MS. SCHLASEMAN: Yes, theirs does not, but they do it each refueling outage.

CHAIRMAN ABDEL-KHALIK: And that's what STP has committed to in tech specs?

MR. HEAD: I believe so. We have a cleanup system, yes. Oh, yes.

MR. TOMKINS: Well, we have a cleanup -

MS. SCHLASEMAN: Not in tech specs.

MR. HEAD: But we have a cleanup system that is -

MS. SCHLASEMAN: Oh, we have a system, and we have a suppression pool cleanliness program. And the frequencies are specified in the program.

MR. HEAD: So, we feel for many reasons, these are bounding values. And our goal is to not have to debate that. It was really just to perform a test. And if the test passed, then -

CHAIRMAN ABDEL-KHALIK: I understand.

DR. WALLIS: So, should we claim that having more produces more of a pressure drop?

With the pressure drop, some pressure drop results were normal as having fewer particles gives higher pressure drop.

MS. SCHLASEMAN: I think that's if you have RMI and you have a type of material that builds up an extra - a secondary filter, if you will.

DR. WALLIS: I don't think that RMI has anything to do with those types.

MR. ANDREYCHEK: Dr. Wallis, I just did a quick back-of-the-envelope calculation here. If we take the one cubic feet of fiber and a number of, say, a hundred square feet of strainer area, we're talking about 0.001 inches of -

DR. WALLIS: That's too small.

MR. ANDREYCHEK: Yes.

DR. WALLIS: That's too - your number is too small.

MR. ANDREYCHEK: Sorry. 0.01 inches of fiber.

DR. WALLIS: That's right. That's right. So, it seems very small.

MR. ANDREYCHEK: Yes, it is very small. And I think at that thickness we're looking - and the assumption again, and it is an assumption, it's uniformly distributed over all the surface area of the strainers, were well below what we would expect to get -

DR. WALLIS: Just give me the evidence. I mean, how thin does it have to be before it doesn't produce any effect?

MR. ANDREYCHEK: Okay.

DR. WALLIS: Because we have this thin bed thing.

MR. ANDREYCHEK: I understand. Okay.

MS. SCHLASEMAN: The thin bed effects, I can run over and get the report, but it's considerably more than 0.01 inches.

DR. WALLIS: It's a magic number which makes no sense in that report.

MS. SCHLASEMAN: It was -

DR. WALLIS: No one has really studied thin bed effect with any quantitative understanding.

MS. SCHLASEMAN: Well -

DR. WALLIS: It does seem very, very, very thin. I agree.

MS. SCHLASEMAN: And because it is so thin if you uniformly distribute it, it's our assumption that it all is going to flow through the holes because there's just not enough material for the fibers to lace together and form a bed.

So, that's why we're postulating it all goes through the strainers if it's truly just destroyed fibrous insulation. So, we take no credit for it being stopped by the strainers.

And as you pointed out several minutes ago, basically our strainers, all they do is they stop the RMI. I mean, that's - we believe that all of that material will pass through the strainers, except for the RMI which physically -

DR. WALLIS: So, you think that the ten mils is not enough to block the strainer?

MS. SCHLASEMAN: I'm sorry. Say that again?

DR. WALLIS: Ten mils is not enough to cover a strainer? Ten mils of hairs in your bathtub drain -- compare it with something you know. Doesn't take many fibers to have an affect on a drain in a household.

So, you've got to be quantitative about it. You've got to be -

CHAIRMAN ABDEL-KHALIK: What's the diameter of the fiber compared to ten mils?

MS. SCHLASEMAN: Tim, Nucon.

MR. ANDREYCHEK: Nucon is on the order of 0.07 inches diameter.

CHAIRMAN ABDEL-KHALIK: 0.07. 70 mils.

MR. ANDREYCHEK: 70 mils, approximately.

CHAIRMAN ABDEL-KHALIK: 70 mils. So, it's considerably larger than the average thickness of a uniformly distributed bed.

MR. ANDREYCHEK: Yes.

CHAIRMAN ABDEL-KHALIK: So, I just can't see it becoming an effect if the thickness -

DR. WALLIS: 70 mils?

MR. ANDREYCHEK: 0.07 fiberglass.

CHAIRMAN ABDEL-KHALIK: That seems too big.

MR. ANDREYCHEK: Diameter.

CHAIRMAN ABDEL-KHALIK: That's one-and-three-quarter millimeters.

DR. WALLIS: But it's not fiberglass. The stuff is blue jean dust. That's why you've got to test the real stuff. This argument is bogus because the latent debris is not fiberglass.

MEMBER BROWN: It might be Dockers. You never know if they're wearing blue jeans or Dockers.

MEMBER BLEY: PC dust.

MEMBER BROWN: Yes, exactly.

CHAIRMAN ABDEL-KHALIK: Let's keep this in focus, please.

MS. SCHLASEMAN: May I make one other comment about - the ABWR containment is extremely small. And you only go into it when you're on an outage. It's inerted. I mean, it's different than a PWR containment.

And as far as the quantities and the human access to the space, we believe we're in a very different situation from the PWR containment.

So, that's another reason why we believe that the latent fiber of one cubic foot - and we are using fines, because that's something that we know how to grind it up and test it for the downstream fuel effects test.

But that is a conservative number for an ABWR containment that is only accessed by humans on refueling outages in full PCs and hairnets and everything else. I mean, it just doesn't have humans in blue jeans running around -

DR. WALLIS: That's a good argument.

MS. SCHLASEMAN: - all the time.

DR. WALLIS: That's a good argument. And it would be really buttressed if you had - you probably have data from BWR containment showing very much less latent fiber.

MS. SCHLASEMAN: Well, we couldn't come up with any. I mean, the -

DR. WALLIS: We have data from PWR containments, because the NRC showed it to us.

MS. SCHLASEMAN: Right.

DR. WALLIS: So, if you can base it on something other than an assumption - your arguments probably are very good, but they're all so qualitative.

MS. SCHLASEMAN: I think our problem, Dr. Wallis, is that the BWRs went through this the first time 15 years ago. And the Utility Resolution Guideline at that time, and I was part of the Owners Group Subcommittee on that at the time, the concept of latent fiber wasn't a concept.

And so, BWRs have not specifically as an owners group, addressed that and made that argument to NRC about how different we are from a human access standpoint and fiber and latent fiber and what's appropriate for a BWR versus a PWR.

What we've done at South Texas because we're ahead of the curve because we're having to address GSI-191 before the operating US BWRs, they're getting through that now, but we're ahead of them, that that is, you know, we use the TEPCO experience.

And TEPCO experience is if clean, they couldn't come up with anything except for bits of rope. And so, we're using their experience.

MR. ANDREYCHEK: Also if I may, Dr. Wallis, you are correct. There has been a fair - every PWR has undergone a walk-down both for fibrous insulation and other sources, coatings and latent debris.

The BWRs are just recently performing similar type walk-downs to look for latent debris, and that information has not yet been available to anyone, to the best of my knowledge, at this point.

It may be coming available to NRC shortly, but certainly is not generally available. And I agree with Caroline. Using the Japanese experience is probably the best information that we have available to us that can be used and related back to what kind of latent debris might be inside the ABWR containments.

CHAIRMAN ABDEL-KHALIK: Were there any surprises in the results of the walk-downs of BWRs?

MR. ANDREYCHEK: Of which? Ps or Bs?

CHAIRMAN ABDEL-KHALIK: Bs.

MR. ANDREYCHEK: Couldn't tell you. I have not been a part of that.

CHAIRMAN ABDEL-KHALIK: Okay.

MR. HEAD: You mean in the domestic?

CHAIRMAN ABDEL-KHALIK: Yes.

MEMBER ARMIJO: Now, is there another source of zinc in the - now, you don't have a recirc piping system, but do you in the - do you plan to add zinc for dose reductions in other parts of the systems or not?

MS. SCHLASEMAN: We're hydrogen water chemistry at this point.

MEMBER ARMIJO: Hydrogen water chemistry, you know, you'll have some noble metals in hydrogen, but do you add zinc in this plant or not?

MR. HEAD: I don't know what our plans are with respect to that, but I -

MEMBER ARMIJO: Because if you did, you'd be accumulating zinc -

MR. HEAD: Right.

MEMBER ARMIJO: - on surfaces, and would that be released and that included in your assumption?

MS. SCHLASEMAN: It is not included in our assumptions. I can tell you that.

MR. HEAD: It's not in the assumption.

MS. SCHLASEMAN: And I don't think it's in our -

MEMBER ARMIJO: You want to check on that.

MS. SCHLASEMAN: I don't think it's in our licensing basis right now.

MEMBER ARMIJO: It may not be, because what are you going to reduce doses on if you don't have recirc pipes?

CHAIRMAN ABDEL-KHALIK: So, the question is whether zinc addition is part of the water chemistry.

MEMBER ARMIJO: right. And does it have any influence on debris loading. Because over the years you'd add a lot of zinc, and it will accumulate on surfaces and everything else and -

MS. SCHLASEMAN: Right. And our breaks are feedwater or main steam. So, it would be - I mean, it's all primary containment system - primary coolant. I agree with you. We have not looked at that.

CHAIRMAN ABDEL-KHALIK: I think that's an important question to see how much is there.

MR. HEAD: We'll take that as an action item and we'll go back to it.

CHAIRMAN ABDEL-KHALIK: Because you don't want this limit to preclude the possibility of doing zinc addition in the future.

MS. SCHLASEMAN: Right. We'll have to go

back and check that.

CHAIRMAN ABDEL-KHALIK: Okay.

MS. SCHLASEMAN: So, then from this slide, I'm going to back up to Slide 31, and the impact on strainers, our position is that our total corrosion products with chemical effects is less than 60 pounds. And our fiber quantity are very small relative to our strainer sizes.

And, therefore, we do not believe that we needed to do an additional strainer head loss testing in addition to what had already been done to size the strainers for the reference Japanese plant.

But we have commitment to downstream effects on fuel testing, and that's the next part of the presentation.

DR. WALLIS: Just as a part of getting this accurate, I mean, the number quoted for the thickness of the fiberglass was much too thick. I think we just need to get the right number.

CHAIRMAN ABDEL-KHALIK: What was that again? I'm sorry.

DR. WALLIS: I think someone said 70 mils for fiberglass. 70 mils is a couple of sheets of paper. I mean, it's quite a few sheets of paper.

CHAIRMAN ABDEL-KHALIK: Right. It's one-and-three-quarter millimeters. That's pretty thick.

DR. WALLIS: Never going to be anything like as thick because the fiberglass is much finer than that.

MR. ANDREYCHEK: I will confirm the number. The correct number.

MR. HEAD: And so, the number is the one cubic foot coated across all of the strainer?

DR. WALLIS: I'd say about ten mils or something like that.

MR. HEAD: Is that what we're going to confirm?

CHAIRMAN ABDEL-KHALIK: Compared to the diameter of the fiber.

DR. WALLIS: It would be nice if you'd do that right up front instead of going through hours of discussion of stuff which is irrelevant.

I'm sorry. I mean, it seems if the bottom line is that you can only cover so many mils of the strainer, just then we'll do the whole thing from the beginning instead of going through all this stuff -

MR. HEAD: But you'd have to know --

DR. WALLIS: - which we have to question because -

MR. HEAD: I mean, a lot of this

discussion, though, has been focused on the ultimate testing of the fuel.

DR. WALLIS: That's okay for that purpose.

MR. HEAD: Okay. And so, that's the preview to the -

DR. WALLIS: Okay.

MR. HEAD: - fuel testing that we then will get into much more interesting discussions.

DR. WALLIS: Thank you. Thank you. I'm just looking for the convincing argument for the issue we're talking about now.

MR. HEAD: Well, our goal is from the selection of the ABWR including decisions we've made at the site, has been to make the strainers essentially irrelevant.

And I believe we've done that. And now all that's now going to end up on the fuel. And so, that's where we'll be getting after lunch, I'm sure.

MS. SCHLASEMAN: Except for most of the RMI.

MR. HEAD: Except for the RMI. Yes, of course.

CHAIRMAN ABDEL-KHALIK: The one follow-up item that you will --

MR. HEAD: Yes, right.

CHAIRMAN ABDEL-KHALIK: - is the diameter of the fiber vis-a-vis the thickness of the bed if it were uniformly distributed to one cubic foot.

MR. ANDREYCHEK: We'll confirm the thickness of the fiber and we'll also reconfirm the thickness of the resulting bed. That's open there, yes.

CHAIRMAN ABDEL-KHALIK: Thank you.

MS. SCHLASEMAN: And this is of the Nucon that we don't have in our plant. This is the diameter of the Nucon fibers that we don't have.

MR. ANDREYCHEK: That's correct.

MS. SCHLASEMAN: Okay. Good.

CHAIRMAN ABDEL-KHALIK: Okay. I'm just wondering if this is a good time to break for lunch before we get back.

MR. HEAD: Because now the potential for proprietary -

CHAIRMAN ABDEL-KHALIK: Right. So, we will break for lunch until -

MR. HEAD: Mr. Chairman.

CHAIRMAN ABDEL-KHALIK: Yes, sir.

MR. HEAD: I hate to interrupt, but could we do an action item recap for this first portion?

CHAIRMAN ABDEL-KHALIK: Yes, sir.

MR. HEAD: I think that would be important, because we're going to do some stuff at the break, I think.

CHAIRMAN ABDEL-KHALIK: Okay.

MR. HEAD: So, I'm going to ask, I guess, first of all, you know, Jim, we had said Action Item 46 we believe is closed. That was early on in your discussion about the pH.

MS. SCHLASEMAN: Oh, the boron concentration?

MR. HEAD: Boron concentration.

CHAIRMAN ABDEL-KHALIK: Boron concentration.

MR. HEAD: I'm just going to ask if - I believe we've answered the question, and I believe that the issue behind it was we made moot by the way we're -

Then the action item we're going to on the break, provide the details of the vacuum breakers for a typical - we're going to accept an action item on the loads, how the loads are calculated on the strainers that we believe you'll be able to find. But if not, then we'll come back at a future meeting and - probably in Chapter 3. I'm sorry.

Yes, in Chapter 3 we'll have that prepared as part of that discussion, if necessary.

Caroline, do you want to say anything?

MS. SCHLASEMAN: I guess I just - I wasn't clear. Did Dr. Wallis want to see the design specification that actually lays out what the loads are, I mean, actually has response spectra and the drag loads and the - I mean, that's Chapter 3 material, actually, but -

MR. HEAD: Right. And so, when we do Chapter 3 next, we'd be prepared to discuss that in case there were any follow-up questions.

CHAIRMAN ABDEL-KHALIK: Right.

MR. HEAD: Okay?

MS. SCHLASEMAN: Okay.

CHAIRMAN ABDEL-KHALIK: There's another action item which is the analysis performed for the Japanese reference plant with respect to the thin bed effects bounds the STP case.

MS. SCHLASEMAN: That gets back to the thickness of the coating.

CHAIRMAN ABDEL-KHALIK: Yes. I mean, it's all -

MR. HEAD: I think that's related to -

CHAIRMAN ABDEL-KHALIK: I mean, if you can do this comparison and show us that a thin bed will not really form at all in this case -

MS. SCHLASEMAN: Right, right. Okay.

CHAIRMAN ABDEL-KHALIK: - then, you know.

MR. HEAD: Right. And then I captured one that attempted to address, I guess, there is a question about, you know, where there are surrogate for zinc, the aluminum hydroxide is the worst, you know, is an appropriately conservative assumption. And I believe you have a question on that.

So, I think that's an action item for us to contemplate and -

CHAIRMAN ABDEL-KHALIK: Right. Assuming it to be as bad as the aluminum, right.

MR. HEAD: Right. I captured something that hopefully we'll discuss at break regarding the actual sludge the Japanese encountered that I think Caroline will show us.

MS. SCHLASEMAN: Oh, did you want to see the TEPCO report?

MEMBER ARMIJO: In the sludge, I asked if it was iron oxide. And you said -

MS. SCHLASEMAN: Yes.

MEMBER ARMIJO: - you thought it was, but we didn't know for sure.

MS. SCHLASEMAN: Well -

MEMBER ARMIJO: And the other assumption you said the sludge itself is independent from all these other chemical phenomenon going on. It's just some inert particulate material that doesn't get involved in the downstream effects.

Well, I don't know. Maybe I'm prejudging, you know, whether this - there's so many chemical forms and materials in here. I don't know what's involved in the overall downstream effect and what is not.

I know RMI is not, because it gets caught at the strainer. That's the only thing that isn't -

MS. SCHLASEMAN: Well, four percent. Four percent goes through. Four percent of it goes through.

MEMBER ARMIJO: Some of the shards get through. Okay.

MS. SCHLASEMAN: 4.3 of it goes through. 4.3 percent goes through.

MEMBER ARMIJO: But sludge is not a chemical. It's - is it iron oxide? Is it dirt?

MS. SCHLASEMAN: Yes, it's a particulate iron oxide.

MEMBER ARMIJO: Okay.

MS. SCHLASEMAN: I mean, that's how the URG defined it. And that's what we do. Like I said, we do have - our pool is stainless steel lined. And that was - that number came from carbon steel toruses. Some of - one of which at least is not independent.

And so - and the number is actually too low for them, but the - it's the URG-defined value. And then we've gone ahead and for test purposes, we're saying that's all particulate.

And then additionally we have the gelatinous aluminum oxy-hydroxide to cover our aluminum corrosion products and our zinc corrosion products. That's how those all stack up.

MR. HEAD: I have two more. One, zinc addition as part of water chemistry.

MEMBER STETKAR: I think, Scott, I was doing a little homework here. And in the original DCD, it says that provisions are available for zinc addition. That isn't refuted in anything that I can find in your FSAR.

MR. HEAD: How that quantity compares to, you know, what we got here, I think, is what's going to be important. And whether it would actually -

MEMBER ARMIJO: Get involved.

MR. HEAD: What will happen to it? Does it actually know that an accident's just occurred and I need to go down to the suppression pool or not?

I suspect not, but, you know, we'll -

MEMBER ARMIJO: It's not going to be quiet inside the core.

MR. HEAD: Right. And then finally a calc we're going to do with regard to diameter of the fiber versus the thickness of the thin bed.

So, some of that we'll either attempt to address during lunch or, if not, possibly tomorrow or, if not, then -

CHAIRMAN ABDEL-KHALIK: You've captured the ones from this morning -

MR. HEAD: Yes, sir.

CHAIRMAN ABDEL-KHALIK: - with regard to the NPSH calculation for the RCIC pump?

MR. HEAD: Right.

CHAIRMAN ABDEL-KHALIK: And the one with regard to the lubrication, the quality of the coolant and the possible plugging of the filter?

MR. HEAD: Right. So, the 77 degrees versus a hundred in NPSH discussion, and the RCIC, is the two I have.

And we had one for a moment regarding Part 21, and I -

CHAIRMAN ABDEL-KHALIK: And that's

resolved.

MR. HEAD: Yes, sir.

CHAIRMAN ABDEL-KHALIK: Okay. All right. At this time, we'll break for lunch. We will reconvene at quarter to 1:00.

(Whereupon, the proceedings went off the record at 11:40 a.m. and resumed at 12:45 p.m.)

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

12:45 p.m.

CHAIRMAN ABDEL-KHALIK: I guess we would like to go into a closed session at this time. So, at this time we will switch to a closed session, if the reporter can note that. And we'll make sure that only people who have the need to know and are allowed to be here, are here.

MS. BANERJEE: Yes.

CHAIRMAN ABDEL-KHALIK: All right. Thank you.

(Whereupon, the proceedings went into a closed session at 12:45 p.m. and went back on the record in open session at 3:03 p.m.)

CHAIRMAN ABDEL-KHALIK: So, we're now in an open session, please. And we will move on to Slide Number 53.

MR. VAN HALTERN: Slide 54.

CHAIRMAN ABDEL-KHALIK: Okay.

MR. VAN HALTERN: Marty Van Haltern, the primary presenter on this as well.

For South Texas 3 and 4 for the ABWR, the long-term cooling acceptance criteria is we want to make sure that the core remains covered flooded with at least a two-phase mixture so we have no long-term heatup effects.

The heat from the core, is transferred to the ultimate heat sink and transferred through the RHR heat exchangers to the reactor building cooling water system, and then from the cooling water system to the reactor service water system.

And then we have for each service water train, we have a dedicated basin and cooling towers with two cells per train.

The criteria for the long-term cooling and containment analysis, is that the ultimate heat sink maintains that service water temperature less than equal to 35 degrees C, which is 95 degrees F.

CHAIRMAN ABDEL-KHALIK: It's the other way around, you know. You're not going to maintain the service water below 35 degree. You mean, you know, you can live with service water temperature up to 35 degrees and maintain adequate long-term cooling.

MR. VAN HALTERN: Okay. And then we -

DR. WALLIS: So, what happens after 30 days?

MR. HEAD: The 30 days has always been there - you presume that you would be doing something and be able to - like refill the ultimate heat sink or -

DR. WALLIS: So, you're bringing up a fire truck or something or -

MR. HEAD: Depending on the scenario, we may be, you know, offloading the core by then. There's a lot of stuff that - 30 days is a long time to -

MR. VAN HALTERN: It is the criteria for assuring that you don't require makeup. So, it provides some level of conservatism.

DR. WALLIS: But after an accident of the core failure, you have to keep it cool forever or for a very long time.

MR. VAN HALTERN: Correct. Some of the key aspects of the ABWR design are the large pipes connect to the vessel above the core. Unlike the BWR where with a recirc line break you could - your downcomer level, maximum level is about two-thirds core height. Here, you've flooded up above the core.

The PCT in the large-break analyses, occurs very early, approximately five seconds, due to essentially going through a boiling transition as the pumps coast down.

The core remains cooled by two-phase or sub-cooled water throughout. And the clad temperature maintains well below the initial PCT.

This is a figure of the reactor pressure vessel showing the main steam line, the main feed line. These are well above the top of the fuel. The RHR or low-pressure flooder also is above the (indicating) and Jim's got that. And the sparger you see above the core, is the high-pressure core flooder sparger.

There is a drain line, a two-inch drain line in the bottom of the vessel.

DR. WALLIS: So, there's a really big space below the core?

MR. VAN HALTERN: The lower plenum. Absolutely.

DR. WALLIS: Is that bigger than the usual BWR?

MR. VAN HALTERN: No, you have to be able to withdraw the control blades. So, you have to have space for that.

MR. JAIN: We don't know how -

DR. WALLIS: It's pretty.

MR. VAN HALTERN: For long-term cooling, of course you want to maintain a continuous ECCS injection to keep things flooded.

The minimum contingent if you look at a LOCA with a single failure, you should have at least one high-pressure core flooder providing flow inside the shroud above the core for all of the assumed breaks, except for if I break that high-pressure core flooder line. And then I take a failure of the other break.

DR. WALLIS: What are the pipes that are shown above the core?

MR. VAN HALTERN: That's the sparger.

So, if I break one of those lines and I assume the failure in the other pump or the other train, I would have no flow going above -

DR. WALLIS: So, it's like a core spray, except it's not designed to have complete coverage of the core; is that it? You have water up there.

MR. VAN HALTERN: Correct.

It will have at least two low-pressure flooders that inject outside the shroud. One of the trains injects into a feed line, and the other two into the spargers that are in the downcomer area. And, again, each of those is about 4200 gpm.

Now, in the long term, you may align one of the three low-pressure flooders to a drywell or wetwell spray.

And this is just a simple diagram of the ECCS. I did not mention the RCIC for long-term cooling because for - particularly for large breaks as you depressurize, you won't have sufficient steam.

MEMBER CORRADINI: Just out of curiosity because I've been looking for it and I can't quite find it, this little cartoon seems to show the RCIC suction direction from the bottom of the suppression pool.

Is that -

MR. VAN HALTERN: That's a cartoon.

MEMBER CORRADINI: It's just a cartoon.

MR. VAN HALTERN: If you remember the plain view that Caroline showed of the different -

MEMBER CORRADINI: Yes, but that didn't show elevations.

MR. VAN HALTERN: Yes.

MEMBER CORRADINI: I haven't seen an elevation before that showed really where those suction lines were. So, I was just curious. Thanks.

MR. VAN HALTERN: I'm sure you folks have seen this before as well. Just to look at the ECCS capability, the lower line is the boiloff rate for the core. And, again, assuming the 71 standard and 20 percent.

One high-pressure core flooder would provide about 3200 gpm. One low-pressure flooder would provide about 4200. So, a combined train of low pressure and high pressure is about 7400 gpm. That's one train. That's the bravo or Charlie train. So, you have a, you know, an excess of water relative to core boiloff.

Now, what is the end state, so to speak? I mean -

DR. WALLIS: Why do you have so much more water than a core boiloff?

MR. VAN HALTERN: That's the design. The low-pressure flooders are designed for multiple tasks, including RHR, you know, shutdown cooling, suppression pool cooling. They also can supplement spent fuel pool cooling. So, they have large capacities.

MR. JAIN: And, Dr. Wallis, the ECCS system is really designed for initial fill of the system after a blowdown. And once that has happened, all those pumps are just now too big essentially for that.

MR. VAN HALTERN: Essentially one of the features that - you're going to put in a lot of water to keep the core cool and the excess will spill out.

For small breaks, if you can reestablish normal level in the vessel, the operators at some point will transition to shutdown cooling in long term. And then there would be inventory makeup from the suppression pool as needed.

And you have the high-pressure core flooder available to do that if you don't want to realign the low-pressure flooder.

For any other breaks other than ones that you can reestablish level, you're going to recirc from the suppression pool. The heat removal is going to be through at least two RHR heat exchangers. And, again, that will take the heat out to the reactor cooling water and the service water to the ultimate heat sink.

For a LOCA, your decay heat is ultimately discharged to the suppression pool, and that cooling is automatically initiated. The RHR cooling by the reactor cooling water will start as soon as the pumps start.

I think you've seen the containment analysis previously and we've had some discussion earlier. In the containment analysis, they did not start that cooling until 30 minutes.

So, there is a conservatism in that assumption. And even with that 30-minute delay, the suppression pool temperature stays below a hundred degrees C or 212 degrees F.

MEMBER ARMIJO: But this is a follow-up item.

MR. VAN HALTERN: Right. Correct. For the

RCIC.

For the - again, for long-term cooling, we're not looking at RCIC. High-pressure core flooder and the low -pressure flooders, those NPSH calculations don't credit the accident over-pressure, are based on the hundred degrees C, and are based on the loading on the strainer to maximize the head loss across the strainer.

DR. WALLIS: How do you determine that head loss? It's by experiment?

MR. VAN HALTERN: I'll defer to Caroline on that.

MS. SCHLASEMAN: This is Caroline Schlaseman. The strainer head loss is done in accordance with the URG methodology. And there's an analytical correlation. And then the analytical correlation is confirmed by supplemental testing, confirmatory testing.

DR. WALLIS: Well, I'm confused now. Isn't this where you told us there wasn't any pressure drop because it was such a small amount of stuff?

MS. SCHLASEMAN: It's going to be -

DR. WALLIS: So, what are you going to use for the value if there isn't any?

MS. SCHLASEMAN: The head loss will be

pretty darn close to zero.

DR. WALLIS: But you still - if you need to get one, you need to have some way of calculating something other than zero.

So, you say no new testing is needed. Do you have enough information to calculate that, first of all?

MS. SCHLASEMAN: Based on the RMI loading, yes.

DR. WALLIS: On the RMI loading.

MS. SCHLASEMAN: Right.

DR. WALLIS: And you ignore the other stuff?

MS. SCHLASEMAN: No, no. The correlation will also include the particulates. It will include the particulates and the RMI loading.

What we were saying was we didn't need to do an additional chemical effects test as a separate additional item.

DR. WALLIS: Okay.

MS. SCHLASEMAN: Because we don't have any significant quantity of fiber.

DR. WALLIS: And this comes from some Japanese tests or something?

MS. SCHLASEMAN: It was testing done at CCI for the Japanese plant. That is correct.

DR. WALLIS: Okay.

MEMBER CORRADINI: And, again, that last bullet, there's still a question in my mind, anyway, about RCIC.

MR. VAN HALTERN: Absolutely. I understand there's a question on RCIC. But for long-term cooling, we're not crediting -

MEMBER CORRADINI: I got high-pressure core flooder and I got RHR Those I understand.

MR. VAN HALTERN: Excellent. Okay. Keep going.

DR. WALLIS: Going to face the question of possible flashing in the strainer if it's a hundred degrees C.

MR. VAN HALTERN: Submerged by a fairly deep -

DR. WALLIS: By a meter or something?

MR. VAN HALTERN: No, no.

MR. JAIN: Five or seven. I think the water level is pretty high.

DR. WALLIS: So, you're going to show that the pressure drop is so low it doesn't -

MR. HEAD: Submergence will be part of our answer on all the other questions also.

MR. VAN HALTERN: Yes. These strainers are low in the suppression pool and our normal level is -

DR. WALLIS: Balanced by quantitative analysis, not by saying something is big and small, but by numbers.

MR. VAN HALTERN: Right.

DR. WALLIS: It's probably all right. It just seems that it - but we could actually compare some numbers.

MR. VAN HALTERN: Yes. Understood. Keep going.

So, I'm under the impression that you have looked at the service water in the basin. Some of this we'll be able to go through very quickly.

The service water is supplied by dedicated basins that are kept cooled by cooling towers. And the calculations and the analysis for those basins meet the requirement for 30-day capability.

Looking at the long-term, the containment response, we have both - the previous plots that were in the WCAP, only went out to 50,000 seconds. We extended it out to past two days, which is 200,000 seconds.

There really is nothing in the design basis that would require a change in configuration.

I think there's nothing in operator actions which would change the configuration.

So, your long-term drywell pressure will continue to decrease and - with decay heat. And as you - and if you go to the next one, the suppression pool temperature also again as you just continue to move decay heat out and the decay heat decreases, your temperatures will continue to go down.

MR. JAIN: Importantly, there is no change in liner. It's the same equipment we continue to use.

DR. WALLIS: But here it does go up to boiling. There's nothing -

MR. JAIN: It comes to -

MR. VAN HALTERN: Just below.

DR. WALLIS: Then where does this 77 degrees C come in?

MR. JAIN: That's being investigated. We don't have an answer for that yet.

DR. WALLIS: How long do we have to wait until you get to that?

MR. JAIN: It's about 600 seconds by the time you get to 77 degrees.

So, this scale, you cannot read it. It's about 600 seconds.

MR. VAN HALTERN: For this particular case, this is a steam line break. And so, you're not going to have RCIC anyway.

DR. WALLIS: Okay.

MEMBER CORRADINI: Right. RCIC is a small-break -

MR. VAN HALTERN: It is a small-break -

DR. WALLIS: So, the slide should say what it's for, right? It's for a steam line break?

MR. VAN HALTERN: This is for a steam line. These are the limiting cases from the WCAP.

And just restating, there's no real change in configuration. Your decay heat will continue to go down. And you move the heat into the ultimate heat sin, and again repeating the less than 35 degrees C and no makeup.

DR. WALLIS: Maintains the temperature? This is a strange thing.

MR. VAN HALTERN: Less than 35 degrees C.

DR. WALLIS: Okay. I understand. Okay.

This is the cooling tower and stuff that does that?

MR. VAN HALTERN: That's correct.

DR. WALLIS: Okay.

MR. VAN HALTERN: And I'll briefly go through what's in the COLA for that as well. So, the calculations that are in the COLA for the performance of the ultimate heat sink, they're based on assumed reactor power of 112 percent of the license condition.

There are a couple of calculations performed. One of them is to look at the maximum one-day basin temperature based on the worst meteorological conditions. And that one got to a max temperature of 33.1 degrees C or 91.6 degrees F.

DR. WALLIS: Wow.

MR. VAN HALTERN: And that's the first day of the event.

There are also calculations looking at the evaporation and the inventory loss over a 30-day period. And so, they looked at meteorological conditions, the worst meteorological conditions for a 30-day period with respect to humidity and temperature to determine maximum evaporation rate.

They looked at forced evaporation in the cooling towers, natural evaporation from the basin, seepage out of the basin, drift fro the cooling towers. Also included a 30-minute leak on one of the pipes, assuming that you could isolate it in 30 minutes.

And from that, determined what the decrease in the basin inventory was and made sure that you had sufficient inventory to support cooling.

And I think following this, I have a plot of the 30-day temperature of the basin using those meteorological conditions. And that's why especially towards the end, you see some variations and the temperature stays below the 35 degrees C.

MEMBER ARMIJO: How deep is your basin?

MR. VAN HALTERN: Let's see. The basin - we looked at that.

MEMBER ARMIJO: It has to be pretty shallow to get -

MR. VAN HALTERN: Oh, at the end. At the end, yes.

MEMBER ARMIJO: There's not much water left.

MR. VAN HALTERN: It's like three meters above the center line of the -

MEMBER STETKAR: The question was for the initial temperature.

MEMBER ARMIJO: Yes, for the initial - I found it hard to believe that you could get your basin up to 91 Fahrenheit.

MR. VAN HALTERN: Well, you start out pretty high.

MEMBER ARMIJO: So, that's the worst-case, right?

MR. VAN HALTERN: Right.

MEMBER ARMIJO: That's a worst-case. So, it must be a pretty shallow basin to get that much water up to that high a temperature.

MR. HEAD: We don't have - I don't think it's shallow. I think the volume is -

MR. VAN HALTERN: There's a lot of volume that's lost. Hold on a second.

MEMBER ARMIJO: I was born and raised in Texas, and even our swimming pools didn't get that hot. And they were small volumes, not too deep.

MR. VAN HALTERN: This assumes that the basin starts at 32.2 degrees C.

MEMBER BROWN: That's the initial temperature?

MR. VAN HALTERN: That's the initial temperature. That's the assumption times zero.

(Simultaneous speakers.)

MEMBER BROWN: so, the change is about one degree then. 32 to 33.

MR. VAN HALTERN: Right. For that worst one day, right. I'm trying to see if I have any -

DR. WALLIS: Okay. We're on the cooling tower, and that's what brings down the temperature.

MR. VAN HALTERN: That's correct. Okay. Keep going.

It has an adequate water supply. the initial basin water mass is about 60.9 million kilograms.

And at the end of 30 days with no makeup, you're down to about less than three million kilograms.

MEMBER BROWN: 60, you said?

MR. VAN HALTERN: 60.9 million.

DR. WALLIS: That has gone down a lot.

MR. VAN HALTERN: That's correct. 30 days.

MR. JAIN: To answer your question, the initial basin water level is 19.28 meters above the basin floor. So, the height is 19 meters.

MR. VAN HALTERN: So, 20 meters times three. 60 feet.

MEMBER ARMIJO: That's pretty deep.

MR. JAIN: It's a big basin.

DR. WALLIS: And it gets that hot all the way down to the bottom?

MEMBER ARMIJO: It's hard to believe that you could -

CHAIRMAN ABDEL-KHALIK: This is a simple energy-balanced calculation.

MR. VAN HALTERN: Yes, that's exactly correct.

DR. WALLIS: But it's very hard to get the bottom layer heated up. It's stable down there. The cold stays there.

MR. VAN HALTERN: Okay. Keep going.

Just to summarize, ABWR meets those requirements for core cooling, for containment integrity, ECCS NPSH given that we have the question on RCIC still. And, again, with no credit for containment accident over-pressure. So, in terms of long-term cooling, we meet those criteria.

CHAIRMAN ABDEL-KHALIK: Now, we didn't talk at all about gas accumulation.

MR. VAN HALTERN: That's coming.

DR. WALLIS: You don't know that until you've done the tests, right? Given that the test is satisfactory, it doesn't mean -

MR. VAN HALTERN: For the fuel? The fuel test -

DR. WALLIS: Doesn't meet the requirements for long-term core cooling until you've done the tests.

MR. JAIN: That is the fuel - the downstream effect on the fuel.

DR. WALLIS: Yes.

MR. JAIN: That is a correct statement.

DR. WALLIS: So, this statement will not be true for some years, right, or am I looking at something else here?

MR. VAN HALTERN: We have to get an acceptable fuel design to use it.

DR. WALLIS: Right.

MR. VAN HALTERN: So, the ABWR design, the plant design meets these criteria.

DR. WALLIS: But it will -

MR. VAN HALTERN: You're correct that that component needs to be tested and we need to make that component work.

DR. WALLIS: But it will be designed - it will meet the requirements.

MR. JAIN: Right. Exactly. And if we would - if necessary, we would have to change the fuel design or change the debris loading or whatever we have to do.

MR. HEAD: But we believe with the ABWR design and the actions we have taken with respect to minimizing zinc, aluminum, fiber and all the other actions we've taken, that we believe we have the licensing basis at this point in time.

We are going, obviously, to confirm that with whatever fuel that we test.

DR. WALLIS: And what's that based on? You made some calculation before you did the test and made some - you must have made some estimate to feel confident now.

MR. HEAD: We feel confident that based on removing as many of the challenges as possible, that we have a basis for the licensing of this plant with GE-7 fuel.

CHAIRMAN ABDEL-KHALIK: With the ratio of 4800, it's hard to believe that the test would not be successful.

DR. WALLIS: It's hard to believe it could ever happen. I mean, with the argument you use already, it's hard to believe that that big number is that big.

CHAIRMAN ABDEL-KHALIK: We'll ask the staff.

MR. HEAD: Jim.

MR. TOMKINS: Okay. We talked about some potential challenges to long-term cooling. There's debris impacts on strainer NPSH, downstream effects on fuel and -

CHAIRMAN ABDEL-KHALIK: What's strainer

NPSH?

MR. TOMKINS: That's the -

(Simultaneous speakers.)

MR. TOMKINS: Clogging of strainers. I mean, you know, you have to maintain NPSH for the inlet to the pumps.

And then ECCS gas accumulation is - I'll discuss that briefly, because that's another potential challenge.

STP 3 and 4 has some design features that address gas accumulation. I think everyone knows gas accumulation as plants have seen, that they can get gas building up in the discharge and suction lines of the ECCS systems.

STP 3 and 4 has fill and vents provided in these systems. Suction piping is below the minimum level of all the water sources. The strainers are designed to be continuously submerged. I think the minimum level you would see in the suppression pool is still well above the - where the strainers are.

And then ABWR has keep-fill equipment in each of the ECCS systems. RHR has a power-operated keep-fill system that can run to make sure if there's any leakage out of the discharge lines, that pump can replenish it.

The operation of that pump is actually indicated in the control room. And there is some kind of pressure indication as well in the control room. So, it's able to be monitored.

The other two systems, high-pressure core flooder and RCIC, they have keep-fill that's supplied by a direct connection to the condensate storage tank.

That's the design. But, really, the important thing is how you translate the design into how the plant is actually constructed.

And we have design controls in place that give guidance about how you set up the piping for - so your fill-in vents are in the right place.

And the other thing we have I think that's a plus, is that the - we're doing all of the ECCS piping design with three-dimensional modeling tools. So, we can actually see what the pipe looks like in the plant. We can see interferences prior - in design space, essentially.

Whereas the previous generation of plants, a lot of the - they weren't able to do that. And when people were out constructing the pipe, adjustments had to be made in the field. And with that adjustment in pipes, sometimes high-point vents that were supposedly high points, were no longer high points. So, I think we're in better stead with regard to that.

In terms of surveillance and monitoring, there's two tech specs that require us to maintain the systems kept full on a 31-day frequency. There's one for when you're operating, and there's one when you're shut down.

And then the industry - various industry groups are comprehensively looking at this gas accumulation. The NRC has issued a Generic Letter 2008-1. And they are actually looking at different - potentially some different tech specs.

NEI 09-10 has been issued, and that seems to large address Generic Letter 2008-1. And that will guide the procedures and the training that we put into the plant. And I think I have every - I think it's very likely we would fully adopt that guideline once the NRC accepts it and it's approved.

So, in terms of gas accumulation, most of the things that I think matter as far as gas accumulation, are things that we're doing in the future. So, I -

CHAIRMAN ABDEL-KHALIK: Is there an ITAAC to verify the piping layout?

MR. TOMKINS: There is an ITAAC to verify the piping layout. It might be a stretch to say that goes to the level of detail of verifying high-point vents and verifying gas.

We do not have a specific ITAAC on gas accumulation, but we do have a general arrangement ITAAC that says, for example, on the RHR keep-fill pump, that is in Tier 1. And so, that would be - certainly the presence of that pump would be verified through ITAAC.

CHAIRMAN ABDEL-KHALIK: So, how is the ITAAC going to be sort of verified that it's been met? Just walk-down, or are people actually going to do laser measurements and determine piping elevations?

MR. TOMKINS: Maybe Marty can address that, but I -

MR. VAN HALTERN: The ABWR design, the ITAAC were developed in 1990 - or were approved in 1997. There are a couple of ITAAC which look at the design of the system.

One is, as Jim mentioned, a functional walk-down. And that's more just function. Am I supposed to have a keep-fill pump, do I have the keep-fill pump? That type of thing.

There is DAC on piping, which is really driven to, you know, you have to design your piping according to ASME. You have to demonstrate you have the stress reports and that you've met all the ASME criteria.

But there is no ITAAC at least that I'm aware of, that looks at have we installed it with this slope because those designs were not available at the time.

What Jim mentioned is in the design of the plant, they're doing a 3-D model layout, and they are very aware of these issues and they are imposing, you know, that we'll have - horizontal lines have some slope and that you put the vents at the high points.

So, that will be done as part of the design and part of the construction. And the drawings will includes those limitations or those slopes.

I think Tom Daley may have some additional information on that perhaps.

MR. DALEY: Tom Daley, NINA STP 3 and 4. I'd just like to make a few comments.

We do have an aggressive 3-D model program. And that model was developed over the course of the design. During that time, there are three design reviews stationed at - scheduled at various points in the design development.

And each of those design reviews has a specified checklist for items that are reviewed during the course of that design review. And the last one which is done just before drawings or issued for construction, it specifically talks about checking piping slopes and high-point vents, that they're located at their appropriate locations.

That model then you push a button, basically, and it spits out the isometrics that are issued for construction. So, there's no - nothing lost in the translation from the model to the design.

Once it gets into the field, I think we've all had our lessons learned from the last time around. There's a very aggressive quality control program that signs off that the construction meets the design.

And then there is an ASME walk-down scheduled, basically a 7914, that does take configuration into consideration.

MEMBER BROWN: Do you have - as part of the quality control issue, when you - I understand the 3-D design and the nice specificities you have on where things are and everything else, but I'm asking this in relation to the program that I was in for a while.

We had a nondeviation-type approach to piping systems, as well as electrical cabling and everything else. But we actually specifically went and looked and checked actual dimensional locations to make sure that happened.

So, are these just done visually or if you find, I mean, some people out in the field just kind of run to suit, I'm close enough.

How do you really guarantee that you get the right flows?

MR. DALEY: Well, that ASME walk-down is detailed because it's done mostly from a stress standpoint. So, you do have to make sure your hangers are located in the correct position. But it does also cover configuration installation as well.

MEMBER BROWN: Are there reference points to make measurements to that -

MR. DALEY: Oh, sure.

MEMBER BROWN: - that they have reference to?

MR. DALEY: yes.

MEMBER BROWN: And that comes as part of the drawing package and the little plates are put in or whatever?

MR. DALEY: There's a regular program that addresses this and it does have those aspects to it.

MEMBER BROWN: Okay. Thank you.

MR. TOMKINS: That's all I have.

MR. HEAD: Okay. I'm just going to quickly go through overall conclusions. And then at the end of this, I was thinking maybe before the NRC came up that we would go through the action items because I want to make sure we're -

CHAIRMAN ABDEL-KHALIK: Absolutely.

MR. HEAD: This is - well, much of it is a repeat, but we do have multiple water sources. Large pipe is above the core. PCT early in the transient. Maybe ABWR design, plus some of what we've done at STP, it minimizes debris and chemical effects.

The strainers are going to meet the Reg Guide 1.82 Rev 3 guidance for conservatively assumed debris quantities.

We believe that, you know, we've minimized the generation of latent fiber and debris, but obviously we're going to confirm all that with the fuel testing. And part of our discussion here will be exactly, you know, what would - what we will consider with respect to either changes in the COLA or in another presentation to ACRS later.

These bypass, you know, we've described the defense and depth with respect to the core flooder and the design bypass paths.

We had a quick briefing on ECCS gas accumulation, which is an industry issue, which 1 and

2 is addressed. And so, it's a legacy issue that we're all aware of and we feel confident we're going to address carefully.

CHAIRMAN ABDEL-KHALIK: Now, the fifth bullet, have the analyses performed actually demonstrated adequate core cooling or have demonstrated the conditions under which adequate core cooling would be maintained or have established the conditions under which adequate core cooling would be maintained?

MR. VAN HALTERN: If I can jump in?

MR. HEAD: Yes.

MR. VAN HALTERN: The latter, I mean, the analyses have demonstrated conditions under which adequate core cooling can be maintained.

CHAIRMAN ABDEL-KHALIK: Right.

MR. VAN HALTERN: But given that it's a test acceptance criteria if you fail that, you're not going to live with it. You're going to change something, either the fuel design or the debris loading or whatever, in order to get to acceptable conditions.

CHAIRMAN ABDEL-KHALIK: Because, I mean, there is no way right now that your analysis - any analysis would show you that adequate core cooling will actually be maintained without the demonstration.

MR. VAN HALTERN: Without the test. That's correct.

MEMBER ARMIJO: I'm confused. I'm confused then. Your third from the last bullet, the supplemental cooling on the high-pressure core flooder or these design bypass paths provide cooling even with a hundred percent blockage.

Now, how is that consistent with your answer to Said's earlier question?

MR. JAIN: Maybe I can clarify it and sorry for causing -

MEMBER ARMIJO: If I believe that statement, I'd say why do you need to do any fuel tests.

MR. VAN HALTERN: Why do you need to do the test.

MEMBER ARMIJO: Yes.

MR. VAN HALTERN: That's correct.

MR. JAIN: but our primary basis is really that we'll have acceptable results. The other two things we did are defense in depth. What if the filters would completely block? And we have assurance that, yes, we can still provide adequate core cooling to the fuel.

So, in a way, if we find out -- if we say that the test is essential, which is what we are committing to, then - in fact, that bullet suggests that we don't need to have the test or a test -

MEMBER ARMIJO: Seems to me you've got it the wrong way around. That your primary argument is the supplemental cooling analysis, unless you can't rely on the HPCF or these design bypass paths. And the defense and depth is, by the way, we have a very clean plant and we run a lot of fuel tests that shows it won't block that much anyway.

Just seems to me like --

CHAIRMAN ABDEL-KHALIK: But that calculation assumes that there is no debris.

MEMBER ARMIJO: Well, that's a hundred percent blockage.

CHAIRMAN ABDEL-KHALIK: No, no, no. The third bullet from the bottom assumes that there is no debris. So, there is no debris accumulation on top of the core.

MEMBER ARMIJO: Well, I think that's probably an easier argument to win than debris at the bottom of the core.

MR. JAIN: Mr. Chairman, if the bottom is clogged, there is only so much debris to go around.

CHAIRMAN ABDEL-KHALIK: I understand. But the analysis itself -

MEMBER ARMIJO: Look, you've committed to do a lot of good stuff, and I'm not going to try and dissuade you, but it seems to me that your arguments really are you've got a lot of sources of water, particularly the high-pressure core flooders that unless those are gone, you've got a good way to cool that fuel.

MR. HEAD: So, it all adds up, though, to our conclusion with respect to the last bullet. We believe we meet the long-term cooling requirements.

DR. WALLIS: You didn't really perform these analyses for latent fuel and fiber debris. You have a hope that the tests will prove that it's okay.

That's very different from having some technical analysis which shows that it's okay. You've established some criteria, but you have no analysis which showed that you will meet those criteria.

CHAIRMAN ABDEL-KHALIK: That's the point that we made earlier.

DR. WALLIS: This is a misleading statement.

CHAIRMAN ABDEL-KHALIK: it is an incorrect statement.

MEMBER CORRADINI: But, Graham, if they dare to try and show an analysis of that experiment, would you buy it?

I mean, play it out. If they showed you a calculation with debris, you'd say, how do you know that's the debris?

DR. WALLIS: Well, I know. But if you buy something like a bridge, and they say this bridge won't fall down, but we're going to do a test first of all to show that it won't fall down, that's not a very convincing argument, is it?

MEMBER CORRADINI: But I think the key things you brought up originally was the spatial distribution and the type of debris. So, if they could assume some sort of debris pattern and show success, I'm sure they could, and then margin to failure or margin to -

DR. WALLIS: But there's no analysis that predicts this debris, first of all. There is no analysis to predict the pressure drop. It's all based on experiment.

CHAIRMAN ABDEL-KHALIK: That analysis predicts the conditions under which adequate core cooling will be maintained.

DR. WALLIS: That's right.

DR. JAIN: And the other two flow paths, the bypass flow path and the high-pressure core flooder, understand that we have not explicitly accounted for debris in those flow paths, but that is an analysis shows we do maintain adequate core cooling.

MEMBER ARMIJO: We didn't get into the details of that analysis, but maybe you want to hear it some day.

CHAIRMAN ABDEL-KHALIK: Any additional questions for the applicant?

Okay. Thank you very much. We're one hour behind schedule. So, we'll move on to the staff's presentation.

MR. HEAD: Mr. Chairman, did you want to do our action items first?

CHAIRMAN ABDEL-KHALIK: Oh, I'm sorry. Yes, sir. Yes, sir.

MR. HEAD: Okay. I'm going to start with where we left off and capture this as an action item that with respect to the partial rod test and that - the partial rod length test.

CHAIRMAN ABDEL-KHALIK: Yes, sir.

MR. HEAD: At this point in time, that would appear to be something that we would brief you on after the test is performed. And at that point in time, we would either be able to demonstrate that that was an appropriate test, or we might have adjusted appropriately.

CHAIRMAN ABDEL-KHALIK: You indicated that you will also modify your write-up so that you will examine the results of the test based on that short bundle. And at that point, you'll determine whether or not those results are adequate and whether you need to move to a full-length bundle.

MR. HEAD: yes, sir. But, you know, the write-up was - we're definitely going to go back and look at the write-up with respect to the protocol that we talked about.

CHAIRMAN ABDEL-KHALIK: For the debris, how you mix it up. But also you indicated that there was this top point where you will evaluate the results of your short bundle experiments and determine whether there is, you know, debris accumulation along the entire length so that the assumptions of debris accumulation near the bottom would be an adequate assumption or you would have to go to a full-length bundle.

DR. WALLIS: Well, a full-length bundle would have to have boiling in it.

CHAIRMAN ABDEL-KHALIK: Not if it's all cold.

Go ahead.

MR. HEAD: You know, this one may have been overtaken by some of the other suggestions, but it was during the discussion about flow from the top and the high-pressure core flooder essential change and flow distributions and whether that would impact the distribution.

And I think where we ended up with that was that if we run the test further to see our margin to blockage or to failure, that that would give us a perspective on that.

DR. WALLIS: What I thought you should do is you should run a code to predict how the flow distribution varies when you have the high - the high-pressure core flooding as well.

Because if there's flow down some channels, this changes the story. We need to know that.

MR. JAIN: Dr. Wallis, that will be -

DR. WALLIS: It's not just a question of showing margin. We want to know how much this effect changes the problem.

MR. JAIN: I'm reluctant to say that any

core results will be acceptable to - because this will be a CFX benefit code and will be three opinions on one result.

MR. HEAD: As you noted, what's below the core, you know, the amount of - there's a lot of hardware.

MR. JAIN: There's a lot of - the guide tubes are in the way. This is a very, very complex analysis.

MR. HEAD: I don't see how that code could be run and that the results would be -

MR. JAIN: Believable.

CHAIRMAN ABDEL-KHALIK: Your code doesn't actually model individual vertical channels for each bundle, or does it?

MR. HEAD: No.

CHAIRMAN ABDEL-KHALIK: It doesn't. And, therefore, that kind of calculation would be impossible to do.

MR. JAIN: Yes, it will be very difficult for us.

CHAIRMAN ABDEL-KHALIK: Because we're not modeling individual bundles.

Okay. So, this will essentially - this issue will be addressed by determining the margin.

MR. HEAD: That was what I heard later on in the discussion as maybe one way of addressing that.

MR. JAIN: Yes.

MR. HEAD: And then I took an action item that we may want to present to you at a later date, you know, ACRS briefing, that the flow at different K values, that would be useful to see, you know how much the - how the flow changes.

Okay. There was an extensive discussion on 95 percent versus NCPR. And I assume that we - okay.

There was the question on the - what was the right proportionality. The 1.2 versus, you know, two.

CHAIRMAN ABDEL-KHALIK: Versus the square law.

MR. HEAD: The square, right.

And so, is that still an action item that you would like to -

CHAIRMAN ABDEL-KHALIK: Yes, that's actually a very important action item that we need to find out what the impact of this exponent on this normalization.

MR. HEAD: Okay. So, that's something we need to brief ACRS on in upcoming ACRS?

CHAIRMAN ABDEL-KHALIK: If you can at a future meeting if you have an answer to that at one of our subcommittee meetings.

MR. HEAD: Okay. And then there was the - I view this as something we would address in this post-COL, is the length of time that we run the experiment or the test because -

DR. WALLIS: Repeatability.

MR. HEAD: Repeatability, and then there was the aspect of a breakthrough. If we run it so fast and we have a breakthrough, how does that really replicate, you know, what was going to be happening in the core?

So, I viewed that as something that we would have to consider as part of our test either protocol or test assessment, you know, our analysis of the test results.

And then we owe you - we answered the question on the area of the strainers, but then we need to provide you tomorrow a - comparing that with the fiber thickness.

And that's all I have. And I'll ask my staff if anyone else has anything else they thought was something we need to be doing.

CHAIRMAN ABDEL-KHALIK: Mark or George, do you have any additional items beyond the ones that were -

MR. TONACCI: I think we have an adequate number of them.

CHAIRMAN ABDEL-KHALIK: No, I mean, you know, have we captured all of them? That's the point. And I don't have anymore on my list. So, thank you.

MS. BANERJEE: Can I ask about this AP-1000 and the members interested to know why an approach different from AP-1000 had been used or that's resolved now?

CHAIRMAN ABDEL-KHALIK: I'd rather not. That's sort of a whether the right hand is talking to the left hand kind of question.

MR. JAIN: And the flashing at the strainer, is that issue - have we answered saying that there is a sufficient head of water in the suppression pool, the strainers are significantly submerged?

MR. HEAD: We still have the NPSH question.

MR. JAIN: That's a separate -

MR. HEAD: That's different. Okay.

CHAIRMAN ABDEL-KHALIK: All right. Thank you.

MR. HEAD: Thank you.

CHAIRMAN ABDEL-KHALIK: All right. Stacy, are you going to lead it off?

MS. JOSEPH: Yes, if I can find my cheat sheet.

All right. Here we go. All right. Good morning. My name is Stacy - or afternoon.

(Laughter.)

MS. JOSEPH: My name is Stacy Joseph, which I have told you this morning, and we're here to present the staff's evaluation of Chapter 6 and long-term cooling. And I'm joined here today by Hanry Wagage and Gregory Makar.

To start, I'm going to give you a brief overview of what the staff will be presenting. I'm going to summarize the open items in Chapter 6 related to containment and control room habitability.

The staff is going to provide a presentation of their review of the ECCS suction strainers. We're going to summarize how long-term cooling is assured in STP's ABWR. And finally I'm going to summarize the staff's ACRS action items related to Chapter 6.

There were seven open items in the SER with open items. The containment open items for 14, 15, 16, and 18 were presented as confirmatory items to the ACRS in June of last year. And these confirmatory items have since been closed.

In open Item 17, vacuum breaker protection, the staff requested that the applicant provide more detailed information on the design of the vacuum breaker shields.

The applicant provided a preliminary design of the shield and stated that the design would be finalized after completion of the structural loads evaluation. Staff reviewed STP's preliminary design and the open item has since been closed.

To close the toxic gas calculation open item, the staff performed an audit of the applicant's toxic gas calculations and requested additional information about the assumptions for a maximum puddle radius, the timing for toxic gas simulation and sensitivity of chlorine release from sodium hypochlorite.

The applicant showed that their assumptions were in fact conservative, and the staff was able to conclude that there is no toxic gas threat to the STP Units 3 and 4 control room.

Inclusion of the suction strainer open items will be discussed later in the presentation by my colleagues.

We'll now move into that section on ECCS suction strainers. Technical staff members Hanry Wagage, Gregory Makar and James Gilmer will each be presenting in their respective areas of expertise.

And with that, I'll turn it over to Mr. Wagage.

MR. WAGAGE: My name is Henry Wagage. I'm going to present an overview of South Texas Project debris strainer design and STP latent fiber bypass fraction in response to ACRS Action Item Number 47b.

These are the highlights of STP debris strainer design. STP used Reg Guide 1.82 Revision 3 guidance.

And the only thermal insulation in the South Texas Project containment is reflective metallic insulation. We use a smaller debris head loss on the ECCS strainer than other types of insulation.

STEP strainers of the same design as that are referred in Japanese ABWR plan. STP prohibits using fiber and calcium silicate used in the reference Japanese ABWR plant.

STP containment does not have aluminum or trisodium phosphate, reduce chemical precipitates that cause debris head loss on the ECCS suction strainer and downstream effect on fill and components.

STP had an operational program on

suppression pool cleanliness. This program is to ensure that the primary containment is free from debris that could become dislodged in an accident and be transported to the ECCS suction strainer and interfere with the proper functioning during a design-basis event.

As part of the suppression pool cleanliness program, STP will perform remote visual inspection of ECCS suction strainers and the supplement pool flow to ensure there is no debris present.

DR. WALLIS: Can I ask you about the first bullet?

This Reg Guide discusses many things, but it doesn't say how to calculate anything, does it?

So, the performance of a strainer is - relies up on an experiment to show that it will work. Is that a true statement?

MR. WAGAGE: This Reg Guide gives guidance to design strainers. And experiment would confirm the performance of the strainer.

For this plant, South Texas is using reference Japanese ABWR plant strainers, the same strainers. And those strainers have been tested with the vertical loop.

DR. WALLIS: yes, I think that's a better starting point than the Reg Guide. The Reg Guide is very qualitative.

But if there's been real tests with this Japanese strainer, that's a good starting point, at least to me.

MR. WAGAGE: STP ECCS consists of three residual heat removal pumps, two high-pressure core flooder pumps and one reactor isolation pump. Each pump is provided with two T-connected strainers.

DR. WALLIS: These strainers are in different places per pump or these are two attached to one inlet?

MR. WAGAGE: For the same pump, they are connected at the same -

DR. WALLIS: So, they're at the same place?

MR. WAGAGE: At the same place.

DR. WALLIS: Okay.

MR. WAGAGE: ABWR certified design has an ITAAC for the RHR, HPCF and RCIC systems, which refers to an acceptance criteria and all 50 percent blockage of pumps, suction strainers in determining the NPSH margin. Reg Guide 1.82 Revision 0 dated June 1974, provides the 50 percent blockage criteria.

This criteria, what it says is that in

calculating NPSH margin, assume 50 percent of the strainer is blocked, but this criteria is not used anymore. And later, revisions of Reg Guide 1.82 does not have that. During an RAI, staff ask the applicant to change the NPSH margin criterion to be consistent with Reg Guide 1.82 Revision 3.

The next point is STP changed the ITAAC acceptance criteria to analytically derived values for blockage of pumps, suction strainers based upon the as-built system.

During highly improbable event that all suppression pool suction strainers will become clogged, the alternate AC independent water addition mode of RHR allows water addition to the core and containment.

During this mode of RHR, the fire protection system pumps provide water to the vessel and to the wetwell and drywell sprays from diverse water sources to maintain cooling of the fuel in containment.

In sizing the ECCS strainers, STP use the same design as reference Japanese ABWR. This reference Japanese ABWR uses fiber and calcium silicate insulation addition to reflective metallic insulation.

STP replace fiber and calcium silicate insulation with RMI. RMI gives smaller head loss on ECCS suction strainers than the other types of insulation.

Therefore, STP has less severe debris load than that for the reference Japanese ABWR plant, giving smaller head loss than the plant.

However, STP strainers are designed for the pump runout flow rate while the reference Japanese ABWR strainers are designed for the pump design flow rate.

Pump runout flow rate is higher than the pump design flow rate. And, therefore, if all other conditions are the same, STP strainers will have higher head loss than that for the reference Japanese ABWR.

DR. WALLIS: Well, the first bullet, this means that they used the same strainers as the Japanese did.

MR. WAGAGE: Yes, same size.

DR. WALLIS: In every way.

MR. WAGAGE: Yes. There is two compensating factors, because of renewal of troublesome insulation with RMI, STP would have vessel head loss, but STP is designed for pump runout flow rate to have higher head loss.

By using this condition, STP calculated that there is NPSH margin available for ECCS pumps. During this calculation, STP had certain amount of fiber. Later on, STP decided to remove all the fiber with the RMI. That mean that available NPSH margin given in that proprietary report will be even more.

To calculate the strainer head loss from RMI, STP use NUREG/CR-6808 correlation. After review, the staff determined that STP strainer design was conservative and acceptable.

ACRS Action Item 47b is on latent fiber debris bypass fraction. As mentioned before, STP containment does not have fiber insulation.

However, for operation flexibility, STP assumed latent fiber debris amount of one cubic foot in the debris strainer design.

DR. WALLIS: What is the basis for that number?

MR. WAGAGE: That is for operational flexibility in case that - as I said, this plant prohibits using -

DR. WALLIS: Yes, but why is it one instead of 0.1 or ten or something? Why is it one?

CHAIRMAN ABDEL-KHALIK: This is what they can live with in real life.

DR. WALLIS: Someone just said let's assume one?

MS. JOSEPH: That was off of data that they took from the reference ABWR, right?

MS. SCHLASEMAN: This is Caroline Schlaseman. That's close.

MS. JOSEPH: Oh.

MS. SCHLASEMAN: It was a different ABWR.

MS. JOSEPH: Oh.

MS. SCHLASEMAN: It was the TEPCO plants, the Kashiwazaki-Kariwa Units 6 and 7. TEPCO provided us their containment inspection results. And based on that, their containment was very, very clean.

The only amounts of fibrous material that was found was some bits of rope. And based on that we said, wow, that's, you know, less than a half a cubic foot.

We will go ahead and assume that we have one cubic foot of latent debris - latent fibrous debris.

DR. WALLIS: So, it's based on the rope found in another ABWR.

MS. SCHLASEMAN: That's correct.

DR. WALLIS: All right.

MR. WAGAGE: In response to RAIs 4.4-3 STP proposed ten percent latent fiber bypass fraction. During the last meeting, the ACRS subcommittee raised a concern on the fiber bypass fraction.

DR. WALLIS: Excuse me. That rope was not fiberglass, was it?

MS. SCHLASEMAN: That's correct.

DR. WALLIS: But you're assuming it's fiberglass.

MS. SCHLASEMAN: Oh, that is because we needed to test something. And we made what we believed was a conservative assumption of a surrogate material. And we took the assumed one cubic foot of miscellaneous fibrous latent debris which could be cloth, could be rope, could be whatever that somehow escapes the containment cleanliness program.

And we would assume for the purpose of testing, that it was one cubic foot of destroyed fibrous insulation.

DR. WALLIS: This is one of my comments on all this over the years here that really - textile fibers behave very differently from fiberglass.

I don't understand why the staff is accepting this testing only with fiberglass, but they seem to have done so.

MS. SCHLASEMAN: And I guess I'd like to again reiterate that our ABWR containment is not accessed except for during refueling outages. It's extremely small. And the persons who go in and out are in full PCs and we don't expect to have a large amount of textile materials.

DR. WALLIS: Well, if my wife tried to make a felt hat out of fiberglass, it wouldn't work. It would work very nicely with textiles.

So, there is something different that. It's an old question. I've raised it before and didn't get any answers. So, I just mention it's surprising to me.

MR. WAGAGE: I think the plant does not have any - it's not supposed to have any fiber. For operational flexibility, they use one cubic foot of fiber for testing and analysis assumed to be certain type.

MEMBER ARMIJO: Just a quick question. Was there a mass associated with that one cubic foot like so many pounds or kilograms of fiber?

MS. SCHLASEMAN: For the testing purposes for downstream effects, we're going to be assuming that it is - that it's Nucon. And the density of Nucon is about two-and-a-half - it's about -

MR. ANDREYCHEK: This is Tim Andreychek. It's 2.4 pounds per cubic foot.

MEMBER ARMIJO: Okay. I'm trying to connect that with the number I heard for PWRs based on practicality of maintaining a containment that clean.

It's in the ball part, but there doesn't seem to be any consistency with what the criteria are for latent fiber between - that the staff applies for PWRs and BWRs.

MEMBER BLEY: It was a cubic foot there, too.

MEMBER ARMIJO: But a different mass.

MEMBER BLEY: Yes, but it was a cubic foot.

MEMBER ARMIJO: And I thought -

MEMBER BLEY: And I think it was a mix.

MEMBER ARMIJO: I thought it was mix of cotton fibers, hair.

MEMBER BLEY: And some fiberglass.

MEMBER ARMIJO: And some fiberglass. So, there's no consistency between these two. I don't know if there needs to be, but I'd probably feel more comfortable and more like along what Graham says.

MR. ANDREYCHEK: Excuse me. I missed what you were discussing about the mix of fibers and whatnot.

MEMBER ARMIJO: Yes, in the PWRs, I think they have mix of materials in that one cubic foot of latent debris for latent fibers.

So, you know, it just seems like there's not any consistency between what the staff is finding acceptable for BWRs and PWRs, you know. I think it's the same problem.

DR. WALLIS: You don't have people wandering around in an ABWR containment quite as much. They're not wandering - they're not in there as much as they are in a PWR containment.

MEMBER ARMIJO: I just think the approach is fine. The operations people say it's practical to control the cleanliness to this level.

DR. WALLIS: It's a muscular containment, isn't it?

MEMBER ARMIJO: And pick that as your acceptance. But the kind of material, I think, is important. And I don't think it all will be particularly in this case, will be something - it will be Nucon.

In fact, that's the thing we know it won't be.

(Laughter.)

MEMBER BLEY: That's what confuses me.

MEMBER ARMIJO: So, it's kind of hard to understand.

MR. ANDREYCHEK: My recollection on the mix of fibers, if you would, is that for operating PWRs, fiberglass has been used as the surrogate fiber material.

For the AP-1000, there was some fuel testing that was done that did involve use of human hair, as well as some cotton fibers. But that was for the fuel testing.

My, you know, the best of my knowledge based on what I've seen and reviewed of the sump screen testing, it's all been fiberglass. For the PWR Owners Group fuel debris capture testing, it's all been fiberglass as the fiber.

The only variation has been for the AP-1000 fuel testing. And that's, I think, maybe three tests that used a different type of material. And that's going to be revisited again, I believe, coming up in some additional work that may be done, may not be.

MR. WAGAGE: As I mentioned, the ACRS Action Item 47b, there was a concern on fiber bypass fraction. Then staff ask STP to provide justification for the ten percent bypass fraction value.

In response, STP proposed to increase the fiber bypass fraction to 100 percent. The staff determined that 100 percent fiber bypass fraction was conservative and acceptable. This is a confirmatory item.

Next person is Gregory Makar.

MR. MAKAR: Well, I'd like to address three topics. The coatings evaluation -

CHAIRMAN ABDEL-KHALIK: I'm sorry. How is this confirmatory? What is it that you're going to confirm?

MS. JOSEPH: We need to confirm that the FSAR - the next revision of the FSAR is updated to show that it's a hundred percent.

CHAIRMAN ABDEL-KHALIK: Is updated to reflect that. Oh, okay.

MS. JOSEPH: That's all it is.

CHAIRMAN ABDEL-KHALIK: Okay. All right. Thank you.

I'm sorry. Please proceed.

MR. MAKAR: So, I will address three topics; coatings evaluation, the downstream x-vessel effects or effects on components, and then the - how we resolved our open item.

The first two of those, coatings and

downstream effects, these when we had the briefing last summer, we had no open items. So, there's been no change in the status of these. So, I'll just review them quickly and then get to the chemical effects open item.

So, with respect to coatings, the applicant is using the URG-approved value of 85 pounds of coating. A combination of inorganic zinc and epoxy. These coatings are located on concrete floors and on steel above the wetwell. As you heard, they are stainless steel where it's wetted.

The coating debris is included in the - in the strainer testing that the applicant has described, which is a mix. It was actual coatings that were reduced to a distribution of sizes. So, it was a mixture of flakes and particles.

For the fuel downstream in-vessel effect evaluation, the testing of the fuel assemblies, these coatings will be included as fine particles. Which when there's the possibility of a filtering bed, conforms to the staff's guidance for using those small particles which are effective at causing head loss. So, the coatings, again, has been evaluated and we find those acceptable.

For downstream effects on components, the

- again, there's no change since our briefing last summer. The applicant has proposed a methodology which is an approved WCAP. It was developed during GSI-191 and obviously for PWRs, but - so, our evaluation entailed looking at the types of components and materials they are using and their commitment to use that WCAP in accordance with the staff's Safety Evaluation which includes limitations and conditions.

And so, we were able to conclude that the methodology and acceptance criteria apply. And that their commitment to provide that evaluation as design details become available, will be something - they provide that evaluation to us 18 months before -

MEMBER STETKAR: Greg, I didn't get - I don't know whether - we probably have a copy of it, but I didn't get a chance to review it.

The discussion in the SER with regard to this WCAP focuses on things like wear of internals of valves and wear of internals of pumps.

Does the WCAP address something like the issue that we brought up this morning regarding performance of this, you know, water lubrication system and plugging under particulate and debris? Because it's a different design than what is typically found.

MR. MAKAR: Okay. I wasn't here this morning.

MEMBER STETKAR: Oh, okay. Well, I didn't know whether you were in the back.

MR. MAKAR: I heard the question secondhand. We didn't address that component specifically, you know. Clearly.

MEMBER STETKAR: Okay.

MR. MAKAR: But from - and the WCAP itself addresses wear, abrasion, as you said. Also, plugging of any openings that are in the ECCS core spray flow paths. So, that's orifices, valves. And there are equations and acceptance criteria for -

MEMBER STETKAR: So, in principal, I mean, this isn't, you know, one could argue this is an internal part of this pump assembly.

MR. MAKAR: Yes, since it's not called out.

MEMBER STETKAR: I'm just concerned that somebody says, well, I followed the methodology that's approved under this WCAP and I looked at everything. And I don't have to look at this because it's an internal piece of this pump.

MR. ANDREYCHEK: May I provide some insights on that, if I may?

There's a primary author on that document.

the methodology applies across the board. It takes into account that there might be some design differences in specific pumps, because there are a variety of pumps even used on the PWRs and the criteria is take a look at the specific design.

I mean, for example, Davis-Besse had a very unique design pump that was subjected to certain kinds of wear.

The general criteria is here is the general methodology, look at the design of the pump, take into account the specific, unique features of the pump and evaluate it using the general methodology of blockage, wear, abrasion, erosion that - for the equations that are generated in the document.

So, although that specific design may not be included in the WCAP, the WCAP does ask the evaluator to pay attention to the design-specific features of any given component that they're looking at.

CHAIRMAN ABDEL-KHALIK: But we don't know if the applicant has already performed that evaluation for the RCIC pumps. And that's what they will follow up with.

MEMBER STETKAR: Well, and plugging of an orifice that is designed to control flow is a little bit different than plugging of a filter that's designed to collect the stuff that's plugging it.

MR. ANDREYCHEK: Understand. And part of - and, again, if you look at the entire document, it talks about generating - calculating debris concentrations and evaluating, so on and so forth.

So, I believe that the general methodologies applicable requires the analyst or the evaluator to apply the methodology.

MR. MAKAR: And I think there's also an ITAAC associated with that pump that - on the design of it. And the design standard for it has acceptance criteria which include, I believe, that.

MEMBER STETKAR: Yes. I mean, what was discussed this morning, and you weren't here, was that essentially reliance on the ASME QME-1 2007 qualifications criteria, again, in principal, should pick this up in principal.

I'm just curious in practice, whether it will.

MR. MAKAR: Okay. Moving on to chemical effects, and I'll just review on this slide the status when we came here for the briefing last June.

So, for the chemical effects, the key guidance we're looking at is NEI 0407, the staff safety analysis on that - Safety Evaluation, I should say.

There was a 2008 document on chemical effects guidance for closing out General Letter 2004-02 responses. And the applicant also used a WCAP 16 5 30, which is an approved WCAP for addressing chemical effects again developed for PWRs.

Now, in their chemical effects analysis, they had included iron oxides in their head loss testing. There was zinc present only in the form of this inorganic zinc coating. And there was no aluminum included in the design.

There was latent aluminum assumed, this is review, four-and-a-half square feet. And that quantity was calculated based on at the pH with the lowers aluminum solubility, how much aluminum could you tolerate and keep it from precipitating as a solid.

And, again, that calculation was done by assuming a more or less infinite supply of aluminum as it corroded for the 30 days.

Now, we had an open -

DR. WALLIS: Excuse me. If they'd assume ten, then the other 5.5 would have fallen out anyway; is that right?

If they had assumed ten feet square, what would have happened?

MR. MAKAR: They would probably have the same - a slightly higher -

DR. WALLIS: They'd have the same amount, wouldn't they?

MR. MAKAR: Sure.

DR. WALLIS: Because they've reached the maximum. So, assuming a hundred wouldn't make any difference, is that right?

So, they've assumed the worst, is that right?

MR. MAKAR: Well, the corrosion rate is based on the exposed surface area.

DR. WALLIS: That's the rate, but there's a limit to how much you can get.

MR. MAKAR: So, at that temperature and pH, you have a value of solubility.

DR. WALLIS: Limit.

MR. MAKAR: Yes, yes.

DR. WALLIS: So, if there were a hundred feet squared, it wouldn't make any difference. You can't get anymore in there; is that right?

CHAIRMAN ABDEL-KHALIK: It would precipitate out.

DR. WALLIS: It would precipitate out. Is that good or bad?

CHAIRMAN ABDEL-KHALIK: What was that, again? I'm sorry.

DR. WALLIS: Is it good or bad if it precipitates out?

If they had a hundred, I think what you're saying is that this 4.5 reaches some limit in the amount of aluminum oxy-hydroxide you can get, and get it to the screen.

MR. MAKAR: Right. If you stay below that value, that surface area for that period of time at that temperature and pH, then based on the solubility data they were using, that that aluminum would stay dissolved in solution and would not become a debris source.

DR. WALLIS: Wouldn't become a problem?

So, at 4.5 feet cube square there's no problem?

MR. MAKAR: Well, we had an open item at that point. We weren't able to complete our evaluation.

DR. WALLIS: Excuse me. Suppose it were ten feet square. What would happen?

MR. MAKAR: Well, you would dissolve more aluminum into solution -

DR. WALLIS: Yes.

MR. MAKAR: - based on the surface area. That would at that same -

DR. WALLIS: Some of it will precipitate.

MR. MAKAR: Yes, what's in excess, there's a quantity that is the solubility limit -

DR. WALLIS: Right.

MR. MAKAR: - some grams per liter. And the excess would precipitate.

DR. WALLIS: If it precipitates, is it then forgotten or is it -

MR. MAKAR: If it precipitates, the it has to be evaluated as a debris source.

DR. WALLIS: So, they've assumed the amounts that doesn't create any debris source then?

MR. MAKAR: Correct.

DR. WALLIS: So, why assume it? I don't understand why they assume something which is just the limit where it doesn't matter. It just doesn't sound reasonable.

CHAIRMAN ABDEL-KHALIK: Could you explain the logic, please? I think there is a logic issue here.

MS. SCHLASEMAN: We were originally asked by the staff to come up with a value for latent aluminum. And to do that, we did what Greg has described and what I described this morning. We went ahead and came up with the maximum amount of aluminum under the worst-case conditions of pH and temperature that would not precipitate out and come out of solution. And so, there would be no aluminum oxy-hydroxide formed.

DR. WALLIS: It's also assuming away the problem.

MS. SCHLASEMAN: That's correct. We felt we could - we felt we could meet the 4.5 square feet of latent aluminum. We would identify anything that was larger than that.

DR. WALLIS: So, what's your --

MS. SCHLASEMAN: However --

(Simultaneous speakers.)

MS. SCHLASEMAN: There's a second piece of this.

So, the staff then asked us what would happen if we formed sodium aluminum silicate due to exposed concrete, because we have to postulate that we're going to lose qualified coatings off the floor that's close to the break.

And so, we ran that number and we came up with a quantity of sodium aluminum silicate. And we did not have the solubility data for sodium aluminum silicate that was acceptable to the staff.

We had some that we felt showed that it also would not come out of solution, but we couldn't reach agreement on that. And so, we decided to conservatively assume no solubility and that all of our material from the four-and-a-half square feet would precipitate out. It was just a way to reach agreement in closure.

DR. WALLIS: So, it's a very strange thing. You start by assuming 4.5 because that's the limit. You've got no problem. You assume the problem away.

And then you say staff doesn't like that. So, we'll assume that all the 4.5 precipitated, but it still has no connection with reality.

CHAIRMAN ABDEL-KHALIK: Well, if they can limit the amount of aluminum surface area to less than that, then that's reality.

MEMBER ARMIJO: It's a practicality criteria.

DR. WALLIS: But the practicality criteria has nothing to do with the fact that 4.5 is the original limit assumed that prior wouldn't precipitate.

MR. MAKAR: Well, it was based on - it was based on solubility data generated for the GSI-191 program and -

DR. WALLIS: But then they assume it does precipitate anyway.

MR. MAKAR: Well, later, because we - because we did not accept the assumption that - or the evaluation that it wouldn't precipitate.

DR. WALLIS: You see -

MEMBER ARMIJO: A more logical approach to this would be to say, hey, we can tolerate nine square feet. 4.5 doesn't precipitate. The other 4.5 meets your criteria, you know.

You're making them assume that 4.5 square feet dissolves and then precipitates out.

MR. MAKAR: No, we didn't. We -

MEMBER ARMIJO: That's what they did. That's what I just heard.

MR. MAKAR: Well, we don't - there are many areas where there are not clear requirements like how much fiber a plant has to assume is in containment when they really believe it's zero. So, we have to evaluate what they propose.

We were very skeptical that there would be zero aluminum. And so, their option, the option they exercised, was to see if - they know that aluminum has some solubility and they had some solubility data.

So, they chose to look at how much of this aluminum can we keep dissolved in the solution so it doesn't become a chemical debris source?

And the staff has accepted for operating reactors, short-term solubility not for a full 30 days, but for some period of time until you cool the temperature down.

So, that's not - there is precedent for taking credit for solubility of aluminum in this kind of situation.

But as we told you in June, we were not satisfied that their analysis of the solubility data and that their story was complete. And so, that was part of this open item.

DR. WALLIS: Maybe we can forget it because they told us that it's all dominated by the zinc anyway. And this small amount of aluminum whether it's 4.5 or nine or 25 makes no difference; is that true?

MR. MAKAR: That's true.

DR. WALLIS: So, forget it.

CHAIRMAN ABDEL-KHALIK: Okay. Let's move on.

MR. MAKAR: But it was also related to the form of the inorganic zinc debris, whether this would be like a hard particle or could it be more of a gelatinous material like the aluminum oxy-hydroxide.

We also asked as Caroline said, if there was a contribution of exposed concrete it could contribute.

Now, at that time, that was the only - aluminum was the key debris source. And even if there was only a little bit of it, it's a big difference in GSI - in the GSI-191 world, having zero debris is much different than having a little bit or a lot.

Zero hadn't been done before for 30 days. So, that's why in the end, as you said, we found that this aluminum precipitate is not dominant.

So, the next slide, please.

MEMBER ARMIJO: Before you leave that, did the staff satisfy itself that there is no gelatinous form of zinc?

MR. MAKAR: No.

MEMBER ARMIJO: Let me -

MR. MAKAR: Well, I'll skip this slide and get to the zinc. This slide is -

MEMBER ARMIJO: I just want to get this clear in my mind. There is no gelatinous form of zinc that can form? Is that a correct statement, or not?

MR. MAKAR: No, no, that was part - that slide was a summary of the open item that we had when we briefed you last.

MEMBER ARMIJO: Okay.

MR. MAKAR: And we did not accept that -

MEMBER ARMIJO: At that time.

MR. MAKAR: - argument that - the assurance that zinc corrosion products would not be gelatinous. We weren't sure.

MEMBER ARMIJO: Okay. And now, you're going to tell us what you are sure of, I hope.

CHAIRMAN ABDEL-KHALIK: But back to the aluminum issue, regardless of what the assumption is, the 4.5 square foot limit is a real limit that will be imposed on the plant.

MR. MAKAR: Yes.

CHAIRMAN ABDEL-KHALIK: Okay.

MR. MAKAR: Mr. Chairman, do you want me to review the aluminum again or do you think we've covered -

CHAIRMAN ABDEL-KHALIK: No, I think we've covered it. We understand what's going on.

MR. MAKAR: Okay. So, for inorganic zinc, again we - all we have is the inorganic zinc coating and some uncertainties.

DR. WALLIS: I think the important thing is that Slide 13 you admitted that precipitate total from aluminum is 0.1 of a pound. If inorganic zinc is anything like it at 47 pounds, it would be a huge problem.

MR. MAKAR: Okay. so, we have some uncertainties about the zinc. It's underneath an epoxy coating. So, we don't really know how much it will be - is actually exposed.

What the surface area would be depends on what the size the debris is in. The corrosion rate that we apply to the zinc has not been established for BWR chemistry as it has been for PWR chemistry.

And we don't know if we did dissolve zinc into solution, what form these precipitates -

DR. WALLIS: So, please, could you clarify that because I got the impression that they were assuming that the zinc somehow washed off the surface in the form of balls, and then oxidized.

And you seem to be saying that, no, it dissolves off the surface and then precipitates. In which case, the precipitate could take all kinds of forms, not just be balls. Not be brown balls as they seem to assume.

MR. MAKAR: Well, initially that was their position that the zinc would be in the form of zinc oxide particles that would not change.

DR. WALLIS: If it dissolves and then precipitates again, it could take all kinds of -

MR. MAKAR: Correct. And we weren't really sure what it - what the zinc would do. And so, we had a number of questions about this. And the applicant proposed, as summarized here, that they're going to assume that that coating is 100 percent zinc, metal like a metal coupon, you know, that it's reduced completely to small particles. And these are tiny particles. Ten micron, which is the smallest particle size we've assumed for other coatings.

And it turns out - now, again, this coating is - the quantity of the coating back when the URG was developed, was based on a zone of influence of ten pipe diameters.

Now, it's covered by a qualified epoxy coating that has a 4-D zone of influence. Nonetheless, they're assuming that it's completely exposed and reduced to the finest particle.

And we also know it's not a hundred percent zinc, because it's actually 80 to 90 percent zinc and has some other materials in it. And the zinc that's in it is partly oxidized.

So, this is a - by assuming it's a reactive form of metal and applying the corrosion equations developed for the WPAC, they completely dissolve this quantity of zinc at the low end of their pH range and about a quarter of it at the high -

MEMBER ARMIJO: When you say "low pH," this is less than seven?

MR. MAKAR: Yes.

MEMBER ARMIJO: But you're not going to have that pH in the BWR, especially if you put the boron in.

MR. MAKAR: Definitely going to put the boron in, but that is their - their ECCS equipment design requirements cover the range of pH 5.3 to 8.9. And that's the - that's the pH range that they felt had to be considered for their analysis.

DR. WALLIS: So, when it dissolves and makes an oxide, does it release hydrogen?

MR. MAKAR: Yes, presumably it would.

DR. WALLIS: And what happens to that?

MR. MAKAR: We did not -

MEMBER CORRADINI: It joins the hydrogen up there with the zirconium oxidation.

I think he's kind of asking what's the

inventory you're expecting.

MR. MAKAR: Yeah, I don't know the - I don't know the -

DR. WALLIS: It does release hydrogen, though, it does.

MR. MAKAR: I'm sure it does.

DR. WALLIS: So, your picture is that the particles are dissolved off the wall without being released?

And then somehow as the gauge changes or something, does the precipitate then form somewhere else? Is that the picture?

MR. MAKAR: Well, the picture is that once this - once you have this zinc dissolved in solution, then will it, you know, again, we're looking at does it form chemical debris?

But, again, look at solubility and see how much there is, how much it forms, or you could take the GAI-191 type approach and assume that it all precipitates.

DR. WALLIS: The form of the precipitate is very important for clogging.

MR. MAKAR: It is. And that's - if we can - could you go to the next slide, please, Stacy?

DR. WALLIS: So, the particles being - what is the significance of the particles being ten microns?

MR. MAKAR: Well, it increases the surface area by about a factor of 40 over the -

DR. WALLIS; Oh, but it does dissolve. So, after it dissolves, it forgets that it was a ten micrometer particle.

MR. MAKAR: Correct.

DR. WALLIS: And then it precipitates as something else.

MR. MAKAR: Right.

DR. WALLIS: Okay.

MEMBER ARMIJO: And that's really the key question. What does it precipitate as?

MR. MAKAR: Okay.

DR. WALLIS: Right.

MEMBER ARMIJO: If you could tell us that, and Westinghouse assumed it would precipitate just like the aluminum oxy-hydroxide.

MR. MAKAR: Well, initially there's another step there. They propose that it would become zinc oxide. And as you said, there are different choices.

You could say zinc oxide, zinc hydroxide, zinc silicate. Now, you consider what we - there are things we know and don't know.

In the ICET, the integrated chemical effects testing done for GSI-191, there were some - I think there was some zinc silicate form evaluated, but they have a lot more source of silicon and we don't have a lot of data.

There was also if you just look up zinc corrosion in fairly pure water, the zinc form is zinc oxide or zinc hydroxide at this pH.

So, we really don't have a - I think the case is pretty strong for zinc oxide or hydroxide. Less strong for if you want to imagine something that's heavier and would create more debris and more complex.

If we wanted to say silicate, for example, we could do that. We could take some of that 22 kilograms of dissolved zinc and the - about two grams of silicon that's available from the concrete, and that would change some of that zinc oxide to zinc silicate, but it wouldn't change the overall quantity of precipitate significantly.

DR. WALLIS: The main thing is what form is it.

MR. MAKAR: Yes.

DR. WALLIS: Is it sort of a long chain, gooey sort of thing that attaches onto things or is it a ball or what is it?

That's the key thing.

MR. MAKAR: Well, that's what was done. And so, the thing you have to look at next is what is the effect of these precipitates. And certainly, that's part of it.

Stacy, would you go ahead, please?

MS. JOSEPH: Sure.

MR. MAKAR: Okay. So, we talked about the form that we accepted zinc oxide as the precipitate. Also, the corrosion rate.

Again, we don't have - the PWRs developed corrosion rates for zinc in PWR environments. So, we're applying those - the applicant is applying those formulas here for the release rate of zinc, which we found reasonable because zinc is - the corrosion rate is very dependent.

And as you heard a lot of this, the zinc, most of it or all of it dissolves anyway. And at the higher end of the pH range, it is similar to the PWR water because you would have the boron from the slick system at that point.

So, overall we considered this a reasonable way to go to use those equations for corroding the zinc. We're not aware that boron is an inhibitor.

DR. WALLIS: The question is you just assume it's all dissolved, don't you? Or am I -

MR. MAKAR: Well, they looked at the two - over that range of pH. And what they did and when - they looked at the total aluminum precipitates and zinc precipitates at the two - over the range of pH. And they specified a precipitate quantity based on the pH value that gave the most overall debris.

And so, in one of those pHs was -

DR. WALLIS: But it's not assumed that all the exposed zinc forms precipitate. There is some chemical analysis.

MR. MAKAR: Well, yes, it's a release rate in this WCAP. You tell it how much surface area of zinc and how much mass is available, and it calculates -

DR. WALLIS: Oh, it doesn't just take all the zinc in the zone of influence and dissolve it?

MR. MAKAR: The user enters the surface area and mass of the zinc, and the pH and temperature profiles.

DR. WALLIS: Okay. It's more complicated than I thought.

MR. MAKAR: It's a pH and temperature-dependent equation for release rate.

Okay. So, now that we've established that we have some chemical debris to deal with, how are we going to do that?

And the applicant proposed that because there is not a continuous fiber bed on the strainers, that there is no effect on head loss at the strainers from these chemical debris because they've been observed to go through if there's any bare strainer area. And if this is - this conforms to our guidance for closing out Generic Letter 2004-02.

Now, in the vessel is a different story. And so, this chemical debris needs to be included in the rest of the debris load. There are potential effects in there.

So, this will be in the downstream analysis. You've heard the quantity. It's about 56, 57 pounds of zinc oxide that has to be considered.

It's included in the calculation of the -

DR. WALLIS: If there's - I'm sorry. I'm following up on my previous question. On your Slide 14, it says zinc coating completely corroded.

That means to me, that it all is dissolved. You don't need to worry about chemical kinetics at all. It's all dissolved.

MR. MAKAR: But that was not an assumption. It was dissolved when the - when those corrosion rate equations - when the corrosion rate equation was applied to it.

DR. WALLIS: But it still - is it all dissolved or not?

MR. MAKAR: Yes.

DR. WALLIS: So, we don't need to know the kinetic - we know that it's all there. It's all dissolved. To reach that limit, it's all gone.

MR. MAKAR: Yes, because of the kinetics.

DR. WALLIS: Okay. So, the kinetics are sort of dwarfed by the fact of the amount available.

MR. MAKAR: Now, the precipitation kinetics were not - we're not worried about. We're assuming that it all precipitates.

DR. WALLIS: Okay. Well, I'm trying to simply the problem. Essentially, all the zinc which is exposed is dissolved.

MR. MAKAR: Yes.

DR. WALLIS: Okay. That makes it simple for me. I understand that. I can't understand all the chemistry, but that's okay.

MEMBER CORRADINI: That's right. You got the hydrogen part. I think you're doing pretty good.

DR. WALLIS: Well, I don't want to know where that goes.

MEMBER CORRADINI: I'm trying to compute how many moles that is. Now, you got me into it.

It's only a few moles compared to what you get from an assumed zirc interaction, but you're doing well. Keep on going.

DR. WALLIS: Do you want to get to dinner?

MEMBER CORRADINI: Well, that's your choice.

CHAIRMAN ABDEL-KHALIK: Please continue.

DR. WALLIS: That was very useful. Thank you.

MR. MAKAR: Okay. Now, Jim Gilmer will describe the fuel assembly test in more detail. I've been touching on it a couple times. And so, now we get to that critical question, what do we do with this assumed zinc oxide for that test?

And now, they've already - we approved the use of this aluminum oxy-hydroxide surrogate for aluminum debris and that's based on not just that it's bad for head loss testing. It's so bad that it's hard to imagine anything worse.

And we're talking about -

DR. WALLIS: I don't like that.

MR. MAKAR: I understand. Understand.

DR. WALLIS: I'm not imaging something worse.

MR. MAKAR: Yes, yes. It's hard. So, we get that and we -

DR. WALLIS: Nothing could be worse than GSI-191 as it's been evolving.

MR. MAKAR: But this is the proposal before us that in that fuel assembly testing, the zinc oxide will be represented with the same aluminum oxy-hydroxide surrogate that's used for aluminum and, in some cases, calcium phosphate.

We don't know that that's - or zinc could form something nastier than aluminum oxy-hydroxide, but - and we may be wrong.

So, there are two things I want to say about that. One is that we have turned a - if you step back a minute, we've taken a qualified inorganic zinc coating that's under a qualified epoxy coating, turned it into the finest possible particles, completely dissolved it and assumed that it all precipitates. And now we are including it as the, you know, pretty aggressive head loss-causing chemical.

So, we feel like there is a -

MEMBER CORRADINI: Isn't that the dominant head loss stuff other than latent debris? I mean, I'm listening to you go through this, but it dominates it. Except for latent debris, I don't know, it's a cubic feet or something, this is it.

MR. MAKAR: With the right mixture of other things, yes. So, we felt that was a reasonable and acceptable approach.

DR. WALLIS: You assume that zinc oxide couldn't be worse than aluminum oxy-hydroxide, because aluminum oxy-hydroxide is so bad. That's not a very convincing argument.

MR. MAKAR: Well, the question is, the decision point is do we on - put this in open item until you come back with a completed test program comparable to the GSI-191.

DR. WALLIS: Embarrassing to have a test program down the road which showed that it was worse.

MR. MAKAR: Well, we will know because their - that's the second thing I want to say about it is that we - there is test - testing being done under the BWR.

DR. WALLIS: with zinc?

MR. MAKAR: Yes. And so, we may find out that we were wrong.

DR. WALLIS: So, that's good.

MR. MAKAR: And we will have to deal with that.

DR. WALLIS: Good. So, there is a confirmatory test of your assumption.

MR. MAKAR: Well, it's not even a confirmatory test. It's the BWR Owners Group looking big picture at all their debris sources and potential chemical effects.

MR. NORATO: Mr. Chairman, if I may, Mike Norato from NRO.

The answer is we don't know for certain that zinc will not form any worse precipitate than aluminum oxy-hydroxide. That is the worst that we know now. So, yes, there is some uncertainty.

However, there is also a great deal of conservatism as Greg has indicated throughout. So, the staff felt that when you balanced the uncertainty against the conservatism at this point, that we do have reasonable assurance.

CHAIRMAN ABDEL-KHALIK: Thank you.

MS. JOSEPH: I think that's the key is the reasonable assurance.

CHAIRMAN ABDEL-KHALIK: Please continue.

MR. MAKAR: That pretty much wraps it up and I'll turn it over to Jim Gilmer.

CHAIRMAN ABDEL-KHALIK: All right.

MR. GILMER: Hi. Good afternoon. I'm Jim Gilmer. I'm the core design reviewer, including the effects of debris blockage on fuel.

As you heard this morning, the certified ABWR design had not addressed the downstream effects on fuel because that issue emerged when ABWR was in rulemaking.

And by inference, the certified fuel, the GE-7, which is an eight-by-eight rod configuration, has not been tested for downstream blockage.

To allow staff to reach a reasonable assurance of safety for the COL, STP has proposed a license condition which you have heard about earlier today which staff feels is an acceptable way to reach a reasonable assurance primarily because fuel cannot be loaded if the acceptance criteria cannot be met during the test.

There are a number of related RAIs, but the one related to core thermal design was RAI 04.04-4. That had the detailed proposed license condition. And as mentioned earlier this morning, the test must be completed and the results submitted to NRC 18 months prior to fuel load.

We expect that someone from staff or many people from staff will actually witness the tests when they take place.

The test protocol will be submitted six months prior to that. So, roughly two years before plan fuel load.

DR. WALLIS: And you're satisfied with a shorter bundle? Three instead of eight?

MR. GILMER: Yes, I'll get into that in a subsequent slide and the reasons why we think it's okay.

DR. WALLIS: Are you satisfied with the power of two in this equation? Is that a problem?

MR. GILMER: I can address that. I guess staff position is that we're never a hundred percent satisfied and we'll use the BWR Owners Group test to inform our future evaluation of the test protocol.

Our current tools, GOBLIN, RELAP, other LOCA analysis codes, all treat the BWR bundles as essentially pipe flow. And it inherently assumes the square relationship for the pressure drop.

So, right now we're kind of limited to that. And their acceptance criteria inherently assumes that. And the constant 1200 value tells us basically what the limit would be to meet the - all the thermal mechanical operating limits with that 95 percent void condition.

And if we find with the Owners Group test for BWR, which will be conducted at their own schedule, that is, well before even before the STP test protocol comes in either 2012 or 2013.

So, we would certainly be looking at whether the exponent two is appropriate or we need to revisit the whole methodology. I think that generically for the agency, that could be an issue.

DR. WALLIS: Well, I think you're probably right, but it needs a slightly more complete argument which shows that if the pressure drop across the bed goes to, say, the 1.2 power, it doesn't make any difference to your argument.

It needs a little bit more rationale, but I think you can justify this, I think, even though the pressure drop through the bed is not in a square law.

MR. GILMER: Right. I think one other thing I couldn't see is that essentially the acceptance condition calculation treats the fuel bundle as a pipe, and the debris almost like a sharp-edged orifice with variable reduction in area until it's almost -

DR. WALLIS: That's all right as your varying A parameter, nor does it change the flow rate pressure drop, which is determined by the rest of the system. Doesn't really matter what you use as that parameter. You're still going along the same code.

MR. GILMER: Right.

DR. WALLIS: Same operating code.

MR. GILMER: Right. And also in the earlier discussion among the members during the Westinghouse presentation, in the analysis, it does not really matter whether all of that loss happens at the lower tie plate inlet or on the first, second or third grid spacers. The fact is that the -

DR. WALLIS: If you have it in the two-phase region, it would make a difference.

MR. GILMER: It would, but the analysis is basically choking off the flow. And the detailed GOBLIN model is calculating what's happening in the upper portion of the bundle.

And that partly relates to why staff feels that bundle is acceptable for the test. I'll come back to that a little more in a subsequent slide.

As you heard earlier in the Westinghouse presentation, the Westinghouse/ABB LOCA methodology called GOBLIN code, which was approved for BWR 2 through 6, is being used for this license condition acceptance now.

Staff is in the process of reviewing it for - specifically for ABWR, but we believe that the main differences being the internal recirculation pumps, can be treated by modeling differences. And there are no fundamental analytical -

DR. WALLIS: I've looked through your slide. Did you face the question - you were here and you listened to the discussion about the distribution across the core?

MR. GILMER: Yes.

DR. WALLIS: And if you do one test with one fuel element, how do you relate that to the distribution of debris and pressure drop across the core.

Do you have any comments on that?

MR. GILMER: Yes. Well, we see it as - 1152, I believe, is the right number of bundles as being individual parallel pipe flow paths.

DR. WALLIS: It would flow up in them?

MR. GILMER: All with upflow in the normal sense of the ECCS performance. And some portion of those, let's say 152 of those, could be blocked, but we have no idea what the actual percentage of total core blockage would be.

But the other thousand that are unblocked are serving to maintain the water in the upper plenum. And because these individual bundles communicate -

DR. WALLIS: Only at the ends.

MR. GILMER: Only at the ends. If the hot bundle should attempt to dry out, you will get spill flow from the upper plenum.

DR. WALLIS: Also, they're injecting them to the upper plenum.

MR. GILMER: Correct.

DR. WALLIS: Up there as well.

MR. GILMER: Yes.

DR. WALLIS: But there's no question about possible downflow in the cold bundles from the water in the upper plenum?

MR. GILMER: Staff spent a large amount of time looking at the countercurrent flow and the -

DR. WALLIS: But that would direct the debris to the channels in which there's upflow, and so there would be more debris per channel.

MR. GILMER: That's correct. Yes.

DR. WALLIS: So, you have to have some allowance for the small debris per channel. Whether it's judgment or what it is, you have to have some allowance.

They have a factor of 1.7 in order to have more margin or something.

MR. GILMER: Well, staff felt that that was conservative using the highest power bundle to -

DR. WALLIS: The effect is the power bundle, not anything else?

MR. GILMER: No, the -

DR. WALLIS: The power that makes a difference, not other things?

MR. GILMER: Well, there are a lot of things that make a difference.

DR. WALLIS: Yes.

MR. GILMER: The GOBLIN model has a very detailed nodalization of the hot bundle. And then the remaining bundles are represented as average channel. And each one of those has -

DR. WALLIS: there was a question we were asking is how much more debris could be on the hot bundle than the average? And there are several effects that influence that. And I'm not sure it's been totally resolved.

CHAIRMAN ABDEL-KHALIK: I think that remains to be an issue. And the applicant will respond to this open item.

DR. WALLIS: I thought about it and -

CHAIRMAN ABDEL-KHALIK: Right.

MR. GILMER: Well, absolutely the hot bundle could have the larger accumulation of several debris.

DR. WALLIS: And you're going to respond to what they submit.

MR. GILMER: Yes, but we felt that it was acceptable because even if the hot bundle is completely blocked from the bottom -

DR. WALLIS: Cooled from the top.

MR. GILMER: - it will - the rods will still be covered with the water from the top. And also during the time when the key power is high, the top will be fed by the high-pressure core flooder, which will be a clean water source from condensate storage.

DR. WALLIS: Okay.

MR. GILMER: Okay.

MR. WUNDER: Mr. Chairman, excuse me. I know that we were scheduled to get off at - or to complete at 5:00. If we're going to be going for much after 5:00, I know I've got some staff who are going to need to make arrangements.

So, if we're going to be going much after 5:00, if we could get a brief recess, we appreciate it.

CHAIRMAN ABDEL-KHALIK: Okay. Why don't we take a ten-minute break to allow people to make whatever arrangements they need to make.

We will reconvene at ten after.

(Whereupon, the proceedings went off the record at 5:00 p.m. and resumed at 5:08 p.m.)

CHAIRMAN ABDEL-KHALIK: We're back in session. Okay. Mr. Gilmer, please continue.

MR. GILMER: Okay. Hanry corrected me on one thing. I probably was thinking of ESP, because I also was involved in that review on the number of assemblies -

DR. WALLIS: It's not 1100.

MR. GILMER: Hanry thought it was 820 rather than 1150, but the concept is still -

(Simultaneous speakers.)

MR. GILMER: Okay. I'll try to accelerate as much as possible.

Westinghouse told you earlier that the assumption in the analysis was at the five-minute level for decay heat post-LOCA. And staff reviewed that assumption during an audit of the calculation and we're satisfied that that's a very conservative assumption.

We also looked at the transport time of

debris considering the operating systems, and we feel that it's appropriate.

You heard a lot about the assumption on the hot bundle. So, I won't belabor that. And no credit for engineered bypass or high-pressure core flood flow.

DR. WALLIS: Assuming that it would be beneficial.

MR. GILMER: Right. And the debris accumulation was simulated by a rapid, like over one minute, reduction in the inlet flow area in the hot bundle.

DR. WALLIS: Because in reality, it takes a long time.

MR. GILMER: It does. Over several hours. Well, since the decay heat is the same constant, the timed element is kind of taken out of the problem.

Next slide. Okay. We did spend a fair amount of staff review time on looking at the appropriateness of the 95 percent void fraction. And Westinghouse stated that's when the boiling transition is -

DR. WALLIS: What kind of boiling transition is that?

MR. GILMER: I'm sorry?

DR. WALLIS: What kind of transition is that? They're seeing film boiling anyway. Understood they assume film boiling anyway to be conservative.

So, what kind of transition are they talking about?

MR. GILMER: Well, that would be from nucleate to -

DR. WALLIS: I thought they already assumed film boiling.

MR. JAIN: That is true. Because we assumed pending scale LOCA assumption. So, once they departed from nucleate boiling, we stayed in film boiling. Didn't allow it to piggyback.

DR. WALLIS: So, what is this boiling transition here?

MR. JAIN: To the steam cooling.

DR. WALLIS: Steam cooling. To dry out or something?

MR. JAIN: Yes.

DR. WALLIS: So, transition from film boiling to steam cooling with the droplets not hitting the wall?

MR. JAIN: Right. If our void fraction reaches one, after that the steam cooling would be. And that's what we want to avoid because that's when you start to see the increase in temperature because of super heating of the steam.

DR. WALLIS: But even when you have some droplets, they don't all hit the wall. They may not cool as effectively as water.

MR. JAIN: Right. You know, that requires nonequivalent code and so there is a little --

DR. WALLIS: I'm just saying that quality of one isn't necessarily the limiting condition.

MR. JAIN: In reality, you're right. There are some droplets. And that would keep the steam at close to saturation conditions. That is correct.

MR. GILMER: Okay. Staff agrees with Westinghouse that if you were to -

DR. WALLIS: There's no experimental verification that 0.95 is the right value?

MR. GILMER: No, there's not.

DR. WALLIS: Somebody's judgment?

MR. GILMER: Yes, and staff is comfortable with that that all the thermal mechanical -

DR. WALLIS: Someday I'm going to keep an inventory of how many decisions are based on judgment.

CHAIRMAN ABDEL-KHALIK: All you need to do is look at the calculated cladding temperatures.

MR. GILMER: Right.

DR. WALLIS: Very, very low.

CHAIRMAN ABDEL-KHALIK: Right.

MR. GILMER: Yes, and that's a good reason why -

DR. WALLIS: Well, that's at the mid-point, isn't it?

CHAIRMAN ABDEL-KHALIK: What was that?

DR. WALLIS: Wasn't that at the mid-point or the top?

CHAIRMAN ABDEL-KHALIK: That was the value calculate corresponding to 95 percent.

DR. WALLIS: It's still very, very low.

MR. GILMER: Right.

DR. WALLIS: So, there is a quantitative argument. It's not just judgment. Based on a quantitative argument, that's much better.

MR. GILMER: Okay. Thank you.

Staff agrees with the Westinghouse position the feedwater line break is limiting large LOCA for this blockage scenario. And we reviewed the calculation at the Westinghouse office.

The guillotine break is assumed in one of the two feedwater lines connected to the feedwater sparger. And as I said previously, no credit was taken for the high-pressure injection from the top of the core. And also, a substantial portion of the inlet flow was assumed to be blocked.

And what saves the day is the unblocked channels replacing any of the hot bundle water that boils off.

DR. WALLIS: So, what you say saves the day is different from what we heard this morning. You're saying that the unblocked channels bring water on the top, and then it comes back down into the blocked channel.

Is that what you said?

MR. GILMER: Yes, that's - basically, yes.

CHAIRMAN ABDEL-KHALIK: This is the alternate calculation assuming full blockage.

DR. WALLIS: Okay. That's why they don't need to take any credit for the injection on the top, because the water comes around the top anyway.

MR. GILMER: Right, from the rest of the core.

DR. WALLIS: Rest of the core. Thank you.

MR. GILMER: And considering the very small total debris source -

DR. WALLIS: Yes.

MR. GILMER: - we think that a very small fraction of the total core will be blocked as well.

And the assumption that the two trains of low-pressure core flooder are available and staff is comfortable with.

The staff performed a series of audits at the Westinghouse office to look at several issues that we were concerned about.

The key one was whether the model analyzed Optima fuel could appropriately represent the certified GE-7 fuel. And Westinghouse did a fairly detailed presentation comparing the design differences.

And also, staff looked at the operating fleet mixed cores and just satisfied ourselves that hydraulically they're similar enough that their analysis is appropriate.

The next bullet I need to clarify a little bit. The assumption of no high-pressure injection being beyond design basis, I should say that is true for a large LOCA.

There is a scenario where one train of high-pressure core flood is - a break is postulated, and the other train has a single failure of the pump or other portion that makes it also unavailable. But that's a much smaller break.

So, the Westinghouse acceptance criteria calculation is based on only the low-pressure injection from the downcomer. And staff believes that's conservative because the other pathways are not credited.

And in the GE design cert, at least one train of HPCF was credited.

DR. WALLIS: but not further debris from them.

MR. GILMER: Yes, that's correct.

And the reason why staff believes the acceptance criteria calculation is acceptable, in summary, the Optima-2 fuel, which is currently the planned fuel to be loaded, and the GE-7 certified fuel are sufficiently similar.

And we believe that the constant decay heat load assumption is very conservative. And then the 1200 in the earlier discussion that is derived in the calculation, actually includes a significant reduction from the true calculated value.

DR. WALLIS: But that's not really - I mean, it's used to relate the calculated to measured flow rates, but the calculated constant gives you a margin of four or something to the point where you actually get too much resistance to cool that bundle.

MR. GILMER: That's correct.

DR. WALLIS: So, that's why it's good. It's not there because it relates the calculated to measured flow rates. You have to do it anyway.

The criterion of 1200 is based on adequate cooling of the bundle, not based on some relationship between flow rates, isn't it?

MR. GILMER: You're absolutely right. That's a better way to say it.

The 95 percent void fraction criteria we believe acceptably meets the -

DR. WALLIS: That is supported by clad temperature?

MR. GILMER: Definitely. Thank you.

DR. WALLIS: Right.

MR. GILMER: The next bullet we see substantial flow are reduction, there was a case with a hundred percent blockage as mentioned by Westinghouse.

And no credit assumed fro the top of the bundle due to high-pressure core flood. There is certainly credit taken from the other assembly.

The one remaining thing that I have not discussed that was brought up this morning is the crud layer buildup, there was a thermal calculation that, as Westinghouse said, showed about a 30-degree

Fahrenheit increase.

And the crud properties and thickness were based on the Westinghouse fuel experience, and staff believes that's appropriate.

Next slide. Regarding testing, as I said before, staff expects to receive the results of the test 18 months prior to plant fuel load.

And the details are described in FSAR Appendix 6C, which you've heard a brief summary earlier today.

Regarding the partial height fuel bundle, there are a number of reasons why we think it's acceptable.

We believe that the - since the calculation applies blockage as a single value at one location, we didn't think it really mattered at what point the bundle is blocked. The fact is that it's - the flow is going to be blocked.

DR. WALLIS: As long as it's not too high up in the bundle.

MR. GILMER: Right. And, really, the GOBLIN code is predicting what does happen in the upper portion of the bundle. That's where the 95 percent criterion comes in.

DR. WALLIS: You heard our discussion about different protocols and doing several tests at the worst condition so that you get some idea of repeatability and so on so that we can get some idea of what the margins really are.

MR. GILMER: Yes. When we do receive the test protocol, we expect to -

DR. WALLIS: Because there seems to be a tendency to do too few tests. The AP-1000 did a lot of tests. Some of these Owners Group tests, there aren't very many tests.

And so, we come back with all the questions and they do more tests. So, I'd rather do all the tests at the beginning and really do it right.

MR. GILMER: We hope to provide that kind of feedback on the test uncertainty evaluation, how many tests physically they will be looking at.

As Westinghouse said, they'll be looking at a range of flow rates that was looking at in terms of kilograms per second. Like one to five, I think.

And as we discussed earlier, the test will be done with sub-cooled water, which maximizes the pressure drop, but - well, staff hopes to -

DR. WALLIS: As long as it stays single phase.

MR. GILMER: Correct. And we believe that it will because of the downflow from the other bundles.

Okay. The summary. Staff finds that there's a reasonable assurance of safety now for the COL for several reasons. And the key one is that the ABWR design for large LOCA, there is no core recovery.

Initially when the heat load is high, there will be clean water sources; the high-pressure core flood and the RCIC from condensate storage tank.

And the suppression pool also will be clean initially. And there's a very tortuous path to get introduced debris from the line break locations.

We believe that the tests described are consistent with the other design-centered tests and the experience to date. And at this point, we believe it's acceptable.

And STP is committed to take lessons learned and apply that when the test protocol is finalized.

CHAIRMAN ABDEL-KHALIK: Okay. Thank you.

MS. JOSEPH: Okay. The next part of our presentation specifically addresses the ECCS action item on long-term cooling. Hanry and Jim are going to address this portion. So, Hanry.

MR. WAGAGE: My name is Hanry Wagage.

Stacy and Jim Gilmer and I are going to present long-term cooling in response to ACRS Action Item Number 52.

ABWR ECCS consists of three residual heat removal pumps, two high-pressure core flooder pumps and one reactor core isolation pump.

RHR and HPCF pumps provide long-term cooling after loss of coolant accident. RHR system operating in suppression pool cooling mode maintains long-term suppression pool temperature.

STP showed by using GOTHIC computer code analysis, that ABWR's peak containment pressure and temperature after a LOCA would stay below containment design pressure and temperature.

The staff confirm STP's results by using MELCOR to perform complementary analysis. The applicant for ABWR design certification showed by analysis that after a loss of cooling accident, the reactor pressure vessel would stay above - the reactor pressure vessel level would stay above the active fuel and adequate core cooling will be maintained.

As stated in ABWR final safety analysis report, during this review the staff verified that the ABWR ECCS meets the performance criteria in 10 CFR 50.46, including the criterion on long-term cooling.

STP resolved all the relevant safety issues related to 10 CFR 50.46(b)(5), including the following: ECCS strainer performance, in-vessel downstream effects, gas accumulation in ECCS system piping.

Of these, I will be discussing the ECCS strainer performance. And James Gilmer will be discussing the other two items.

STP used Reg Guide 1.82 Rev 3 guidance to design its ECCS suction strainers. STP strainers are the same design as that at reference Japanese ABWR plant.

The only thermal insulation in this type of containment if reflective metallic insulation reduce smaller debris head loss on the ECCS strainer than other types of insulation.

The stainless steel liner in the STP suppression pool limits corrosion products in the suppression pool.

Suppression pool cleanup system continually removes debris from the suppression pool during operation.

As described in Section 62171 of FSAR, and operation program on suppression pool cleanliness is to be - is to ensure that the primary containment is free from debris that could become dislodged in an accident and be transported to the ECCS strainers and interfere with their proper functioning during design-basis event.

As mentioned before, RMI is the only insulation material in STP containment. STP prohibits using fiber and calcium silicate used in the reference Japanese ABWR plant.

STP containment does not have aluminum or trisodium phosphate, reduce chemical precipitates that cause debris head loss on the ECCS suction strainer and downstream effects on fuel and component.

DR. WALLIS: But it does have zinc.

MR. WAGAGE: Yes.

DR. WALLIS: It has zinc instead of these things.

MR. WAGAGE: Yes, it has zinc.

Our next presenter is James Gilmer.

MR. GILMER: In summary for the in-vessel effects, STP has demonstrated through their GOBLIN analysis -

DR. WALLIS: And this is the same question that was raised earlier to the applicant. They have not demonstrated that 0.95 void fraction is maintained.

They demonstrated that if 0.95 - or 0.95 void fraction will be maintained if the fuel passes the acceptance test.

MR. GILMER: Yes, that's a better way of stating it.

The calculated peak cladding temperature is well within the 10 CFR 50.46 limits actually by a large margin.

And there are diverse ECCS injection sources for the ABWR design and multiple flow paths available.

And finally, fuel tests must be satisfactorily completed to demonstrate -

DR. WALLIS: The statement here looks like a prediction.

MR. GILMER: Yes.

MS. JOSEPH: In order for them to meet the license condition, they have to pass it.

DR. WALLIS: Fuel tests must demonstrate.

MS. JOSEPH: I think that's the bottom line.

CHAIRMAN ABDEL-KHALIK: Let's continue.

MR. GILMER: Okay. Next slide. Regarding gas accumulation as Westinghouse presented earlier, the ABWR design considers the Generic Letter 2008-01 regarding managing gas accumulation.

And the key points of that are the keep fill system that maintains all ECCS lines filled with water. And then second, the technical specification requirements for venting, as discussed earlier.

And in conclusion, the staff believes that for South Texas, adequate core cooling can be maintained. And the containment pressure and temperature are maintained below the design values. And finally, South Texas will meet 10 CFR 50.46(b)(5).

MS. JOSEPH: Just in summary, we had a couple of action items from the last meeting. Items 47 A and B, we believe we tried to address today. 48 providing the ERI reports on containment, we've done that. And the staff has briefed ACRS on long-term cooling.

In addition, there was another action item, Item Number 50, that requested we perform a separate presentation on the Toshiba strainer reports.

As we discussed, we didn't specifically provide a separate presentation, but we hope that the background we gave today also completes that action item.

CHAIRMAN ABDEL-KHALIK: Thank you.

MS. JOSEPH: And that completes our

presentation.

CHAIRMAN ABDEL-KHALIK: Are there any questions - are there any additional questions for the staff?

Okay. Thank you. At this time, I would like to open the phone bridge line to see if there are any members of the public who would like to make a statement or provide any comments.

Is the phone bridge line open?

Could you please verify?

MS. BANERJEE: I will check.

CHAIRMAN ABDEL-KHALIK: Thank you. We're waiting for the phone bridge line.

If there is anyone on the phone, please identify yourself.

PARTICIPANT: The bridge is open.

CHAIRMAN ABDEL-KHALIK: Okay. If there is anyone on the phone, please identify yourself. Is there anyone - excuse me. Could you please repeat?

Well, there is somebody on the line. Is there anyone on the line who wishes to make a statement or provide comments?

Is there anyone in the room who wishes to provide comments or make a statement?

At this time, maybe we'll go around the -

MEMBER STETKAR: There seems to be mumbling up there.

CHAIRMAN ABDEL-KHALIK: I haven't heard anything.

Okay. At this time, we'll go around the room and see if there are any additional comments that members would like to make. We'll start with Mike.

MEMBER CORRADINI: No, I have no other comments.

MEMBER RYAN: None.

CHAIRMAN ABDEL-KHALIK: Okay.

MEMBER BROWN: No additional comments. Thank you.

CHAIRMAN ABDEL-KHALIK: Sam?

MEMBER ARMIJO: Same here.

CHAIRMAN ABDEL-KHALIK: John?

MEMBER STETKAR: Nothing.

CHAIRMAN ABDEL-KHALIK: Dennis?

MEMBER BLEY: Nothing new.

CHAIRMAN ABDEL-KHALIK: Okay.

DR. WALLIS: Nothing new. I'll write you a letter summarizing some of these things.

CHAIRMAN ABDEL-KHALIK: All right. We have, I guess, as we went along today, captured all the follow-up items that came up during the day. I know we closed a few, but we've probably opened more than what we've closed, but we'll follow up on that. And I think Maitri will just make sure that we have the right list.

Okay. With that, I'd like to thank both the applicant and the staff for very informative presentations today. And we will continue tomorrow.

(Whereupon, the meeting was adjourned at 5:36 p.m.)

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Advanced SER Chapter 6 "Engineered Safety Features" and Long Term Cooling

March 8, 2011

ACRS Subcommittee Presentation Advanced SER Chapter 6

Staff Review Team

- **Project Managers**
  - George Wunder
  - Stacy Joseph
- **Technical Staff**
  - SBCV Reviewers - Andrzej Drozd, Hanry Wagage, Eric Miller, Syed Haider, Raj Goel, Edwin Forrest
  - SRSB Reviewers - George Thomas, James Gilmer
  - CIB2 Reviewers - Robert Davis, Eduardo Sastre-Fuentes, Timothy Steingass
  - CIB1 Reviewer - Gregory Makar

Overview of Chapter 6 Review Topics of Interest

Chapter 6 Open Items	Containment Control Room Habitability
Emergency Core Cooling System (ECCS) Suction Strainers	Latent Debris Assumptions Chemical Effects Downstream Effects on Fuel
Long Term Cooling	Strainer Performance In-Vessel Effects Gas Accumulation
Summary of ACRS Action Items	Action Items 47a, 47b, 48 and 52

Summary of Open Item Closure

7 Open Items in SER with OIs	
06.02.01.01.C-14	Confirmation of revised mass and energy conservatism
06.02.01.01.C-15	Vent loss coefficient FSAR update
06.02.01.01.C-16	Pressure FSAR update
06.02.01.01.C-17	Vacuum breaker protection
06.02.01.01.C-18	Pressure and Temperature FSAR update
6.02.02-27	ECCS suction strainers chemical effects
06.04-2	Toxic gas calculations

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ECCS Suction Strainers and Long Term Cooling

- Hanry Wagage
  - Overview of Debris Strainer Design
  - Latent Fiber Bypass Fraction (ACRS Action Item #47b)
- Gregory Makar
  - Coatings Evaluation
  - Downstream Effects on Components
  - Chemical Effects (Open Item 06.02.02-27)
- James Gilmer
  - Downstream Fuel Effects License Condition (Open Item 04.04-3, ACRS Action Item #47a)

Highlights of Debris Strainer Design

- STP followed RG 1.82 Revision 3 guidance
- All stainless steel reflective metallic insulation (RMI)
- *Not* used in the containment:
  - Fiber, CalSil, Al, or TSP
- Suppression pool cleanliness program
- In-service inspection program
- CCI pocket type strainers with 2.1-mm (1/12-inch) diameter holes

Highlights of Debris Strainer Design *(cont.)*

- Two T-connected strainers per each pump (3 RHR, 2 HPCF, 1 RCIC)
- ITAACs for ECCS pump NPSH based on as-built system
- Alternate AC independent water addition mode of RHR

STP Strainer Sizing

- STP used a reference Japanese ABWR (RJABWR) design
- RJABWR uses fiber and CalSil
- STP replaces fiber insulation with RMI
- RJABWR design uses pump design flow rate while STP design uses pump runout flow
- STP used NUREG/CR-6808 correlation for head loss from RMI
- STP strainer design is conservative and acceptable

Latent Fiber Debris Bypass
ACRS Action Item #47b

- STP assumed latent fiber debris of 0.028 m^3 (1 ft^3)
- STP's February 22, 2010, RAI 04.04-3 response: 10% latent fiber debris bypass
- The staff requested the applicant to justify 10% fiber bypass fraction
- STP's January 6, 2011, RAI 04.04-4 response: 100% fiber bypass fraction
- Latent fiber debris bypass fraction is acceptable and this is a confirmatory item

Coatings Evaluation

- Inorganic zinc with epoxy topcoat (qualified coatings only)
- Applied to carbon steel liner above wetwell and to concrete floor
- Applicant assumes 85 pounds of debris based on the staff's approval of NEDO-32686-A
- Coating debris included in strainer testing in accordance with staff guidance on coatings
- License condition for fuel assembly testing includes coating debris as fine particles, which conforms to the staff guidance for potential thin-bed conditions

Downstream Effects on Components

- Applicant proposed using WCAP-16406-P-A to address downstream components (after completing design details)
- The staff evaluated the applicability of the WCAP-16406-P-A methodology based on the component types and materials
- The staff concluded the methodology and acceptance criteria are acceptable

Chemical Effects
Status at June 2010 briefing

- Iron oxide included in strainer head loss testing
- Zinc present only in the form of inorganic zinc coating
- No aluminum included in the design
- Latent aluminum is assumed (4.5 ft^2)
  - Quantity based on preventing precipitation
- Open Item 6.2.2-27 related to:
  - Solubility and precipitation of aluminum-base solids
  - Form of inorganic zinc debris (particulate or gelatinous)
  - Contribution from exposed concrete
  - Impact on in-vessel downstream effects

Chemical Effects
Resolution of Open Item 6.2.2-27

- Aluminum
  - Precipitate total 0.1 lb
    - Aluminum oxyhydroxide
    - Sodium aluminum silicate
  - Based on use of WCAP-16530-NP-A with inputs for aluminum and concrete
  - WCAP methodology and assumed precipitation of all dissolved Al conforms to staff guidance for PWRs
  - Use of WCAP corrosion equations acceptable
    - Similar water chemistry
    - Conservative assumption of complete precipitation

Chemical Effects Resolution of Open Item 6.2.2-27

- Zinc
  - From inorganic zinc coating (47 lb)
  - Uncertainties:
    - Exposed zinc surface area
    - Corrosion rate
    - Form of zinc precipitate(s)
  - Applicant proposal:
    - Assume coating is 100% zinc
    - Coating reduced completely to small particles
    - Zinc coating completely corroded at low pH
    - Zinc precipitates as zinc oxide (ZnO)

Chemical Effects
Resolution of Open Item 6.2.2-27

- Zinc
  - The staff accepted a baseline approach for PWRs that uses conservative assumptions to balance uncertainty
  - Conservative assumptions applied to inorganic zinc
    - Inorganic zinc coating is 100% zinc metal
    - Coating is completely reduced to particles
    - All of the particles are 10 micrometers in diameter
  - Areas of uncertainty for inorganic zinc
    - Precipitate is zinc oxide (zinc could form precipitates with a higher molecular weight)
    - WCAP-16530-NP-A corrosion rate equations apply

Chemical Effects
Resolution of Open Item 6.2.2-27

- Zinc
  - The staff finds:
    - It is reasonable to apply the WCAP corrosion rate equations
      - Corrosion of zinc is strongly pH-dependent
      - Boron is not considered an inhibitor
    - It is reasonable to assume zinc oxide precipitate based on generic zinc corrosion literature
      - Zinc oxide or hydroxide predicted in water
    - The applicant’s chemical debris analysis of zinc is acceptable

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Chemical Effects
Effect of Precipitates

- Strainers
  - No head loss (no fiber bed)
  - Conforms to staff guidance on GL 2004-02 closure
- Core
  - Potential effects
  - Include chemical debris in downstream analysis
  - Use surrogate chemicals in fuel assembly test
  - Evaluate deposition on fuel
  - Approach conforms to staff guidance
  - Some details not addressed in guidance

Chemical Effects
Fuel Assembly Testing

- Post-LOCA pH transient covers a range
  - Acceptable to use the highest chemical debris quantity predicted within the pH range
- Proposed aluminum oxyhydroxide surrogate for aluminum containing precipitates conforms to staff guidance
- Staff guidance does not address zinc oxide surrogate
- The staff finds it:
  - Conservative to assume all zinc oxide is gelatinous
  - Acceptable to use WCAP aluminum oxyhydroxide as a surrogate for zinc based on its demonstrated effect on head loss
- Therefore, aluminum oxyhydroxide is an acceptable surrogate for all chemical debris in the fuel assembly test

Downstream Effects on Fuel License Condition Requirement

- Certified ABWR design does not address downstream effects of fuel blockage
- Certified GE-7 (8x8) fuel has not been tested for the effects of blockage
- STP committed to license condition requiring testing for the fuel to be loaded
- License condition and test plan overview described in FSAR Section 6C
- Staff review provided in FSER Chapter 6

Downstream Effects on Fuel

- In response to RAI 04.04-4, STP proposed a license condition which requires fuel testing prior to fuel loading:
- “A downstream fuel effects test will be conducted and the results provided to the NRC no later than 18 months prior to fuel load. The test plan, analysis basis, and debris assumptions are described in Appendix 6C.3.1.8. The test procedure will be provided to the NRC no later than 24 months prior to fuel load. The acceptance criteria for this test are based on the following pressure drop equation.”

STP Fuel Test Acceptance Criterion

$$\left[\frac{\Delta P_f}{\Delta P_i}\right]_{(Test-Measured)} \leq 1200 * \left(\frac{W_f}{W_i}\right)^2_{(Test-Measured)}$$

Notes: i denotes initial (i.e unfouled condition), “ f ” indicates fouled conditions, “1200” is the analysis value and “W” is the flow rate into the fuel assembly

STP Fuel Analysis

- Used staff-approved LOCA method (GOBLIN)
- Assumed constant decay heat at 5 minutes post-LOCA
- Model evaluates ‘hot’ bundle performance
- No credit for bypass or HPCF flow
- Debris accumulation is simulated by rapid reduction in inlet flow area

STP Analysis Method

- Calculated flow coefficient is determined assuming the void fraction is < 0.95 (representative of steam boiling transition in the GOBLIN model)
- Feedwater line break is the limiting case, since it results in the minimum reactor vessel water level

STP Analysis *(cont.)*

- Feedwater(FW) line break is assumed in one of the two FW lines connected to the FW sparger
- STP performed analyses assuming no high pressure injection from the top of the core and assuming substantial core inlet blockage
- Analysis assumes Low Pressure Flooder Pumps are running (2 trains)

Staff Review

- Staff audited the calculation which provides the bases for the acceptance criterion (which bounds both GE-7 and Optima-2 fuel)

- Since there are two high pressure injection paths, scenario with no high pressure injection is beyond DBA

- Calculations and criterion are based only on downcomer low pressure injection flow, which is conservative

- In the DCD LOCA analyses, at least one HPCF train is credited

Staff Audit Conclusions

- Calculation approach is acceptable because:
  - Optima2 and GE-7 fuel are sufficiently similar hydraulically
  - Decay heat load maintained constant at level prior to debris reaching fuel
  - Calculated constant(1200) conservatively relates the calculated to measured flow rates
  - 95% void fraction condition used as acceptance value
  - Substantial flow area reduction modeled
  - No credit for flow from the top from HPCF sparger
  - Calculation considers crud layer on fuel rods based on Westinghouse BWR fuel experience

Testing

- Tests will be performed 18 months prior to fuel loading
- STP provided the description of the test plan in FSAR Appendix 6C
  - Single partial height fuel assembly as in PWROG testing
  - Follow the PWROG test plan for debris preparation, addition of debris and monitoring pressure drop
  - Several tests at a range of flow rates
  - Sub-cooled water is used as in the PWROG test
- STP will submit detailed test protocol prior to testing

Downstream Fuel Effects Conclusion

- No core uncovery
- Clean water sources for HPCF and RCIC
- Conservative assumptions in the analysis
- Test Description is consistent with other design center tests and is acceptable
- Test protocol and test results will be submitted to the staff

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Protecting People and the Environment

Long-Term Cooling for ABWR STP Units 3 and 4

ACRS Action Item #52

ABWR Long-Term Cooling

- Long-term core cooling is provided by RHR and HPCF pumps
- Long-term suppression pool temperature is maintained by operating RHR on suppression pool cooling mode
- Analysis showed that containment pressure can be maintained below its design value
- Analysis showed that adequate core cooling can be maintained by keeping the RPV level above the top of active fuel

ABWR Long-Term Cooling *(cont.)*

- ABWR STP Units 3 and 4 resolved all the relevant safety issues related to 10 CFR 50.46(b)(5) including:
  - ECCS strainer performance
  - In-vessel downstream effects
  - Gas accumulation in ECCS system piping

Strainer Performance

- STP 3 and 4 ECCS suction strainers designed according to RG 1.82 Rev. 3
  – Bounded by RJABWR strainer analysis and testing
- Primary containment 100% RMI
- Suppression pool
  – Stainless steel liner
  – Suppression pool cleanup system
- FSAR captures FME and cleanliness programs
- Restricted from containment: fiber, CalSil, Al, or TSP

In-Vessel Effects

- STP demonstrated through analysis that 0.95 void fraction is maintained
- STP calculated peak cladding temperature is within criteria specified in 10 CFR 50.46
- There are diverse ECCS injection sources and injection paths to core
- Fuel tests will demonstrate that low impact on core flow due to debris blockage

Gas Accumulation

- GL 08-01, “Managing Gas Accumulation in Emergency Core Cooling, DHR and Containment Spray Systems,” January 11, 2008.
  - ABWR ECCS discharge line "keep fill" systems provided will maintain all pump discharge lines filled with water
  - ABWR Technical Specifications requirement for venting will increase ECCS pump reliability

Long-Term Cooling: Conclusion

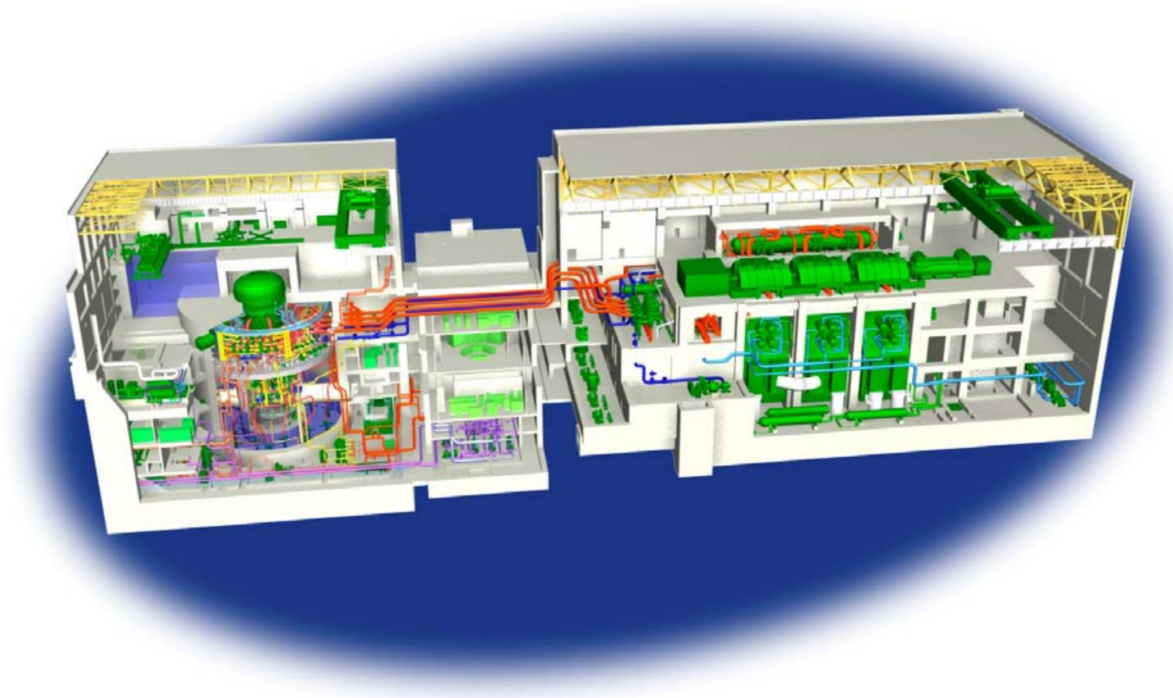
- Adequate core cooling is maintained
- Containment pressure and temperature are maintained below containment design values
- STP meets 10 CFR 50.46(b)(5)

Summary of Chapter 6 ACRS Action Items

Action Item #47a	Downstream Effects: future briefing on test and analysis (license condition) – COMPLETE
Action Item #47b	Downstream Effects: basis for assuming destroyed fiber (10% of 1 ft^3 reaching fuel) – COMPLETE
Action Item #48	Provide three ERI reports used in staff review of containment analysis - COMPLETE
Action Item #52	Staff to brief ACRS on Long Term Cooling - COMPLETE

South Texas Project Units 3 & 4 Presentation to ACRS Subcommittee

Chapter 6: Engineered Safety Features



Agenda

- Introduction
- Attendees
- Chapter 6 Overview
- Recent Topics
- ACRS Action Items
- ECCS Suction Strainers
- Downstream Fuel Effects
- Long Term Cooling
- Conclusion

Attendees

Scott Head	NINA Manager, Regulatory Affairs, STP 3&4
James Tomkins	NINA Licensing, STP 3&4
Tom Daley	NINA Engineering, STP 3&4
Caroline Schlaseman	MPR/TANE
Kenji Arai	Toshiba
Martin Van Haltern	Westinghouse
Nirmal Jain	Westinghouse
Tim Andreychek	Westinghouse
Mary Richmond	Bechtel

Introductory Remarks

- STP 3&4 design is inherently robust with regard to core cooling integrity
  - Large piping is above core
  - Multiple water supply sources
  - Multiple core cooling paths (direct flow, bypass flow, HPCF), each of which on its own provides adequate cooling water flow
  - Fiber and aluminum precluded from containment by design / programs and zinc minimized
  - Reasonable assurance that licensed fuel will meet downstream effects
  - License condition to test the specific fuel to be used in the first cycle 18 months prior to fuel load
  - Conservative fuel test acceptance criteria

Chapter 6 Overview

- Four Chapter 6 based departures
- Significant changes due to containment re-analysis (6.2) and revised ECCS suction strainers (6C)
  - Containment Analysis was discussed in detail at the previous meeting
  - ECCS Suction Strainers, including chemical and downstream effects, will be discussed in detail as part of this presentation
- All COL Information Items completed
- No DAC in Chapter 6
- All Open Items Closed

Acronyms

ADS	Atmospheric Depressurization System
CST	Condensate Storage Tank
DW	Drywell
FME	Foreign Material Exclusion
FW	Feedwater
HPCF	High Pressure Core Flooder
LPFL	Low Pressure Core Flooder (RHR)
LTC	Long Term Cooling
MSIV	Main Steam Isolation Valve
NPSH	Net Positive Suction Head
PCT	Peak Clad Temperature
R/B	Reactor Building
RCIC	Reactor Core Isolation Cooling

Acronyms *(Continued)*

RCW	Reactor Building Cooling Water
RHR	Residual Heat Removal
RJ-ABWR	Reference Japanese ABWR
RMI	Reflective Metal Insulation
RPV	Reactor Pressure Vessel
RSW	Reactor Service Water
SDC	Shutdown Cooling
S/P	Suppression Pool
SR	Surveillance Requirement
SRV	Safety Relief Valve
TS	Technical Specifications
UHS	Ultimate Heat Sink
VB	Vacuum Breaker
ZOI	Zone of Influence

Recent Topics

- Confirmation of FW design used in containment analysis
  - RAI 06.02.01.01.C-14 confirmed that containment analysis will be checked against final feedwater design as part of ITAAC
- Vacuum Breaker shield design
  - RAI 06.02.01.01.C-17 provided preliminary design details
  - This will be covered as part of ACRS Action Items

Recent Topics *(continued)*

- Differences between STP and NRC Staff Toxic Gas Analysis
  - RAI 06.04.-2 reconciled differences between the analyses
- Minor administrative corrections to COLA
  - RAIs 06.02.01.01.C-15, 16, and 18

ACRS Action Items

- Action Item # 46
  - *Provide assumptions used for boron concentration in chemical effects evaluation*

Boron Concentration

- The acceptable concentration of Sodium Pentaborate Solution in the SLC system tank, as a function of temperature, is shown in the STP 3&4 COLA Tech Spec Figure 3.1.7-1
  - The minimum acceptable concentration (by weight) in the SLC tank is 13.4% sodium pentaborate; the maximum concentration is 23.2%
- At the time this question was asked, STP 3&4 was using solubility data from ANL Report “Aluminum Solubility in Boron Containing Solutions as a Function of pH and Temperature,” to determine the quantity of latent aluminum that would remain in solution; now, no credit is taken for solubility of any aluminum corrosion products

ACRS Action Items *(continued)*

- Action Item # 47
  - *Future briefing on downstream test and analysis*
  - *10% vs. 100% bypass of strainer for 1 ft^3 of latent fiber*
  - To be discussed later in presentation

ACRS Action Items *(continued)*

- Action Item # 49
  - *Future briefing on vacuum breaker shield*

Vacuum Breaker Shield Design

- Designed to protect Wetwell-to-Drywell Vacuum Breakers from pool swell impact
- Mounted just below vacuum breakers
  - Welded to RPV Pedestal Wall
- Each of 8 vacuum breakers has its own shield
- V-shape of shield directs upward pool swell away from vacuum breaker

Vacuum Breaker Shield Design
(continued)

- Load from “fallback” of water after pool swell considered in design
  - Pool swell height less than 5 ft. above vacuum breaker
  - Water slug not solid because it is already broken up by deflector plate
  - Strictly a water free fall
- Vacuum breaker operation required much later in accident sequence after pool swell and fallback

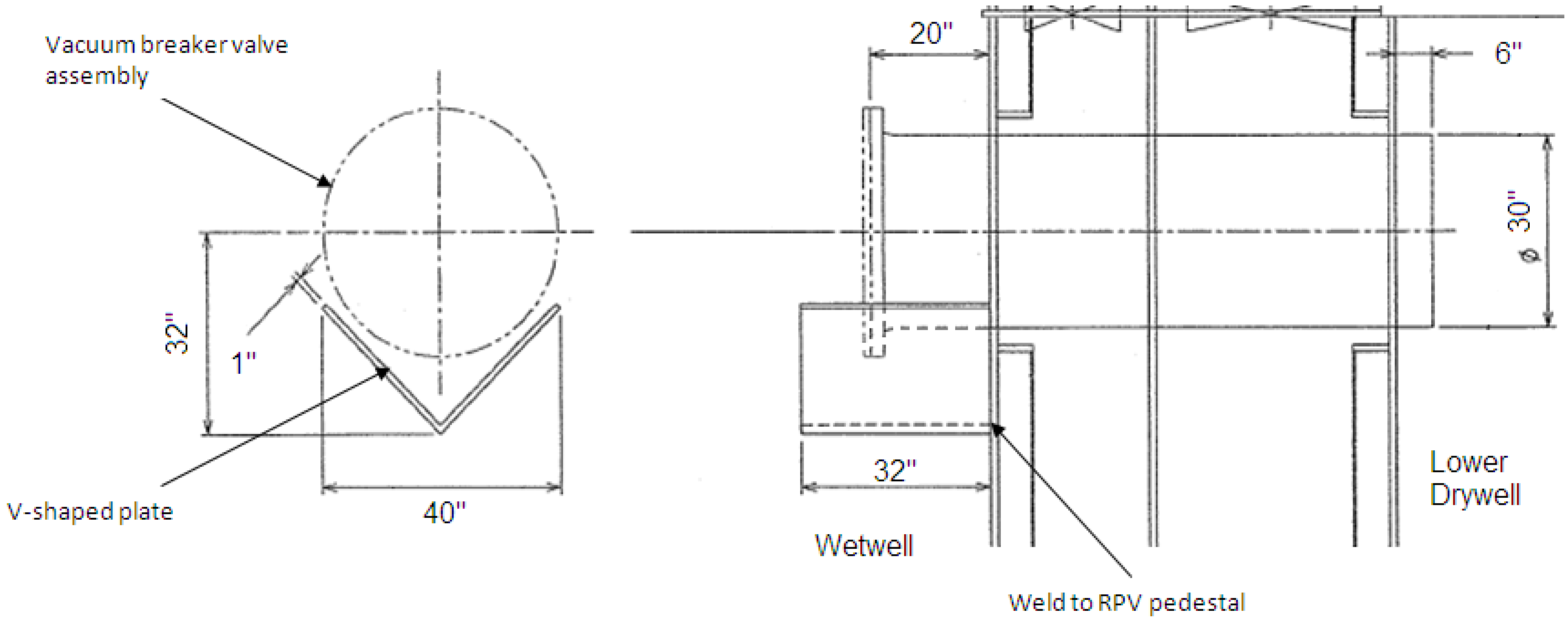
Vacuum Breaker Shield Design

(continued)

- Vacuum breakers designed to operate in water rich environment such as after operation of wetwell containment sprays
- Design information
  - Seismic Category I
  - Not directly attached to the vacuum breaker
  - Made of coated carbon steel
  - Typical dimensions as shown on next figure (actual dimensions may be modified as design is finalized)

Vacuum Breaker Shield Design

(continued)



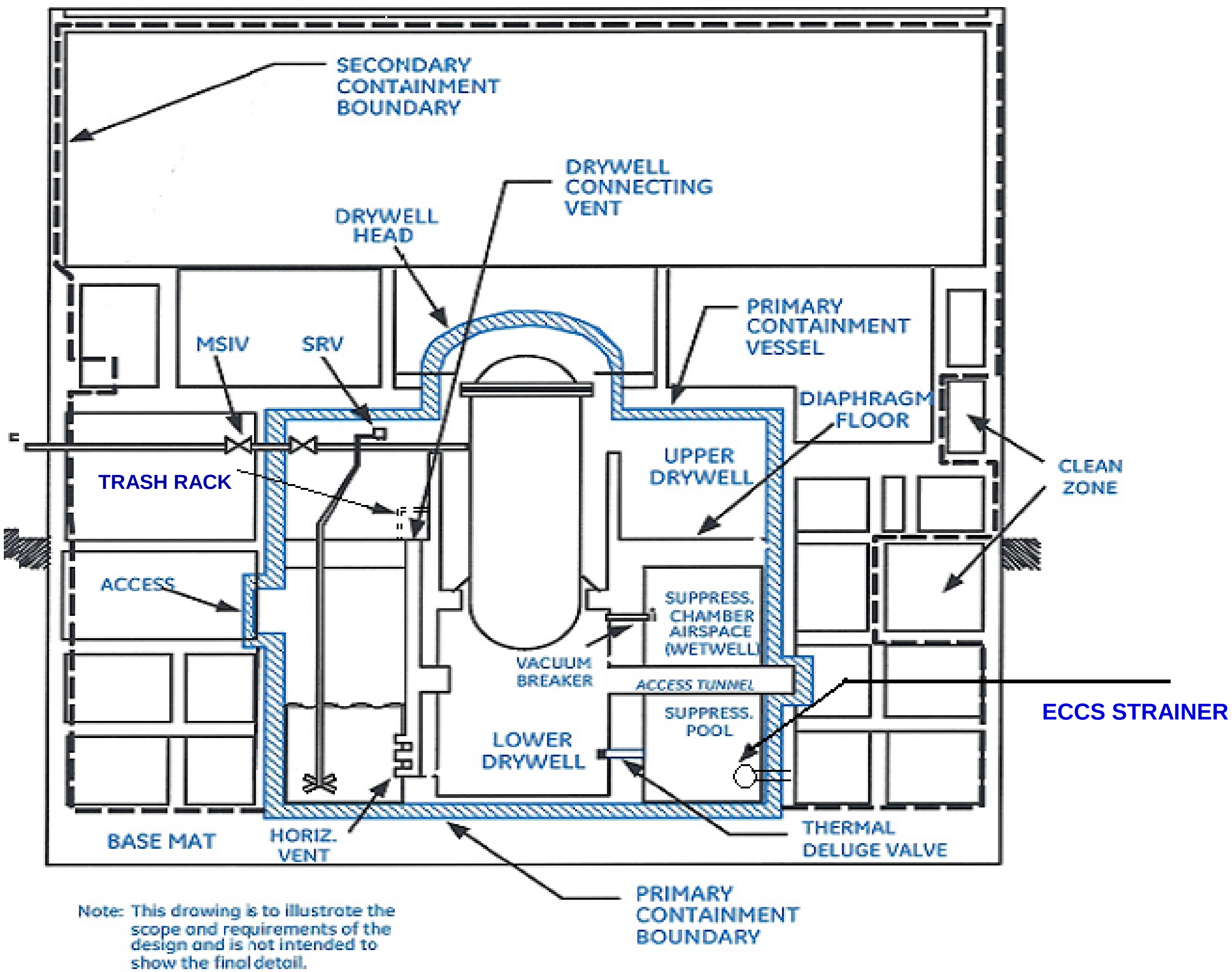
ECCS Suction Strainers

- Background
- Strainer Sizing
- Chemical Effects
- Summary

Background

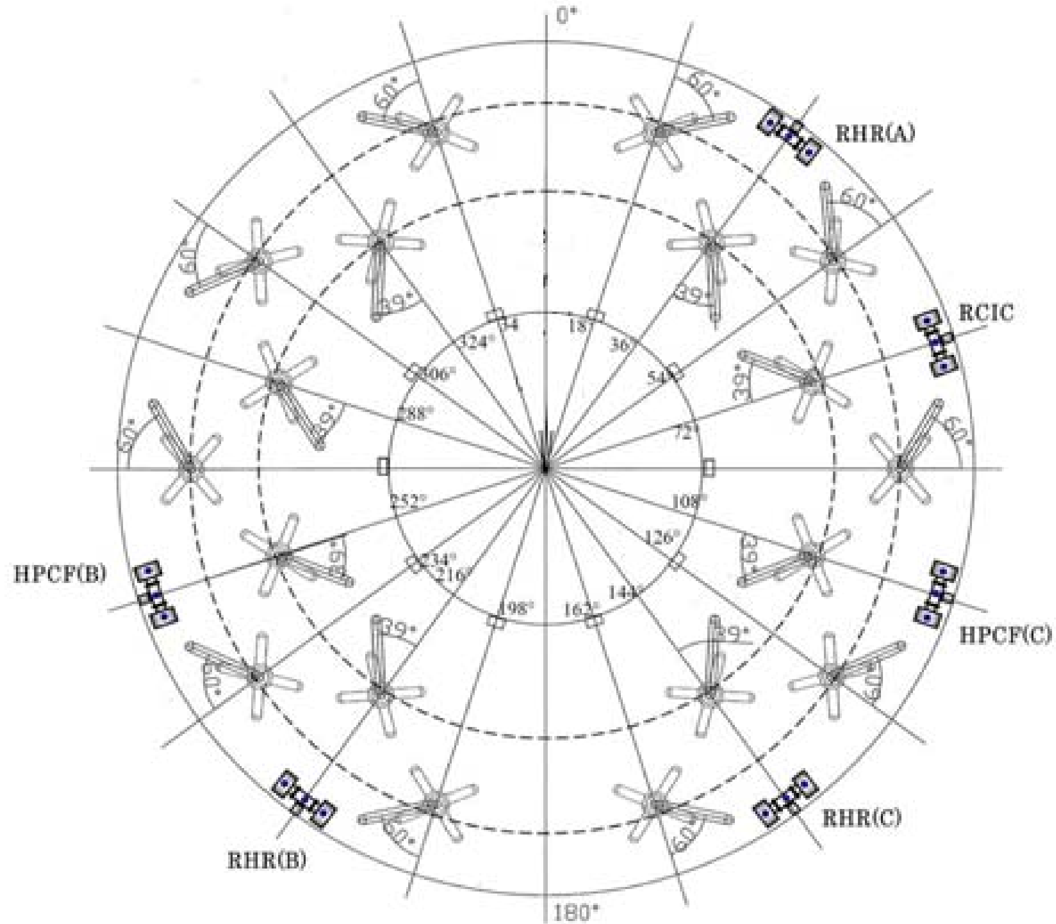
- June 24, 2010 ACRS meeting presentation described how STP 3&4 ECCS suction strainers:
  - Are upgraded from DCD strainers to achieve regulatory positions of RG 1.82, Rev. 3
  - Use Reference Japanese (RJ-ABWR) strainer designs/sizes for STP 3&4
- RG 1.82, Rev. 3 regulatory positions are met primarily by design, which minimizes materials known to challenge ECCS strainers and downstream components

Background *(continued)*



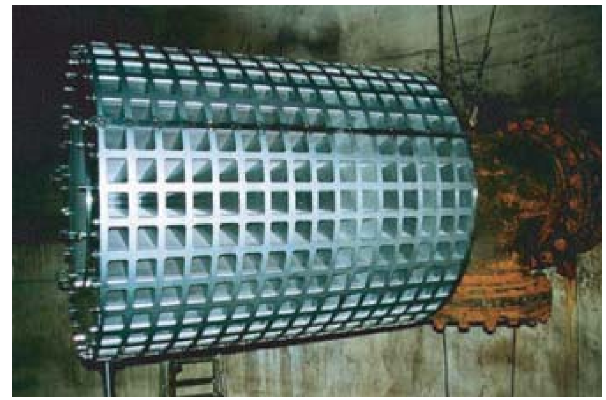
Background *(continued)*

Top View of Suppression Pool Showing X-Quenchers and Suction Strainers



Background *(continued)*

- Control Components, Inc. (CCI) (Winterthur, Switzerland) “cassette-type” strainers
  - Full-scale test in EPRI Charlotte facility
  - Length ~ 4 ft.
  - Diameter between 2.5 and 3 ft.
  - View into cassette filter pocket



Background *(continued)*

- Large filter surface area in compact volume
- Convoluted suction surface disrupts formation of debris “thin bed” and protects NPSH margin
  - “Thin bed” effects result in greater head loss than would be intuitively expected
- Maximum hole size 0.083 inches (2.1 mm) – smaller than DCD value of 0.095 inches (2.4 mm)

Background *(continued)*

- Several US PWRs using CCI cassette-type strainer to resolve GSI-191
  - ANO
  - Byron & Braidwood
  - Calvert Cliffs
  - D.C. Cook
  - Oconee
  - Palo Verde
  - Salem

Strainer Sizing

- The RJ-ABWR replaced original RHR and HPCF strainers with CCI cassette-type strainers in 2005
- RJ-ABWR strainers sized in accordance with BWROG Utility Resolution Guidance (URG)
- Documented in 2 proprietary reports (docketed)
  - Action Item # 50

Strainer Sizing *(continued)*

- RJ-ABWR debris loading included fibrous and calcium silicate insulation (both are prohibited at STP 3&4) so conservatively sized for STP 3&4
- One non-conservatism (use of design flow by RJ-ABWR vs. runout flow per DCD) evaluated and less than effect of debris loading difference

Strainer Sizing *(continued)*

Latent Fiber

- Latent fiber quantity of 1 ft^3 is supported by containment cleanliness experience at TEPCO
  - Small quantities of materials, bits of rope
  - Much less than 1 ft^3 total quantity
- None of the types of fibrous latent materials postulated seem capable of passing through strainer openings (maximum 0.083 in.)
- For downstream fuel test, conservatively assume 1 ft^3 latent fiber is destroyed fibrous insulation small enough to pass through strainers, i.e., use 1 ft^3 in test basis

Chemical Effects *(continued)*

Latent Aluminum

- Latent aluminum quantity of 4.5 ft^2 is based on calculation of largest amount of aluminum that would corrode, but not come out of solution
  - WCAP-16530-NP-A methodology
  - pH range 5.3-8.9 (from DCD)
  - Post-LOCA temperature profile
- Within ability of FME and containment cleanliness programs to detect 4.5 ft^2 aluminum

Chemical Effects *(continued)*

Latent Aluminum

- Conservatively assume that corrosion products from 4.5 ft^2 latent aluminum come out of solution
- Two forms of corrosion products predicted:
  - Aluminum oxy-hydroxide
  - Sodium aluminum silicate
    - Due to assumed exposure to concrete under destroyed qualified coatings within ZOI
- Use aluminum oxy-hydroxide (non-particulate) as surrogate for sodium aluminum silicate in planned downstream fuel test

Chemical Effects *(continued)*

Zinc

- Use WCAP-16530-NP-A methodology to corrode postulated 47 lb_m zinc from destroyed qualified coatings
- Use aluminum oxy-hydroxide as surrogate for calculated 58.6 lb_m zinc oxide in planned testing for downstream effects on fuel

Chemical Effects *(continued)*

Impact on Strainers

- Total corrosion products (58.7 lb_m) and fiber quantity (1 ft^3) are very small relative to ECCS strainer sizes
- Separate strainer head loss testing not needed

Summary of Debris Assumed in Suppression Pool

- Epoxy Coatings = 38 lb_m
- Sludge = 195 lb_m
- Dust/Dirt = 150 lb_m
- Rust Flakes = 50 lb_m
- Stainless Steel Shards (RMI) = 21,528 ft^2
- Latent Fiber (fines) = 1 ft^3
- Aluminum Precipitate = 0.11 lb_m
- Zinc Precipitate = 58.6 lb_m

Suction Strainers Summary

- Strainers conservatively sized based on RJ-ABWR
- Chemical effects are minimal but will be included in downstream fuel test

Downstream Fuel Effects

- This presentation should be conducted in a closed session due to the potential for proprietary information to be discussed

Downstream Fuel Effects

- Downstream Test License Condition
- Downstream Effects Test Plan
- Debris Assumptions
- Analysis Basis
- Test Acceptance Criteria
- Test Facility
- Defense in Depth Analysis

Downstream Test License Condition

- Perform a test to verify that, under conservative debris load conditions, the fuel assembly is adequately cooled
- Based on fuel to be used in initial fuel cycle
- Test to be performed and results provided to NRC at least 18 months prior to fuel load
- Test plan to be submitted 6 months prior to test
- Test Acceptance Criteria based on analysis
- Test done in accordance with description in Appendix 6C

Downstream Effects Test Plan

Downstream Effects on fuel will be determined through testing prior to initial fuel load

- Single fuel assembly description
  - Full-scale cross-section
  - Shortened assembly length
  - Unheated, ambient temperature
- Protocol for introduction of debris (per NRC guidelines)
  - Particulates added first to avoid coagulation (easier to plug interstices in fiber mat)
  - Fiber added
  - Chemical debris added last
- Range of flow rates tested (~ 16 to 80 gpm)

Test Assumptions *(continued)*

- All debris assumed to pass through the strainer except large shards of RMI
- No Settlement / Deposition of debris in Suppression Pool, ECCS or RPV
- No attempt to predict impact on fuel hydraulic losses
  - Demonstrate by test
  - Conservative acceptance criteria and test conditions

Debris Assumptions

Debris	Assumed past Strainer	Debris per assembly	Debris for Test
Epoxy Coatings	38 lb_m	0.04 lb_m	0.07 lb_m
Sludge	195 lb_m	0.22 lb_m	0.38 lb_m
Dust / Dirt	150 lb_m	0.17 lb_m	0.29 lb_m
Rust Flakes	50 lb_m	0.06 lb_m	0.1 lb_m
RMI Shards	926 ft^2 (75.8 lb_m)	1.1ft^2 (0.087 lb_m)	1.8 ft^2 (0.15 lb_m)
Latent Fiber	1 ft^3	1.98 in^3	3.37 in^3
Aluminum Precipitate	0.11 lb_m	0.00013 lb_m	0.00021 lb_m
Zinc Precipitate	58.6 lb_m	0.07 lb_m	0.11 lb_m

Analysis Basis

- Purpose of analysis is to determine flow required to cool hot assembly post-LOCA and then develop a downstream test acceptance criteria
- Analysis performed using LOCA Computer Code - GOBLIN

Analysis Basis *(continued)*

- Analysis based on FW Line Break
- Assumptions to develop conservative test criteria
  - Decay heat held constant at 5 minute value
  - Coolant flow only modeled from lower plenum
  - Hydraulic loss imposed at fuel inlet
  - No credit for bypass or HPCF
  - Debris accumulation assumed over 60 seconds
    - Actual accumulation expected over several hours
  - Accumulation imposed after blowdown and refill are compete at 850 seconds

Analysis Basis *(continued)*

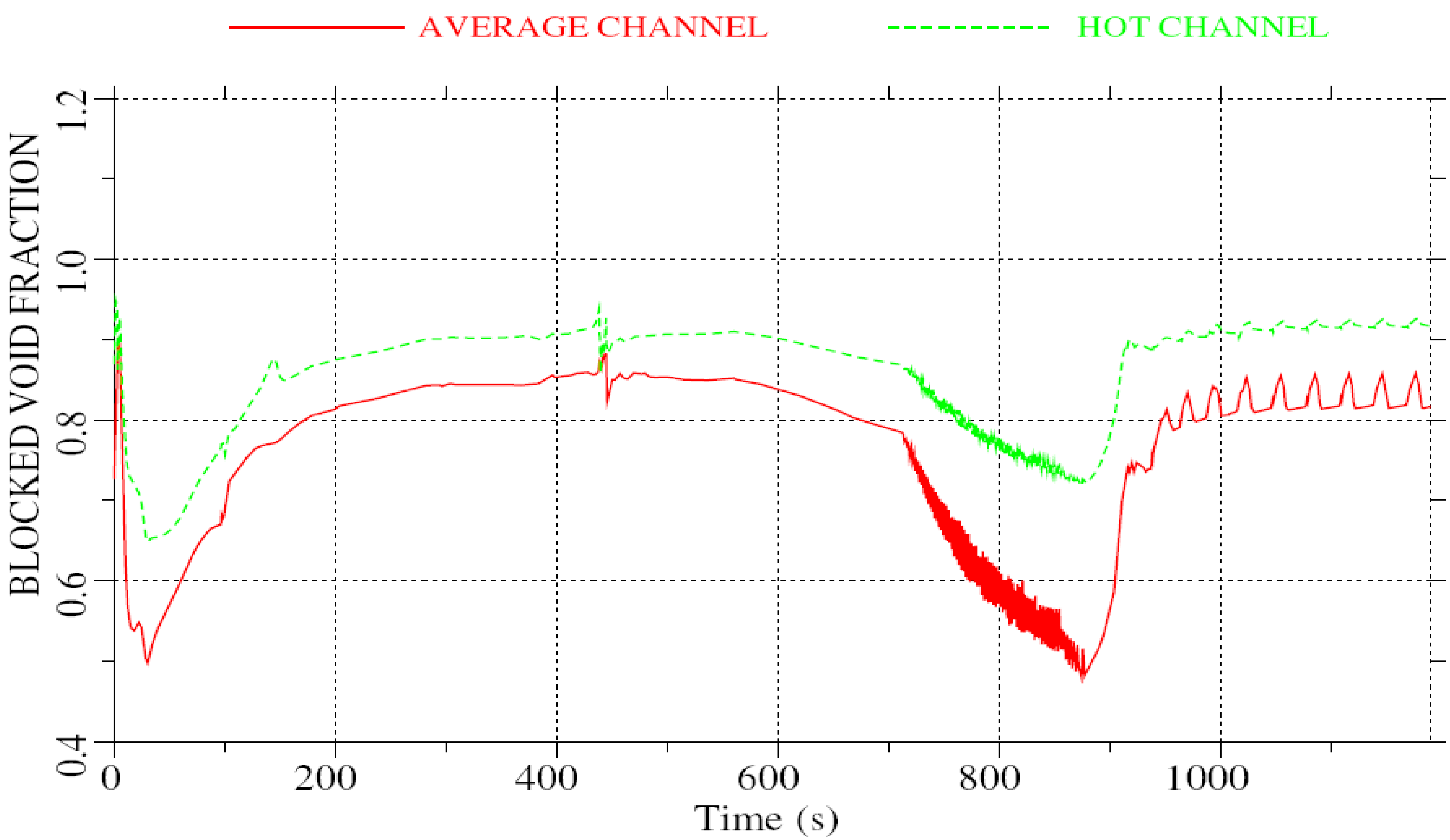
- Significant accumulation of debris at core outlet not expected
  - HPCF initially aligned to CST
  - Upper assembly region more open
  - Flow is predominantly up through the core
- Conservatively imposed loss at fuel inlet with no credit for HPCF

Analysis Basis *(continued)*

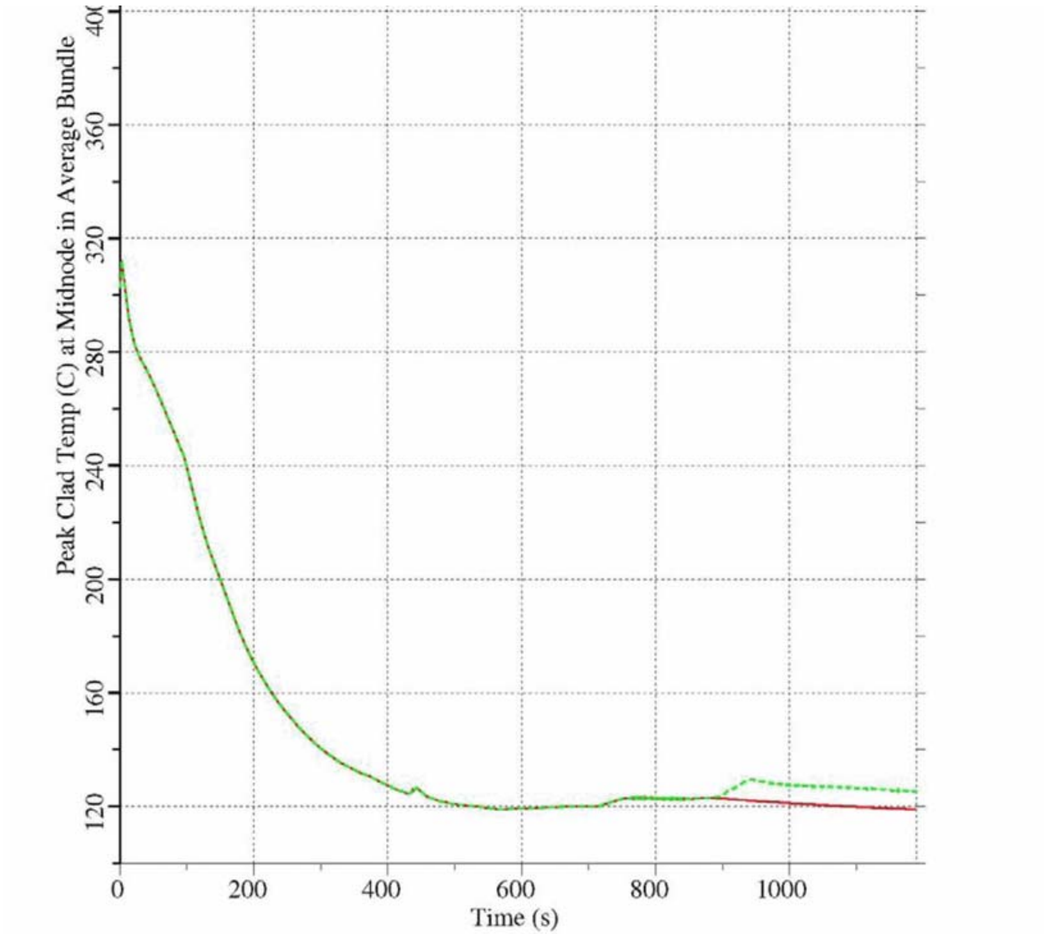
Acceptance Criteria

- Imposed blockage results in hot assembly (and core) void fraction at or below 0.95
- Core remains cooled by two-phase flow

Analysis Basis *(continued)*



Analysis Basis *(continued)*



Test Acceptance Criterion

- Increased hydraulic resistance from analysis applied to test configuration
- Acceptance criterion based on bundle pressure drop due to hydraulic losses
- Captures effect of debris in grids as well as tie plate, debris filter
- Bounds the differences in fuel designs
  - Required flow based upon energy balance
  - Fuel designs are required to be hydraulically similar
- Test acceptance criteria
  - Analysis limit < 4800 times increase in k-factor
  - Test acceptance criteria < 1200 time increase in k-factor

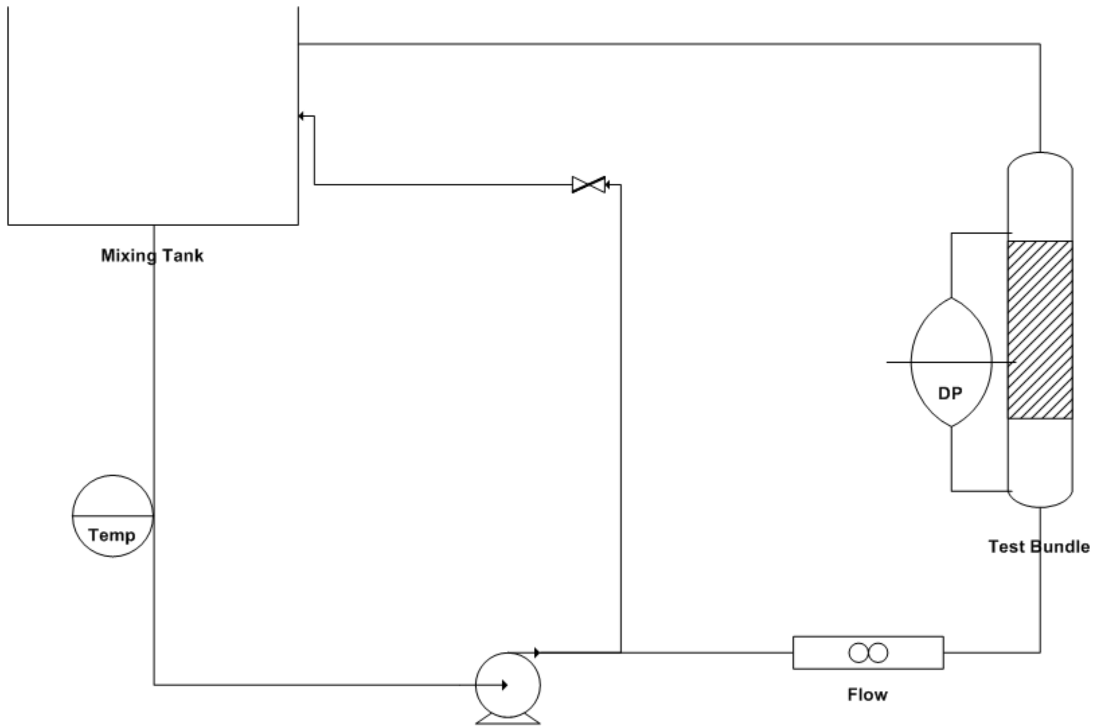
Test Acceptance Criterion *(continued)*

$$\left[\frac{\Delta P_f}{\Delta P_i}\right]_{(Test-Measured)} = \left[\frac{\Delta P_f}{\Delta P_i}\right]_{(Aly)} * \left(\frac{w_i}{w_f}\right)^2_{(Aly)} * \left(\frac{w_f}{w_i}\right)^2_{(Test-Measured)}$$

$$\left[\frac{\Delta P_f}{\Delta P_i}\right]_{(Test-Measured)} \leq 1200 * \left(\frac{w_f}{w_i}\right)^2_{(Test-Measured)}$$

Aly -- Analysis   I -- initial   f -- final

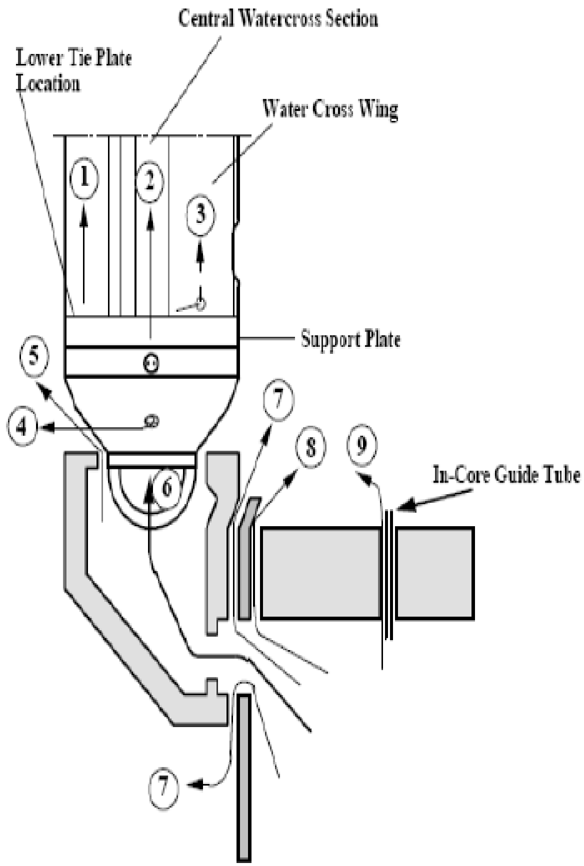
Downstream Effects Test Facility



Defense in Depth Analysis

- Additional analyses performed to examine core cooling with 100 % blockage of fuel inlet
  - HPCF
  - Flow through engineered bypass paths
- Additional analyses demonstrate core cooling is sustained by either of these design features

Defense in Depth Analysis *(continued)*



1. Active coolant flow
2. Flow through central canal
3. Flow through water cross wings (separate inlets)
4. Bottom nozzle bypass holes
5. Leakage between bottom nozzle and fuel support piece
6. Bottom nozzle inlet flow
7. Leakage between control rod guide tube and fuel support piece
8. Leakage between control rod guide tube and core support plate
9. Leakage between in-core instrumentation guide tubes and core support plate

Evaluation of Deposition on Clad

- Deposition on Clad
  - Assumed all debris except RMI forms layer on fuel
  - PCT occurs very early from boiling transition
  - Increase in clad temperature < 30 °C (bounds time when debris would begin to reach core)
  - Deposition will not significantly affect LTC fuel temperature

Downstream Fuel Effects Conclusions

- LOCA debris impact on fuel cooling assessed
  - Fuel tests will demonstrate impact on fuel blockage
    - Conservative Test Acceptance Criteria developed
  - Supplemental cooling from HPCF or engineered bypass paths can each provide sufficient cooling in the event of complete blockage of assembly inlet
  - Deposition on fuel does not cause significant clad heat up

Long Term Cooling

- The remaining portion of this presentation can be conducted in open session.

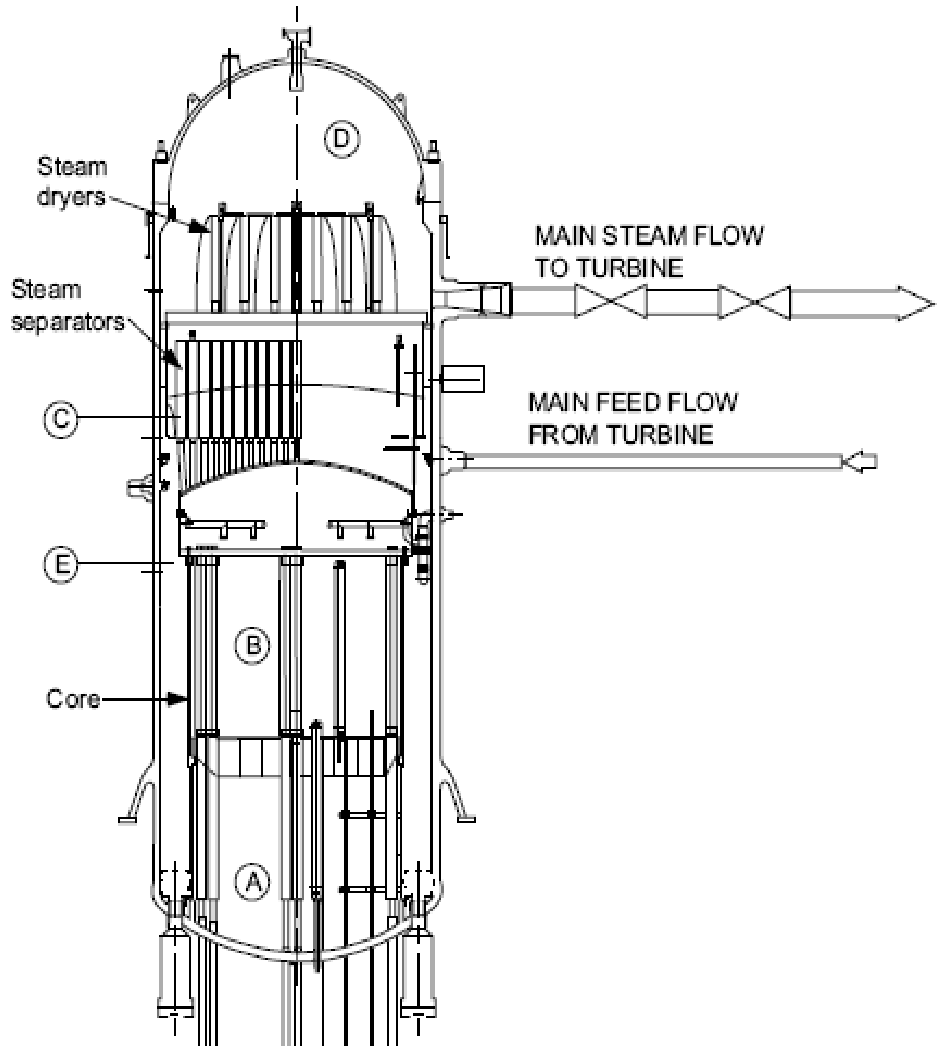
STP 3&4 LTC Acceptance Criteria

- Long Term Core Cooling is assured by maintaining the core flooded
- Core decay heat is transferred to the ultimate heat sink
- UHS maintains RSW temperature < 35 °C (95 °F) with no makeup for 30 days

Background

- In ABWR Certified Design, large pipes connect to the RPV above the core.
- PCT occurs early due to boiling transition
- Core remains cooled by two-phase or sub-cooled water
- Clad temperature during long term cooldown remains well below initial PCT

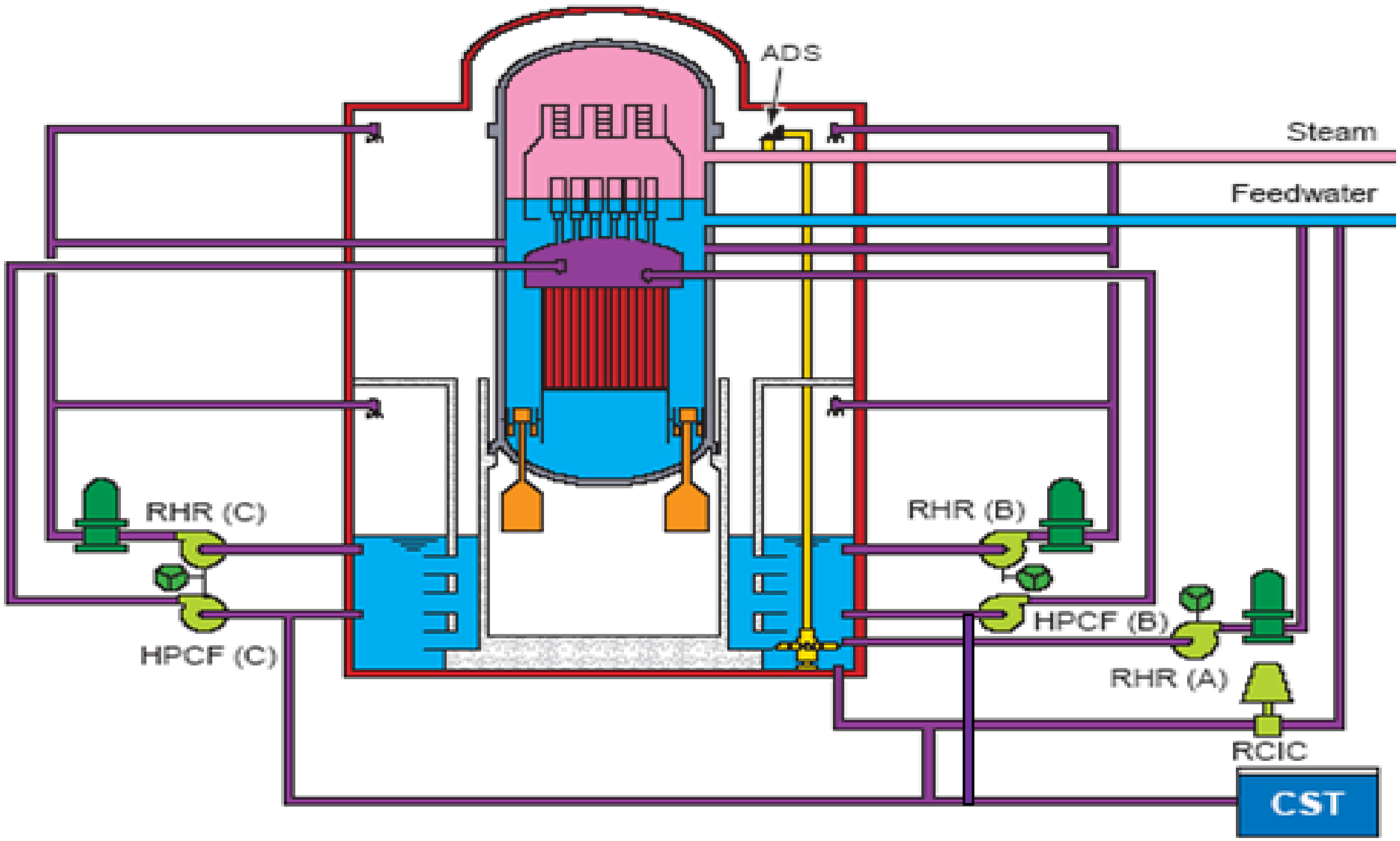
Reactor Pressure Vessel



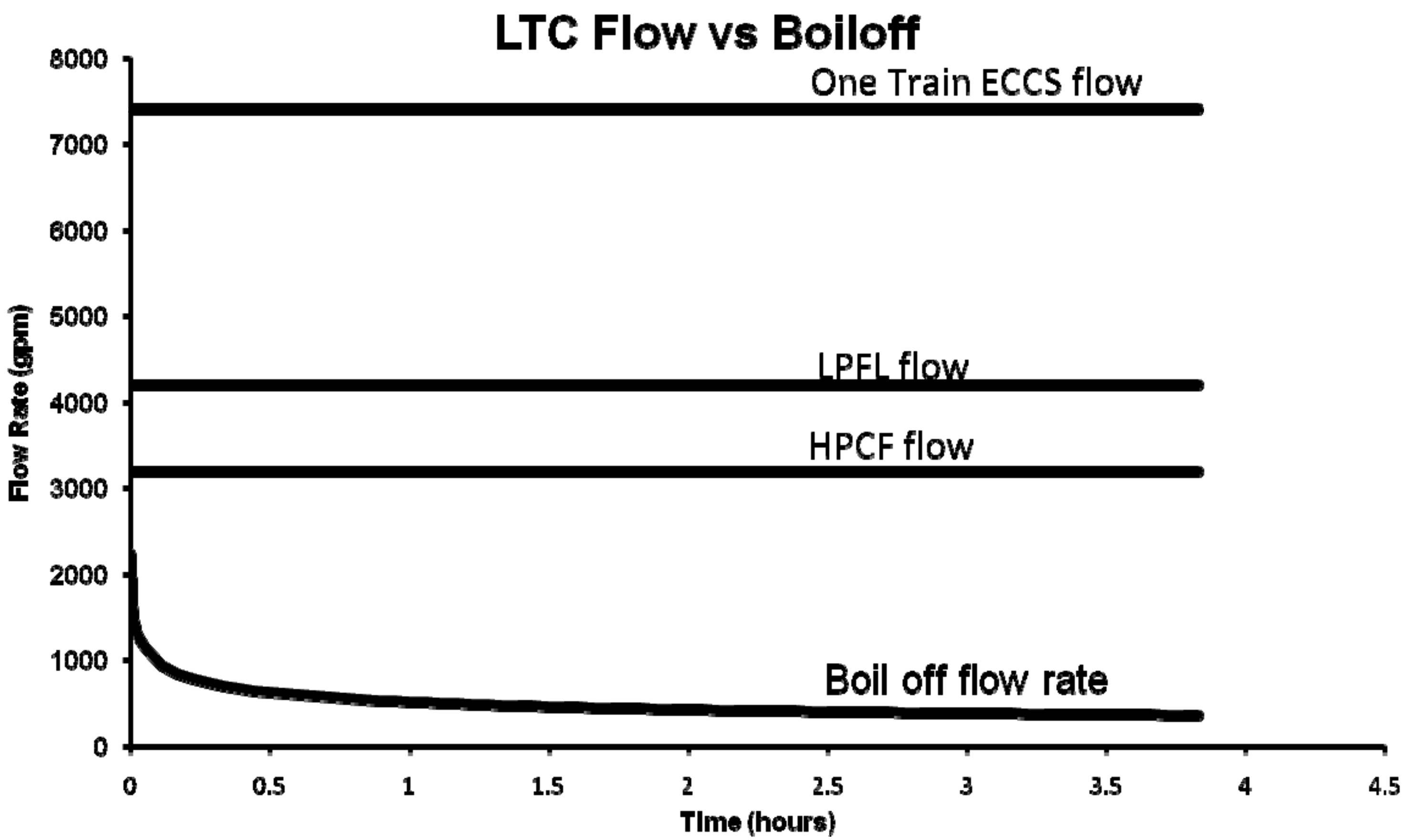
Background

- For LOCAs, a continued ECCS injection maintains the core flooded in the long term
  - Minimum contingent of ECCS injections with a single failure
    - 1 HPCF inside the shroud, from above the core (800 to 3200 gpm)
      - Except for HPCF line break
    - 2 LPFL outside the shroud, from below the core (4200 gpm each)
      - One LPFL may be aligned for Drywell / Wetwell spray

ABWR ECCS Flow Diagram



LTC ECCS Capability



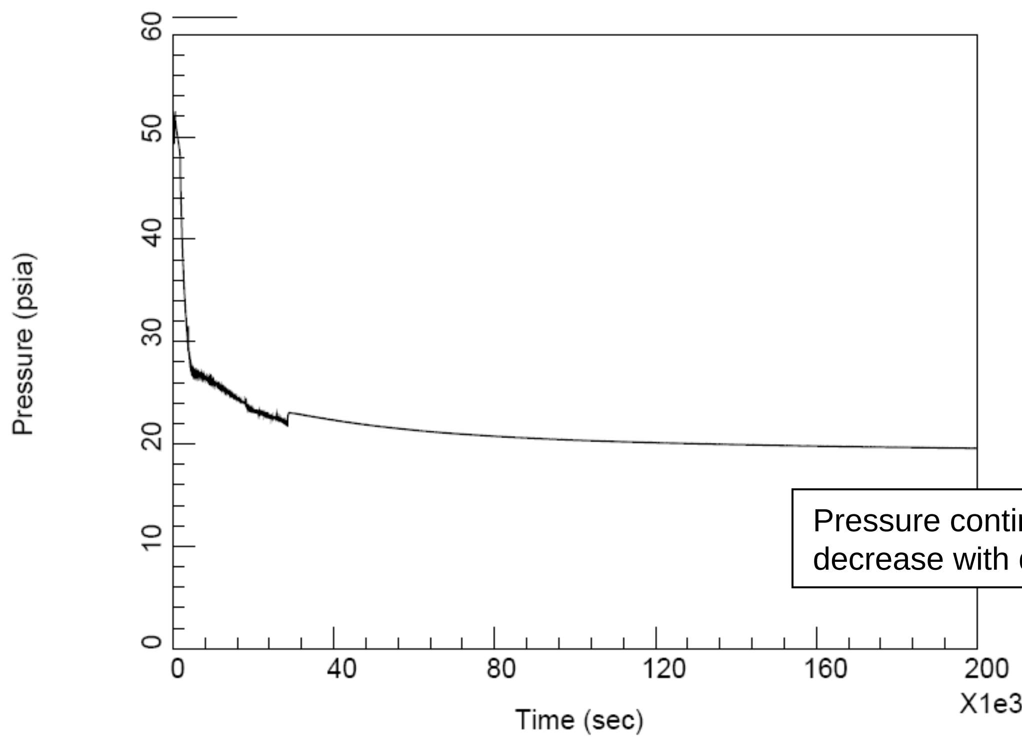
LTC Heat Removal

- For smaller breaks, RHR will be initiated for Shutdown Cooling (SDC), to allow cooldown to cold shutdown
  - Inventory make up from S/P as needed
- All other breaks, Recirculation from the S/P with Heat Removal through 2 RHR heat exchangers to RCW and RSW to the UHS
- Decay heat is discharged to the S/P. The S/P cooling is automatically initiated.
  - Containment Analysis results – assume 30 min delay in S/P cooling initiation , S/P temperature below 100°C
- Pump NPSH – no credit for containment accident over-pressure, based on 100°C (212 °F), with 100% specified debris loading assumed in the strainer head loss calculation

LTC Heat Removal

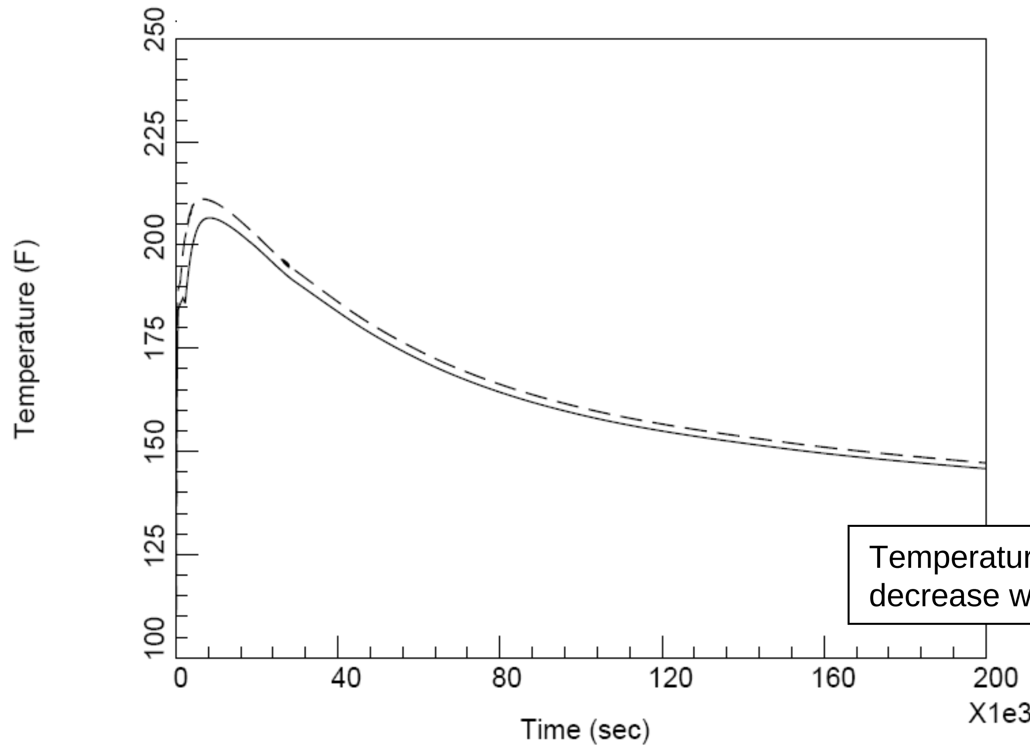
- R/B Service Water (RSW) supplied by a Dedicated Basin
  - Basin is kept cooled by the cooling towers,
  - Ultimate heat sink is the atmosphere and the basin
  - **Meets Standard Review Plan Requirement for 30 day Capability**

Long Term Drywell Pressure



Pressure continues to decrease with decay heat

Long Term Suppression Pool Temperature



Temperature continues to decrease with decay heat

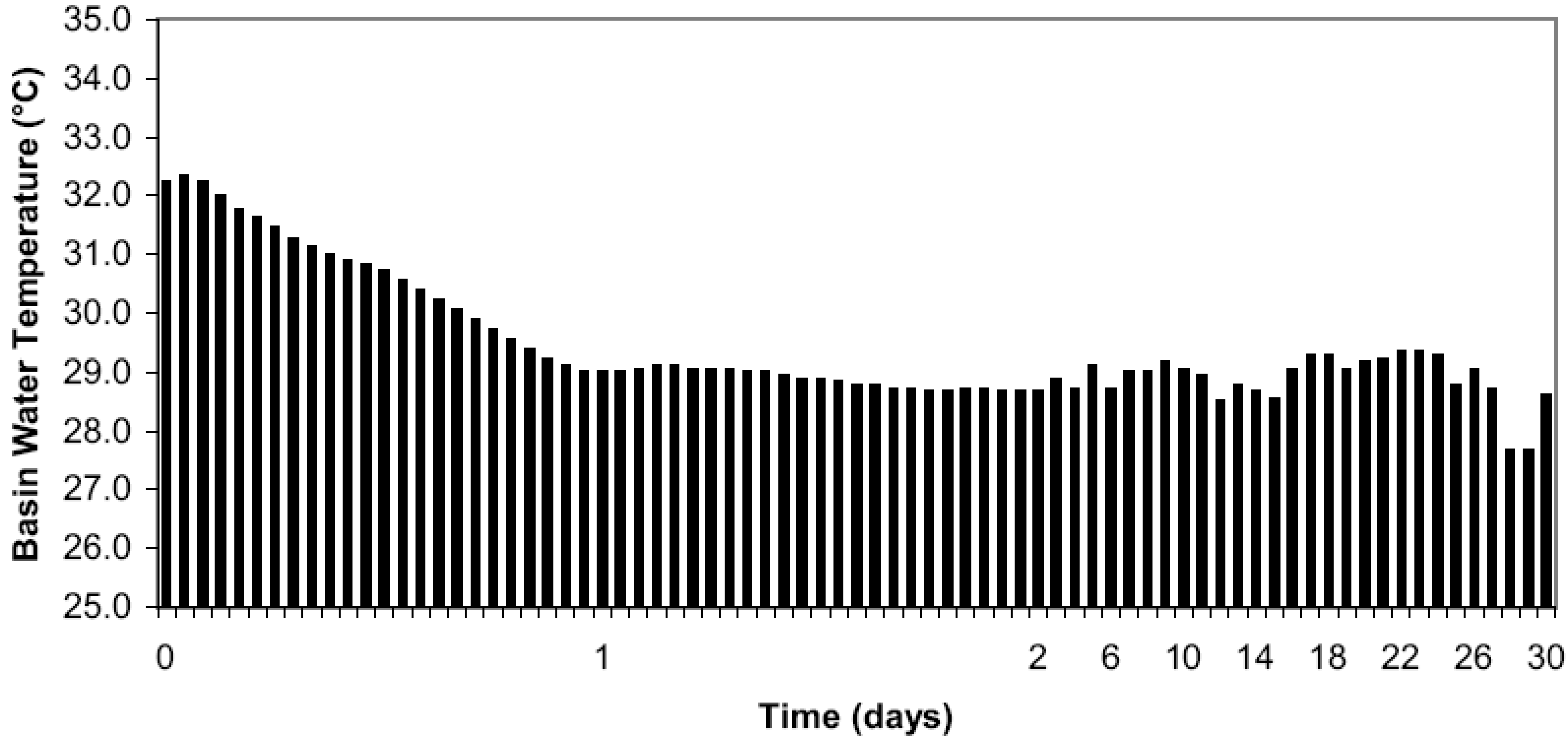
Long Term Cooling

- DW pressure and S/P temperature continue to decrease with decay heat
- RHR transfers decay heat to UHS
- UHS design maintains RSW Temperature $< 35\ ^{\circ}C$ with no makeup for at least 30 days.

UHS Performance

- Based upon 4400 MWt Reactor Power (112%)
- Max 1 day Basin Temperature 33.1 °C (91.6 ° F)
- Basin Low Level accommodates 30-day losses due to
  - Forced Evaporation
  - Natural Evaporation
  - Seepage
  - Drift from cooling towers
  - Passive Failure
- Plot of 30-day temperature for maximum evaporation

UHS Basin Temperature



UHS Basin Level

- UHS Basin has adequate water supply to accommodate 30 day LTC
- Basin initial water mass is 60,950,000 kg
- At end of thirty days with no make-up, basin mass is 2,898,000 kg

Long Term Cooling

ABWR meets requirements for core cooling, containment integrity, and ECCS NPSH with no credit for containment accident over-pressure

Potential Challenges to Long Term Cooling

- Debris Impacts on Strainer NPSH
- Downstream Effects on Fuel
- ECCS Gas Accumulation

ECCS Gas Accumulation

- STP 3&4 Design Features
  - RHR, HPCF, & RCIC piping design minimizes potential Gas Accumulation locations & intrusion mechanisms
  - High point vents provided for Fill & Vent
  - Suction piping below minimum level of water sources
  - Debris Strainers designed to be continuously submerged
  - Keep-Fill equipment precludes formation of voids in discharge piping
- Controls exist to translate design features into detailed Design Requirements, e.g., Piping Specifications, P&IDs

ECCS Gas Accumulation

- Operational Surveillance & Monitoring
  - Technical Specifications (TS) Surveillance Requirements (SR) for ECCS Operating & Shutdown (SR 3.5.1.1 and 3.5.2.3) verify piping is filled on 31-day frequency
  - Industry (Owner's Group) is comprehensively addressing gas accumulation in response to Generic Letter 2008-1
  - NEI 09-10 will guide program implementation
    - Procedures
    - Training

Overall Conclusions

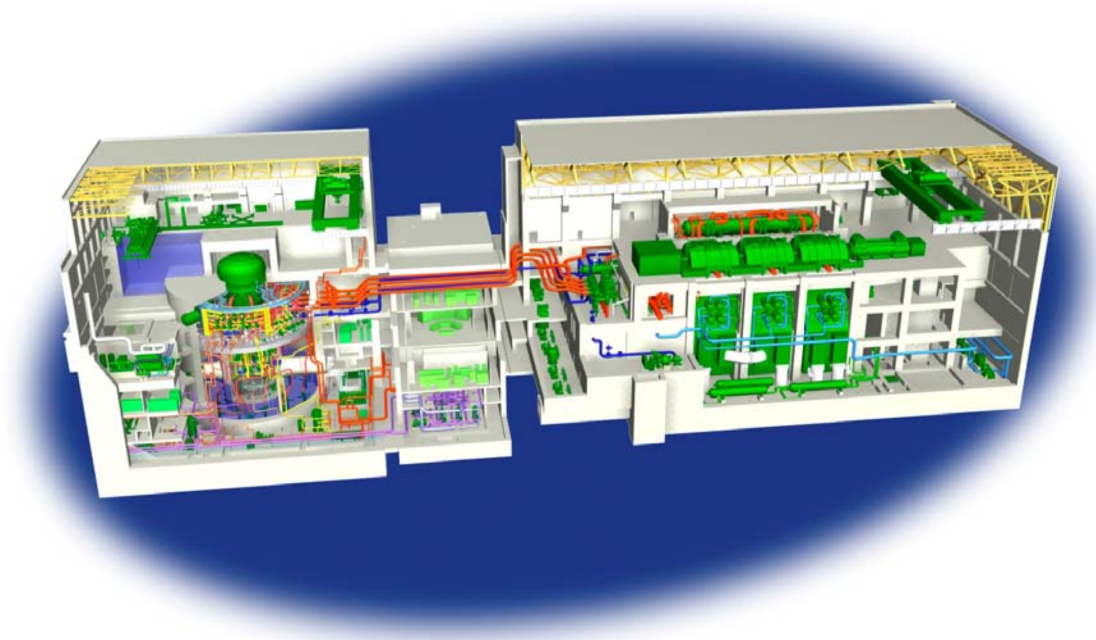
- Multiple cooling water sources available
- Large piping is above core; core remains covered
- PCT early in transient is well below limit; core temperature continues to decrease throughout event duration
- Design minimizes debris and chemical effects
- Strainers meet RG 1.82 Rev. 3 NPSH guidance for the conservatively assumed debris quantities
- Analyses performed for assumed latent fiber and debris and chemical effects demonstrate adequate core cooling is maintained
  - Will be confirmed by fuel testing
- Supplemental cooling from HPCF or design bypass paths can each provide cooling in the event of complete blockage of assembly inlet
- ECCS Gas Accumulation mitigated by ABWR design and programs in place to monitor for continued compliance
- STP 3&4 ABWR design meets the requirements for LTC

Chapter 6

Conclusion

South Texas Project Units 3 & 4 Presentation to ACRS ABWR Subcommittee

Chapter 4 Reactor



Agenda

- Introduction
- Recent Topics
- ACRS Action Items
- Conclusions

Attendees

Scott Head	NINA Manager, Regulatory Affairs, STP 3&4
James Tomkins	NINA Licensing, STP 3&4
John Price	NINA Licensing, STP 3&4
Tom Daley	NINA Engineering, STP 3&4
Nirmal Jain	Westinghouse

Recent Topics

- **Chapter 4** was discussed at ACRS ABWR Subcommittee on March 2, 2010

- Inconsistency between DCD and COLA figures
  - Resolved with responses to RAI 04.03-1 and 04.03-2
  - Corrected by Admin change in COLA Revision 4
- Provide verifiable acceptance criteria for downstream fuel test
  - Resolved with response to RAI 04.04-4
  - To be corrected in COLA Revision 6
- RPV purge flow transcription error
  - To be corrected in COLA Revision 6

Action Items from March 2, 2010 ACRS Meeting

- Fuel Amendment Topical Reports
- Part 21 Stability for ABWR DCD
- Part 21 Process for STP 3 & 4
- All of these items are resolved

Chapter 4

Questions and Comments

South Texas Project Units 3 & 4 Presentation to ACRS ABWR Subcommittee

Chapter 5 Reactor Coolant System and Connected Systems

Agenda

- Chapter 5 Contents
  - Departures and COL Items
- Chapter 5 Summary

Attendees

Scott Head	NINA Manager, Regulatory Affairs, STP 3 & 4
Tom Daley	NINA Engineering, STP 3 & 4
Coley Chappell	NINA Licensing, STP 3 & 4

Chapter 5 Contents

Chapter 5 was discussed at ACRS ABWR Subcommittee on March 18, 2010.

- Tier 1 Departure (RCIC Turbine/Pump)
- Tier 2 Departures
- COL License Information Items

Chapter 5 Summary

- No SER Open Items
- All COL License Information Items have been addressed
- The Pressure Temperature Limits Report was submitted and has been approved by the NRC
- All responses to Requests for Additional Information have been submitted
- All ACRS Action Items have been resolved

Chapter 5 Reactor Coolant System and Connected Systems

Questions and Comments

Presentation to the ACRS Full Committee

South Texas Project Units 3 and 4 COL Application Review

Safety Evaluation Review with No Open Items

Chapters 4 and 5

March 8, 2011

Summary of Staff Review Chapter 5: Rx Coolant Systems and Connected Systems

- P-T Limits
- Compliance with 10 CFR 50.55a (5.2.1.1)
- Applicable Code Cases (5.2.1.2)
- RCIC Turbine Design Change

Pressure-Temperature Limits (5.3.2)

- ABWR DCD COL Item 5.6
  - COL applicant will submit plant-specific P-T limits curves
- STP Response
  - Plant specific P/T limits will be submitted prior to receipt of fuels on site (COM 5.3-3)
  - Submitted a generic pressure-temperature limits report (PTLR)
    - Review and approval of PTLR tracked as OPEN ITEM 05.03.02-1
- Staff Conclusion
  - PTLR Approved (ML1026606586)
  - Open Item 05.03.02-1 is closed
  - Resolution of COL Item acceptable

Compliance with 10 CFR 50.55a (5.2.1.1)

- STP FSAR Section 5.2.1.1 incorporates by reference ABWR DCD Section 5.2.1.1 for use of ASME Code consistent with 10 CFR 50.55a
- In response to RAI Item 5.2.1.1-1, Revision 4 to STP FSAR Table 1.8-21a includes ASME OM Code (2004 Edition) for IST program description
- Confirmatory Item 5.2.1.1-1 is resolved
- STP FSAR Section 5.2.1.1 is acceptable

Applicable Code Cases (5.2.1.2)

- STP FSAR Section 5.2.1.2 incorporates by reference ABWR DCD Section 5.2.1.2 for use of ASME Code cases on reactor coolant pressure boundary (RCPB)
- STD DEP 1.8-1 addresses changes in STP FSAR Tables 5.2-1 and 5.2-1a for RCPB code cases
- STP FSAR Table 5.2-1 specifies ASME BPV Code Cases accepted in RG 1.84 (Section III) and RG 1.147 (Section XI)
- In response to RAI 5.2.1.2-5, Revision 4 to STP FSAR Table 5.2-1 deleted superseded Code Cases
- Confirmatory Item 5.2.1.2-5 is resolved

Applicable Code Cases (5.2.1.2)

- Open Item 5.2.1.2-1 on Inservice Inspection (ISI) Program is closed based on NRC review of Inservice Inspection program in STP FSAR Sections 5.2.4 and 6.6.9.1
- Open Item 5.2.1.2-2 on Inservice Testing (IST) Program is closed based on ongoing NRC review of IST program in STP FSAR Section 3.9.6
- STP FSAR Section 5.2.1.2 is acceptable

Reactor Core Isolation Cooling System (5.4.6)

- STD DEP T1 2.4-3, “RCIC Turbine/Pump,” addresses new RCIC turbine-pump design
- Proprietary Toshiba Technical Report UTLR-0004-P, “Application of Turbine Water Lubricated (TWL) Pump to South Texas Project Units 3 & 4 RCIC Turbine-Pump,” describes new RCIC turbine-pump design and qualification
- NRC staff conducted audit of STP documentation for RCIC turbine-pump design in November 2009

RCIC Turbine-Pump Design (5.4.6)

- Monoblock design (pump-turbine within same casing)
- No shaft seal required
- No barometric condenser required
- No oil lubrication
- No steam bypass line required for warm-up
- Less complex auxiliary systems

SER Open Items 05.04.06

- Open Item 05.04.06-1
  - Revise Topical Report to address functional qualification of RCIC turbine-pump
  - Describe function of RCIC turbine-pump drain leak-off line pump
- Open Item 05.04.06-3
  - Perform pump calculations showing available Net Positive Suction Head (NPSH) margin when head loss for new ECCS suction strainer is determined

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Open Item 05.04.06-1 Resolution

- Topical Report revised to qualify RCIC turbine-pump using ASME Standard QME-1-2007 that is accepted in Revision 3 to Regulatory Guide 1.100
- QA program for safety-related RCIC turbine-pump must satisfy 10 CFR 50, Appendix B
- RCIC turbine-pump included in IST program
- Topical Report clarifies that RCIC turbine-pump drain leak-off line pump has no safety-related function
- Potential flow-induced vibration for RCIC turbine-pump will be addressed as specified in ABWR DCD
- Open Item 05.04.06-1 is closed

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Open Item 05.04.06-3 Resolution

- Revision 4 to STP FSAR recalculates pump NPSH margin using conservative assumptions
- Calculated losses based on 50% blockage of suction strainers
- Pump NPSH calculation in STP FSAR Table 5.4-1a indicates margin of 2.84 meters
- Pump NPSH margin will be verified by ITAAC
- Open Item 05.04.06-3 is closed

Summary of Staff Review
Chapter 4: Reactor

- Downstream Fuel Effects (GSI-191)

  - STP agreed to a COL License condition requiring testing of the fuel loaded in the initial core for downstream effects

  - Staff reviewed the acceptance criteria for the license condition test and the test plan

  - RAI 04.04-3 has been resolved and the proposed license condition was evaulated in Chapter 6 of the FSAR.
- No ACRS Action item