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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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SUBCOMMITTEE ON ESBWR

+ + + + +

THURSDAY

SEPTEMBER 23, 2010

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Michael L. Corradini, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

MICHAEL L. CORRADINI, Chairman

SAID ABDEL-KHALIK, Member

J. SAM ARMIJO, Member

JOHN W. STETKAR, Member

CONSULTANTS:

THOMAS S. KRESS

GRAHAM B. WALLIS

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P R O C E E D I N G S

8:31 a.m.

Opening Remarks and Objectives

CHAIRMAN CORRADINI: The meeting will come to order. This is a meeting of the Advisory Committee on Reactor Sa feguards, Subcommittee on the ESBWR reactor application. My name is Mike Corradini, chair of the Subcommittee.

Subcommittee members in attendance at this time are Dr. Said Abdel -Khalik, Sam Armijo, John Stetkar and currently our consultant, Dr. Graham Wallis, soon to be Tom Kress, and I hope soon to be Charlie Brown. The designated federal official is Christopher Brown.

The purpose of this meeting is to be briefed on the final SERs for Chapter 3, Design of Structures, Components and Equipment, Chap ter 4, Reactors, Chapter 6, Engineering Safety Features, and Chapter 7, Instrumentation and Control Systems, and Chapter 9, Auxiliary Systems associated with the ESBWR design.

The Subcommittee will hear presentations by and hold discussions with represen tatives of the NRC staff and the ESBWR applicant, General Electric Hitachi Nuclear Energy.

The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full Committee. The rules for participation in today's meeting have been announced as part of the notice of this meeting, previously published in the *Federal Register* on August 30th, 2010.

A portion of this meeting may be closed to protect information that is proprietary to GEH Nuclear Energy and its contractors, pursuant to 5 U.S.C. 552(B)(c)(4). A transcript of the meeting is being kept and will be made available as stated in the *Federal Register* notice.

It's requested that speakers first identify themselves and speak with sufficient clarity and volume, so that they can be readily heard. Also, to remind everybody, please silence your cell phones and Blackberrys and any other thing you have with you.

We have not received any requests from members of the public to make oral statements or written comments. We have a phone line open, and the GEH engineers and staff are online; is that correct?

PARTICIPANT: That's correct, we're here.

CHAIRMAN CORRADINI: Okay, and if you need to put it on mute u ntil we need to talk to you. Let me just remind everybody that neither the staff nor GEH plans to present any proprietary information when we're going through these chapters of 6, 7 and 9.

However, if we ask questions, if the members ask questions, particularly on some I&C issues and the details are proprietary, I think we're going to organize ourselves to do it in a fashion that we collect them all and do it at a particular time during the day, so we can close the session.

All right. Other than that, I want to remind everybody that this is our last set of subcommittee meetings on the last set of chapters. The staff has closed all open items on these chapters. I know that will not deter the members from asking probing and exhilarating questions.

So that's the main point of this. I have already been asked by some of the members that we're going to finish on time and on budget at five o'clock tomorrow afternoon. So we will -- I will, and I apologize, sometimes move us along if we need to.

We've broken it down that we're going to start with Chapter 3 today, and then a small amount on Chapter 4, since most of those issues have been closed and been reviewed in past subcommittee meetings, and finish up today with Chapter 9, regardless how long it takes.

So I'd like to turn it to Amy Cubbage to kind of kick us off. Amy?

Staff Opening Remarks

MS. CUBBAGE: Thank you. Just to add to what you said there, for Chapter 3, I'd just like to note that we're not covering every subsection of Chapter 3. We picked selected areas where there were significant open items, and areas of ACRS interest in previous meetings.

So we're going to start off with Section 3.8 today and then go on to selected topics from 3.9 and 3.12. If the Committee has any questions in other areas of Chapter 3, please let us know and we'll try to get the appropriates staff here to answer those questions during the course of the day. With that, I'll just turn it over to GE Hitachi to begin.

Chapter 3 - Section 3.8 RAIs/GEH

MR. NIOGI: My name is Sujit Niogi. I'm from the GE Hitachi, and I'm going to cover Chapter 3.8 open items. The following the NRC RAIs will be discussed in this presentation: 3.8 -79, Seismic Category 2 issue; 3.8-94, soil-bearing capacity. 3.8-96; stability analysis of the structure; 3.8-107, SSDP computer program validation; 3.8 -120, reactor shield wall; 3.8-125, impact of spent fuel rack on spent fuel pool structure.

NRC RAI 3.8-79, confirmed that the Seismic Category 2 and Seismic Category NS structures, which are in close proximity approximately to Seismic Category 1 structures, are designed to Seismic Category 1 requirements. The following structures are in close proximity to Category 1 structures: Seismic Category 2, reactor building, service building and ancillary diesel building. Seismic Category NS fuel building.

Seismic Category 2 and seismic Category NS structures listed above are designed to withstand SSE loads. The method of analysis of these structures are the same as the Seismic Category 1 structures, including the load combinations and the acceptance criteria.

During SSE event, the structures will not collapse and impact the Seismic Category 1 structure. Also, the -- in the structures are large enough to preclude impact due to out of phase displacements during SSE events.

It was demonstrated that a Seismic Category 2 and Seismic Category 1 NS structures which are in close proximity to Seismic Category 1 structures, are designed to SSE requirements. The gaps between the structures are large enough to prelude impact during SSE event.

DR. WALLIS: Impact with what?

MR. NIOGI: Impact with another structure.

DR. WALLIS: Oh, another structure. Oh, particularly the Seismic Category 1.

MR. NIOGI: So it may be that the Seismic Category 2 are NS, doesn't matter. It's not going to impact any other structure.

DR. WALLIS: It's a strange structure that falls without hitting something.

MR. NIOGI: Beg your pardon?

DR. WALLIS: It's a strange structure that falls without hitting something.

MR. NIOGI: It's not going to fall, because are designing Category 2 as NS, not to fall at all.

DR. WALLIS: So the impact you're talking about isn't a falling of something?

MR. NIOGI: It's not the falling. It is a gap between during the out of phase displacement, the --

DR. WALLIS: Oh, I see. So impact you

don't -- impact to me means something hitting something, but you mean -- you mean an influence of something. Okay, I see. Thank you.

MR. NIOGI: So out of phase displacement is not going to --

DR. WALLIS: But you're using impact in the modern way instead of the classical sense.

MS. CUBBAGE: I think they do mean impact, no?

CHAIRMAN CORRADINI: Out of phase. Graham's just asking if things are falling. Your answer is they're not designed to fall, but they're not going to out of phase bump into each other?

MR. NIOGI: Right.

DR. WALLIS: You could use the word "bump."

MR. NIOGI: Bump, yes bump. Contact.

CHAIRMAN CORRADINI: Contact.

MR. NIOGI: Contact.

DR. WALLIS: You mean they don't have any effect on the neighboring structures.

MR. NIOGI: Right.

DR. WALLIS: That's what you sort of mean. You don't mean they actually don't hit them?

MR. NIOGI: No, no. Okay. We have enough

-- between the two structures not to do that.

DR. WALLIS: They're independent.

MR. NIOGI: They're independent. NRC RAI 2.8 3.8-94. Confirmed, that a soil -bearing demand is less than the soil -bearing capacity due to static and dynamic loading conditions. Provide t he technical basis for not considering the -- during an event. Bearing and sliding calculation which uses SASSI results.

The staff noted valleys exists between successive peaks in the site shear waves. The staff requested that these valleys should b e filled in to accommodate the expected variability in site shear wave profiles.

GEH used the energy balance method to calculate the soil -bearing pressure and consider both form and size. GEH demonstrated that the soil-bearing demand is less than the allowable soil -bearing pressure. The results are documented in DCD Tier 1. They're in 5.1-1 and DCD Tier 2, Table 2.0-1.

GEH used the energy balance method, which takes into account the effects of uplift in the linear response calculated by SASSI. We thus concluded that this simplified method provides a reasonable estimate using the linear analysis results on the amount of uplift displacement due to passing of the base mat dimension.

As shown in Figure 1, as shown in Figure 1, the extent of uplift is not extensive, and a large portion of the base mat remains in contact with the soil. GEH complied with the NRC request and filled the spectral valleys between the peaks, as shown in Figure 2. The dotted line was when the valleys are not filled on, and the solid line is when the valleys are filled in.

CHAIRMAN CORRADINI: The staff said the low frequency region. In fact, there isn't much of a valley in --

MR. NIOGI: Yes. They said there is not much, but in several cases, we do have valleys in the -- several valleys in the low frequency range.

CHAIRMAN CORRADINI: And that's what requires -- or that's what, that's the impetus that the staff has to fill in to do, so that you eliminate those large changes.

MR. NIOGI: Large changes, yes.

CHAIRMAN CORRADINI: Okay.

MR. NIOGI: It was demonstrated the soil -bearing demand is less than the soil -bearing capacity in static and dynamic loading conditions.

DR. WALLIS: So this is 5g, this maximum almost?

MR. NIOGI: Yes, it is almost 5g.

DR. WALLIS: Oh.

MR. NIOGI: This is our analysis from the ground elevation. The technical basis for not considering the effect of uplift in the seismic demand loading in the bearing and sliding calculation, which uses SASSI analyses results have been demonstra ted. Spectral valleys between the peaks have been filled in.

NRC RAI 3.8 -96. Confirmed, that the Seismic Category 1 structures meet the sliding stability requirements of SRP 3.8.5. Justify, use the static correlation of friction beneath the base mat, and along the vertical surfaces of the walls.

Justify, use a full passive pressure at the side of the vertical surfaces of the walls in the sliding resistance. How did GEH consider other potential sliding interfaces in addition to the soil shear failure that is base mat to concrete mud mat and concrete to soil.

It does confirm that the Seismic Category 1 structures meet the sliding stability requirements of the SRP 3.8.5, considering passive pressure resistance. Resistance due to friction at the bottom of the base mat, and along the vertical surfaces of the walls. GEH used reduced friction in the vertical walls to calculate friction resistance due to passive pressure.

In this evaluation, passive pressure was needed to comply with SRP 3.8.5 requireme nts. GEH added shear keys to the reactor building, fuel building complex and service complex to increase the sliding resistance. See Figure 3.

In Figure 3, you can see that.

CHAIRMAN CORRADINI: So these were added? I just want to understand. These were added because, if I remember back last time we discussed this, there was -- the staff wanted you to look at variation in the sliding coefficient, and these were added to add extra margin to -- that even if the sliding coefficient was lower, you still met the requirement?

MR. NIOGI: I would not say adding extra margin. I would say that yes, we needed that CRT to get that stability factor SRP against sliding 1.1.

CHAIRMAN CORRADINI: Okay. Thank you.

MR. NIOGI: By roughening the surface face of the mud mat concrete, friction resistance is increased between the mud mat and base mat. Added drafts in the soil under the mud mat to increase the shear resistance. Building structures meet the sliding stability requirements of the SRP 3.8.5.

Static coefficient of frequency of .7 beneath the base mat and the reduced coefficient of friction of 0.5 for the vertical surface of the wall is adequate to provide sliding stability. Additional reinforcement was added to the vertical walls to resist passiv e pressure, to increase the friction relation between the base mat, mud mat and soil.

NRC RAI 3.8 -107. NRC staff reviewed the SSDP computer program validation package, but found that the validation did not satisfy items of interest, such as how does SSDP apply the concrete code used the U.S., and how are the code additions that are accepted by the NRC is incorporated in SSDP to keep it current?

How does SSDP identify critical sections of a structure. In the RCCV structure, how does SSDP evaluate that shear stress to demonstrate compliance with the ASME code? GEH was requested to verify the equations using the SSDP by comparing the quantity results with the equations presented in the concrete textbook.

SSDP calculates stresses of concrete and INPO st rength of force and --. Calculated stresses are compared with the allowable stresses specified in applicable codes. The SSDP has supplemental subroutines for the tangential shear and transverse shear.

It is confirmed that the provided section satisfies the code requirements. The validation of SSDP provides confirmation that the calculation result meets the requirements of the code additions which are specified for the project.

The equations used in the SSDP computer codes were verified by comparing t he results with the results from the equation presented in the concrete design textbook. The validation of SSDP confirms that the calculation results satisfied the requirements of the codes. The coefficients using the SSDP computer code were verified with hand calculation.

DR. WALLIS: How do you verify an equation by hand calculation?

MR. NIOGI: Well --

DR. WALLIS: Either the equation is right or not, it seems to me --

MR. NIOGI: The numbers.

DR. WALLIS: When you use it to calculate?

MR. NIOGI: Yes. You use the equation. I mean you come up with the number, the same number.

DR. WALLIS: You don't, you don't verify F equals MA by using it to calculate them?

MR. NIOGI: No. I think we should say the numbers are verified, yes. The computation has the same number.

DR. WALLIS: Well, compared with what then?

CHAIRMAN CORRADINI: Well, I think -- well, at least the way -- maybe it's the words that you've used today. What I interpreted you to mean was that you went to handbook calcul ations and did a calculation and confirmed it compared to what the computer calculation.

DR. WALLIS: The result. You didn't compare the equation.

(Simultaneous discussion.)

DR. WALLIS: You just compared it to nothing.

CHAIRMAN CORRADINI: Yes. That's what I interpreted it to mean.

DR. WALLIS: Right, right. Well, yes. But I'm just asking him what he means.

MR. NIOGI: Right, yes.

DR. WALLIS: And you know what --

CHAIRMAN CORRADINI: Is my interpretation correct or -- is my --

MR. NIOGI: Yes, your interpretation is fine. We should have said that hand calculated results, yes.

DR. WALLIS: You know, the predictions or something.

MR. NIOGI: Right, yes.

DR. WALLIS: Okay.

MR. NIOGI: Thanks for pointing it out, and it was -- yes. We should have said that, yes. NRC RAI 3.8-120. NRC indicated in their review that the material thickness for reactor shield wall in some locations is better than ten inches. ASTM 8516 is only available up to eight and a quarter inch, inches thick.

ASTM 8709 is only available up to four inches. NRC requested GEH to explain how reactor shield wall will be fabricated. The staff also raised a concern related to welding A-709 material to the containment steel liner and accept the report case for this type of welding.

GEH plans to fabricate using four inch maximum thickness steel using multi-layer vessel construction technique. Multi-layer construction has been very effective for cylindrical pressure vessels more than 16 inches thick. The const ruction techniques allow the multi -layer shells to act as a solid wall.

DR. WALLIS: Well, they can't be attached all along the interface.

MR. NIOGI: They behave as a monolithic structure.

DR. WALLIS: Because of friction at the interface?

MR. N IOGI: Yes. We show the friction technique, you know. You can have it --. There are four different techniques discussed.

DR. WALLIS: To me, if they were heated sufficiently, then they would buckle out from each other, these layers.

MR. NIOGI: Well --

DR. WALLIS: Out of a fire or something.

MR. NIOGI: It is being used for model, to show that technique in the pressure vessel.

DR. WALLIS: Yes. It's all right as a pressure vessel. It's just, I can think of events which might delaminate or separate these layers?

MR. NIOGI: Do you want me to discuss this, bring my metal engineer?

DR. WALLIS: I'm not sure. I'm just

asking you --

MEMBER ARMIJO: What is the shape of the shield wall?

MR. NIOGI: It's a cylindrical shape.

MEMBER ARMIJO: Well, you have -- these are nested cylinders?

MR. NIOGI: Yes, they're nested cylinders.

DR. WALLIS: As long as it's under pressure, it's fine. But it seems to me if you've got say an impingement of a steam jet on the wall or something --

MR. NIOGI: Right.

DR. WALLIS: Then it would be known that you can separate steel liners from concrete by impinging a steam jet and it's happened.

MR. NIOGI: Yes.

DR. WALLIS: So it seems to me there are situations where these layers would tend to separate from each other.

MR. NIOGI: Right. In the case of liner, where the jet will impinge the liner, you know, the thickness of the liner is an issue here is a --. But you're talking about an impingement, you know, that --

DR. WALLIS: So if it's hot enough.

MR. NIOGI: That's right, and also in the case of liner, you know, it is backed by concrete. It's not backed by the steam.

DR. WALLIS: The shield wall blocks the gamma radiation?

MR. NIOGI: Yes. That's the --

DR. WALLIS: It's not a structural --

(Simultaneous discussion.)

MEMBER KRESS: So its purpose wouldn't be bothered by separation or a big bond between the layers? It would still work for what it's supposed to do?

MR. NIOGI: Well, we don't want just to have thick steel sitting there and not doing anything, right? So we'd like to revise that material.

MEMBER KRESS: I see.

MR. NIOGI: So we do it --

MEMBER KRESS: To support something.

MR. NIOGI: --to support something, yes. Definitely, the pipe full blast steam.

MEMBER KRESS: Pipes and things like that, yes.

DR. WALLIS: During seismic events, it stays monolithic?

MR. NIOGI: Yes.

DR. WALLIS: It does?

MR. NIOGI: Yes, it does. Yes.

DR. WALLIS: How are the layers bonded? Do you weld them in particular --

MR. NIOGI: I must talk to our engineer. I want to, you know, in that case I need to have to metal specialist to help me out. Do you want me to bring him in?

MEMBER ABDEL-KHALIK: Yes, please.

MR. NIOGI: Okay.

MR. CRESS: Yes, pleas e. My name is Mirali Cress (ph). I'm the welding engineer, and Sujit was talking about the multi -layers in sections. Yes, we would like to do something like that and probably, if you to -- if there is any fear of separation or something, we can weld them in certain areas, so that it will remain layer.

Normally, we can use press-fitting also, so that it is tied, and this being just the radiation shielding, you shouldn't be having any kind of stresses or structure will get displaced or something.

So ev en if something happens, we could weld them in some areas, where it could remain intact.

DR. WALLIS: Yes, if it's just a radiation shield. I was bothered by the term, the statement here that the multiple layers act as a solid wall, because I can think of situations where they might not act as a solid wall.

CHAIRMAN CORRADINI: In heating situations, I'd agree with you.

DR. WALLIS: Yes, right. But it's not those situations -- it's not designed for those situations, so therefore it's all right.

CHAIRMAN CORRADINI: So just to be clear, just so we're clear about it, so the situations it's designed for is structural -- is of course is the shield, but also structural support, and you said restraints were attached to it, if I remember what you had said.

MR. NIOGI: Restraints are attached to it.

DR. WALLIS: I'm looking at this. It says "pressure vessel" in the drawing. It's not a pressure vessel?

MR. NIOGI: It's not a pressure vessel.

DR. WALLIS: So it's all there. So I'm just looking. The words kind of misled me here.

CHAIRMAN CORRADINI: Open can.

MR. NIOGI: Open can, exactly. That's like BWR, you know, mark one to three. You have a shield obviously made of steel and concrete, you know. This is concrete. We reduce the phase b y using the shield.

DR. WALLIS: That's a radiation shield, okay.

MR. NIOGI: Yes.

DR. WALLIS: Well, it's big enough and strong enough. It could act as shield for other purposes.

(Laughter.)

MEMBER KRESS: I think they made that point, that t hey could do something more than just have it sit there.

MR. NIOGI: Our radiation technique is complying with ASME code fully utilized. Welding of dissimilar material with as similar land material has been satisfactorily addressed.

NRC RAI 3.8-125. Confirm that the impact of the spent fuel storage racks will not adversely impact the spent fuel pool walls.

DR. WALLIS: Now by "impact," you don't mean collision. You mean the effect.

CHAIRMAN CORRADINI: No, I think he means.

MR. NIOGI: I'm really meaning impact.

DR. WALLIS: You mean an exchange of momentum, bumping?

MR. NIOGI: Yes.

DR. WALLIS: Okay.

MR. NIOGI: Confirm that impact of spent fuel storage racks will not adversely impact the spent fuel pool walls.

DR. WALLIS: Secon d impact is -- it means effect or something, yes. The first impact is physical. The second impact is an effect.

MR. NIOGI: An effect.

DR. WALLIS: Okay.

MR. NIOGI: --during SSE event with may cause over -stressing of concrete walls. The free -standing spent fuel storage racks are supported on embedded place on the spent fuel pool base mat. To preclude the racks contacting the walls during an SSE event, the free -standing racks were designed to provide sufficient gap between the racks and the walls.

DR. WALLIS: And that's confirmed by analysis?

MR. NIOGI: That analysis has demonstrated that the racks will not contact the spent fuel pool walls.

DR. WALLIS: Now this is a bit like the PCCS seismic response, where you have structures in water moving around, right?

MR. NIOGI: Right, yes.

DR. WALLIS: There's water in this spent fuel --

MR. NIOGI: There's water, yes.

DR. WALLIS: And the racks are submerged in water?

MR. NIOGI: Submerged in water.

DR. WALLIS: And the last time we met, we had some questions about how you treated the added mass for this situation?

CHAIRMAN CORRADINI: This was for PCCS.

DR. WALLIS: Yes, but I didn't see anything about PCCS in this presentation, or even in the SER.

MS. CUBBAGE: We came back in a separate meeting and addressed those issues.

DR. WALLIS: That was all resolved, was it?

MR. NIOGI: Yes.

MS. CUBBAGE: Yes.

CHAIRMAN CORRADINI: For PCCS.

DR. WALLIS: It was resolved? I thought we just had questions. It was resolved?

CHAIRMAN CORRADINI: Well, we had a subcommittee meeting back in November, where they showed us the additional calculations.

DR. WALLIS: I think I have questions about the validity of the calculations.

CHAIRMAN CORRADINI: It seem to remember at the mo ment you were -- I seem to remember at that moment you were satisfied.

DR. WALLIS: Just evaporated? Well, I read a report. Well, okay, all right.

CHAIRMAN CORRADINI: At the time you were satisfied.

DR. WALLIS: At the time, I read a report. I don't know. It just disappeared into the system.

CHAIRMAN CORRADINI: But this one is spent fuel.

MR. NIOGI: This is spent fuel.

DR. WALLIS: You're not going to talk about PCCS then, because that's already been resolved somewhere?

CHAIRMAN CORRADINI: Well, we're not going to talk about it today.

DR. WALLIS: Okay. I'll have to look back at what date it was that I wrote my report.

CHAIRMAN CORRADINI: Well, I can find it for you if you want.

MEMBER KRESS: Unless they used the same

technique for added mass here. So if he has issues with it in the PCCS, there might be issues here. It would be nice to know how they treated the added mass.

CHAIRMAN CORRADINI: If you want to ask the question to them, then, about your --

MEMBER KRESS: They might not be prepared to answer that, but --

DR. WALLIS: No. I mean the staff in some way is satisfied. I don't know why.

MEMBER KRESS: Well maybe Amy --

DR. WALLIS: Then we'll ask them.

MEMBER KRESS: --could discuss it. You were happy with what they did?

MS. CUBBAGE: We were happy with what they did at the time, and we left with no action items from the Subcommittee.

MEMBER KRESS: You're going to give us a talk after this one?

MS. CUBBAGE: We are.

DR. WALLIS: There was a time we talked about sloshing as well. I remember the time, and I was not satisfied with added mass. But anyway, let's move on.

CHAIRMAN CORRADINI: Yes. In this case, the racks are very submerged.

DR. WALLIS: I don't think that's as much an issue as it was -- the PCCS is a bigger issue.

MR. NIOGI: Right.

DR. WALLIS: That's a bigger issue.

CHAIRMAN CORRADINI: They're near -- I mean from the standpoint of submergence, these are many meters below the water level.

DR. WALLIS: Can't move without pushing the water around.

MEMBER KRESS: The water has to move that.

CHAIRMAN CORRADINI: The PCCS is sitting with the water level near the upper drum, if that -- if my memory --

DR. WALLIS: It doesn't matter for added mass, and that is for sloshing.

MR. NIOGI: Sloshing.

MR. DEAVER: Right. Our racks are more than ten meters below the water surface.

MEMBER ARMIJO: What is the gap between the racks and the walls? Is it how many feet, inches.

MR. NIOGI: No. Six inches, a little less than six inches.

MEMBER ARMIJO: Inches, and what's the maximum amplitude of the rack?

MR. DEAVER: I heard that it's 42

millimeters, in the north -south direction, and in the east-west direction it's 60 millimeters.

MEMBER ARMIJO: That's not very much.

MR. DEAVER: Not very much.

MEMBER KRESS: Is each rack free-standing?

MR. DEAVER: They're free -standing. What we had to do --

MEMBER KRESS: They can impact each other?

MR. DEAVER: What we did is we had to couple all the racks, link them toget her. We have a base plate that they sit in that restrains the separation.

MEMBER KRESS: At the bottom, at the bottom there.

MR. DEAVER: Yes, at the bottom, and also at the top.

MEMBER KRESS: They're linked at the top also?

MR. DEAVER: They are.

MEMBER KRESS: So they have to move --

MR. DEAVER: They have to use this as a complete unit.

MEMBER KRESS: I see.

MR. DEAVER: It eliminated a lot of the complexity of impacts and non-linear analysis.

MEMBER KRESS: Yes. That would make a big difference on the amplitudes too.

MR. DEAVER: Yes.

MEMBER ARMIJO: So is this sort of an egg crate structure, the entire fuel rack structure is one thing --

MR. DEAVER: Yes.

MEMBER ARMIJO: Bonded to some big plate on the bottom of the pool?

MR. DEAVER: It sits in a base plate that has vertical plates that restrain motion.

MR. NIOGI: Shear logs at the day. So there's not going to be space --

MEMBER ARMIJO: And that's sort of welded to the liner or --

MR. NIOGI: No. It's not welded to the liner.

MEMBER ARMIJO: It sits on the liner?

MR. NIOGI: No. The shear log is welded to a base plate, and the base plate is then in turn welded to the embedment plate, which is resting on the -- which is embedded into the concrete base mat.

So you have two layers of embedment. One is shear log welded to the base plate upper rack, which is then connected to the embedded plate, which is connected to the base mat of the fuel group.

MEMBER ARMIJO: And where is the liner?

MR. NIOGI: The liner is then comes and is welded on the top of the base mat, and with a leak system that the water cannot go through. I don't know if there is a --

MEMBER ARMIJO: If there's a sketch or somewhere later in the day, if you could just give me.

MR. NIOGI: Sure. The board I can draw right now, you know.

MEMBER ARMIJO: So I could understand.

MR. NIOGI: The board I can draw right now, you know.

MEMBER ARMIJO: I'd just like to see what it looks like.

DR. WALLIS: Can we dig out this PCCS?

CHAIRMAN CORRADINI: I'm trying.

DR. WALLIS: At some time in the future.

CHAIRMAN CORRADINI: I have your November letter. You don't mention after that any concerns there. It was mainly about hydrogen at the time.

DR. WALLIS: I had about three p ages on added mass in one of the reports.

CHAIRMAN CORRADINI: That was earlier.

MS. CUBBAGE: It may have been in advance.

DR. WALLIS: That was earlier?

CHAIRMAN CORRADINI: That was earlier, and we came back -- they came back. If my memory is, I have, I'm looking. They came back with a series of calculations and varied the parameter.

DR. WALLIS: Maybe I wasn't here, because I don't remember it being resolved. But anyway, the staff is satisfied. That's what matters.

CHAIRMAN CORRADINI: I'll keep on looking, but memory is, my memory is we were in January of `09, approximately then where we were talking about added mass effects, we came back, staff came back and at the November Subcommittee meeting, and that's we --

You were happy about that, but we then went off, talking about the fan performance and hydrogen effects, and that's how -- that was the major open item that came out of the November meeting.

DR. WALLIS: Yes.

CHAIRMAN CORRADINI: That's what I have at this --

DR. WALLIS: Okay. Well, but you'll look into it and we'll figure it out.

CHAIRMAN CORRADINI: Okay, right.

MEMBER ARMIJO: Because of this way you've designed it, even though you have a very small gap, what is the amplitude, the maximum amplitude of this rack, moving towards the liner? Is it half an inch or a tenth of an inch?

(Simultaneous discussion.)

MR. NIOGI: Toward the wall, yes.

MEMBER ARMIJO: Toward the wall, yes. You say it's sufficient gap, so there's two numbers I'm interested in. What is the gap and how much of it do you use in your SSE?

MR. DEAVER: Yes. We just have a few millimeters of gap, but you have to consider that the pool, we're working to the minimum dimensions of the pool, and so in reality, when you get the real as-built, we're going to find --

MEMBER ARMIJO: I'm just looking for how much margin you have between your calculation of how much. When you say it's sufficient gap --

CHAIRMAN CORRADINI: What Sam's asking -- what Sam's asking is when it wiggles, how much is t he open area after it wiggles?

MEMBER ARMIJO: Yes, right. How much is left over?

MEMBER KRESS: How close is this --

CHAIRMAN CORRADINI: How close are you going to get? That's what I guess he's asking.

MEMBER ARMIJO: 90 percent of your gap, 80 percent of your gap, ten percent?

MEMBER KRESS: In a pool like this, it's difficult. It's vibration motions, because you have to have some model for what happens to the water. Did you treat the water at all in these calculations?

MR. DEAVER: Oh yes, definitely.

MEMBER KRESS: You had an added mass calculation?

MEMBER ARMIJO: Then you have an answer somewhere.

MR. DEAVER: Is this -- do we want to get back to them?

CHAIRMAN CORRADINI: I think that's the best thing to do.

MR. NIOGI: Yes . I think we should get back to you with the number, because this is Chapter 9.9, you know.

DR. WALLIS: It helps with these wordy statements if you provide a figure and some numbers.

CHAIRMAN CORRADINI: Yes, it would.

MR. NIOGI: A figure?

DR. WALLIS: A figure and some numbers. This is the way it shakes, this is what we calculate, this is what the gap was, and this is what it is when it shakes. That would be very clear and we'd go away and have to be happy.

MR. DEAVER: What happens at the top of the rack. It will sway --

(Simultaneous discussion.)

DR. WALLIS: Yes, that's what -- otherwise, we can talk forever.

MEMBER ARMIJO: You've got that down. I understand.

MR. DEAVER: Well actually, it's not totally locked down.

CHAIRMAN CORRADINI: So we'll take it as -- you guys will take it as an action item, and I've written it down that we'll come back. Wayne enjoys these little tasks.

MR. MARQUINO: It give me something to do.

CHAIRMAN CORRADINI: Right, okay.

MR. NIOGI: So that -- this is considered my presentation.

CHAIRMAN CORRADINI: Okay, all right. Other questions on these RAIs?

(No response.)

CHAIRMAN CORRADINI: Okay. Thank you very much. I think the way we're doing this is staff is now coming up Amy?

MS. CUBBAGE: Yes.

CHAIRMAN CORRADINI: Okay.

MR. NIOGI: Thank you. Thank you very much.

CHAIRMAN CORRADINI: Thank you very much.

(Off mic discussions.)

CHAIRMAN CORRADINI: Dave, are you going to kick us off here?

MR. MISENHIMER: Yes.

CHAIRMAN CORRADINI: Okay, all right. Go ahead, I'm sorry.

Chapter 3 - Section 3.8 RAIs/Staff

MR. MISENHIMER: Okay. I've Dave Misenhimer. I'm the project manager for Chapter 3, and today Samir Chakrabarti is going to address the significant RAIs open i tems that are related to Section 3.8.

MR. CHAKRABARTI: Okay. Good morning. I'm Samir Chakrabarti. I'm the NRC technical reviewer for ESBWR Section 3.8, and we have with us here today our technical consultants from BNL, which is Joe Braverman and Ric h Morante, to help us with any questions that you may have.

We have completed our review of Section 3.8, and in the first line there's basic regulations and standards that we use for the review. It was a very extensive review that spanned over about five years, I would say, and I also picked it up in the middle of somewhere.

But fortunately, BNL Consultants, they have the same guys who performed the review also, and that ensures some continuity in the relation. We had five design audits that were performed to review calculations and discuss various issues with the applicant.

We have performed the confirmatory analysis of the base mat calculation --

DR. WALLIS: When the base mat -- you asked about whether or not it moves. Does it matter how much water is underneath it?

MR. CHAKRABARTI: Say that again?

DR. WALLIS: Does it matter how wet the soil is? So you said you confirmed analysis of this, and that you were concerned about the base mat moving in the soil, I think?

MR. CHAKRABARTI: Yes.

DR. WALLIS: Does it matter how wet the soil is?

MR. CHAKRABARTI: Well, that's the coefficient of friction that we used.

DR. WALLIS: But it changes a lot, doesn't it, depending on how wet it is, or does it not?

MR. BRAVERMAN: Yes. If you're speaking about -- this is Joe Braverman from BNL. If you're speaking about the confirmatory analysis that we performed, we primarily did independent analysis of the reactor building foundation. We were looking at three areas.

One of the areas was that y ou initially assumed the concrete base mat was one thickness, and in reality, there were two variations of that.

CHAIRMAN CORRADINI: Joe, I think -- Joe? I think you're going to have to get it closer to you. I don't think they're catching what you're saying.

MR. BRAVERMAN: Okay. I'll start again. In the confirmatory analysis that BNL performed, we were looking at three areas. One is G assumed that the concrete base mat was a constant thickness, and the reality, there's some variations in it.

Also, they use a thick shell element, a final element representation for the base mat which is a single like shell element that has through the thickness capability, of being able to use 3D solid element representation, because we questioned how accurate that would be.

The third thing is they used a Naturine (ph) computer code, and BNL followed an ANSYS computer code. So we looked at those differences, and we analyzed seismic loading, dead weight, hydrostamin (ph). So it wasn't intended to study the effec t of the soil and how they modeled the building.

DR. WALLIS: No. But the presentation we heard was about the base mat actually moving or lifting up and so on, and I just wondered what the soil was in those kind of calculations.

MR. BRAVERMAN: Okay, but that's not part of the confirmatory analysis.

DR. WALLIS: No, but I just -- but it was -- you reviewed and accepted GEH's analysis for these other phenomena.

MR. BRAVERMAN: Oh yes.

DR. WALLIS: So I'm asking if the staff understands how the w etness of the soil affects whether or not the base mat moves or lifts off or does various other things? So I'm just asking if the staff understands that, and therefore accepts what GEH submitted?

MR. BRAVERMAN: Yes, we did review that, and we accepted it on the following basis. The SSI analysis used the SASSI code. The SASSI code does not have non-linear, does not have non -linear capability. It cannot lift off, because the springs aren't compression -- not the springs. The contact between the soil a nd the base mat takes compression and tension.

So they did a separate calculation based on the energy balance method, and that formulation does have lift -off capability. So we have relied on that analysis to see what extent of uplift there is, and it's not significant.

DR. WALLIS: And in terms of the friction coefficient, is the wetness of the soil considered?

MR. BRAVERMAN: Well, in the lift -off analysis, friction does not enter. Friction entered in the sliding and overturns.

DR. WALLIS: In th e sliding, right. In the sliding analysis, is the wetness of the soil considered?

MR. BRAVERMAN: In the sliding, the effect of the moisture content in the soil wouldn't, would not --

DR. WALLIS: Has no effect.

CHAIRMAN CORRADINI: Why doesn't it? I'm listening to Graham ask you all these questions. Now I'm curious. Why doesn't it?

DR. WALLIS: I've slid around a lot on wet soil. Now maybe I don't weigh enough to make any difference.

(Laughter.)

CHAIRMAN CORRADINI: You need to be heavier.

MR. NIOGI: I can answer these questions.

CHAIRMAN CORRADINI: Identify yourself please.

MR. NIOGI: This is Sujit Niogi from GE Hitachi. What we did, you know, this is what was mentioned, that if we can slide on a wet surface. Yes. So we know t hat situation. So what we did, we have a trough in in the soil. So the concrete mud mat, when you pour, you pour on the trough on the soil. You get these GRA resistance, like a shear key.

CHAIRMAN CORRADINI: They added -- remember that's what he described. They added what he calls a shear key, essentially like a ring of concrete around the base.

DR. WALLIS: That holds it in place?

CHAIRMAN CORRADINI: Well, that gives you extra margin so when you wiggle it doesn't move as much.

DR. WALLIS: So you wiggle. When the

soil's wet, it doesn't move?

MR. NIOGI: In addition to that, below the mud mat, below the mud mat we have also a trough in the soil.

MEMBER ARMIJO: Are these like corrugations?

MR. NIOGI: Yes, corrugations.

MEMBER ARMIJO: Okay.

MR. NIOGI: Right, like a tool deck.

MR. BRAVERMAN: Also the entire reactor building foundation is embedded in the soil, so it's not like a structure resting on the top surface that can slide.

DR. WALLIS: No, no. I understand that. But the forces can be pretty big when you shake the soil?

CHAIRMAN CORRADINI: Oh yes.

DR. WALLIS: And actually the shaking of the soil can change the friction coefficient itself, because if it moves the liquid around.

MR. CHAKRABARTI: I think question is the friction coefficient that we assumed, how it is impacted by water in the salt marsh or water in the soil. What we have assumed in this analysis, the friction coefficient is based on shear failure of the soil, and because it has been taken as a tang ent of the angle of friction.

Now that value, whether it is impacted by salt water in that soil, I guess not. We have assumed tangent total frictional figure of the soil, and to make sure that the soil absorbs friction, and it does not slide on the surface.

DR. WALLIS: I don't know. I'm just speculating. It seems to me that if you shake a wet soil with a seismic sort of stresses, you're going to squeeze the water out of it. But I'm just curious about this, that's all, and I'm not an expert on it, except maybe in the squeezing of water out of the soil.

But I'm just curious how you handled it, and you can assure me that it's handled properly?

MR. BRAVERMAN: I have no information with me at hand.

CHAIRMAN CORRADINI: He's asking for a judgment.

DR. WALLIS: No, but I guess --

MR. BRAVERMAN: In my judgment, I don't think it will have a significant variation. Plus they're not relying primarily on just the friction alone, as I mentioned. They have a large frontal area that's embedded --

DR. WALLIS: So it has to sort of move a whole lot of soil.

MR. BRAVERMAN: Yes. It's not just friction. It's all of the resisting --

(Simultaneous discussion.)

DR. WALLIS: That probably, that probably does it. Yes, okay. Well --

CHAIRMAN CORRADINI: The applicant stated in the response to RAI 3.8-96 that by roughening the top surface of the mud mat concrete, friction resistance is increased between the mud mat and base mat, added troughs in the soil under the mud mat to increase shear resistance.

DR. WALLIS: That's right.

CHAIRMAN CORRADINI: Is this a skill of the CRHAV? Is there some kind of analysis that relates this to whatever friction factor you assumed, or is this just --

MR. NIOGI: The roughening of the concave surface, you know, for every layer of concrete, it is in the ACI (ph) code. It is accepted by the code, you know. We are just honoring the code.

CHAIRMAN CORRADINI: How

MEMBER ABDEL-KHALIK: How do you relate to the assumed friction factor?

MR. NIOGI: It is -- that code will tell you that this is the number you can use, .7. We are just using the applicable standard and the code used to get this number. Coefficient of friction is always experimental, and we come to the number that will be more conservative.

MR. CHAKRABARTI: Yes, if I may explain. What we have shown in the evaluation is slipping at different interfaces. First is the mud mat and the soil surface. The coefficient of friction assumed, .7, is fairly high, and relies on shear failure of the soil.

To ensure that the soil friction shear, that's when the coefficient and then the mud mat was introduced. So that the, really the soil will shear before there is a tendency to slip at the interface. That was the basis for the coefficient.

And al so, we are pouring foundation concrete about the base mud mat, and this -- all concrete and new concrete, what is the coefficient of friction to assume between that? According to CIT-49, it says it could go maximum .6 coefficient of friction when you pour new concrete on old concrete.

But this coefficient of friction can go as high as one, if the surface of the interface is intentionally roughened. What is meant by intentionally roughened is you roughen so that there is at least quarter inch of depth of the roughening. If you can ensure that, you can go to as high as one as the coefficient of friction.

So we have gone for intentional roughening and used .7 coefficient of friction.

CHAIRMAN CORRADINI: Thank you.

MEMBER KRESS: Educate me a little. I'm not an expert in this area. It seems to me like all the seismic forces are transferred from the soil to the structures.

MR. CHAKRABARTI: Yes.

MEMBER KRESS: Now it's the structures that you worry about, so if you want to lessen the effect of th e seismic event on the structures, you would like to have as much as sliding as you can --

(Simultaneous discussion.)

MEMBER KRESS: What you're doing is increasing the forces?

MR. CHAKRABARTI: Yes, that's right. But we have not performed our analysis --

(Simultaneous discussion.)

CHAIRMAN CORRADINI: My sense of it is

that's an innovative way that a conservative engineer will not touch with a ten-foot pole.

MEMBER KRESS: Oh, you want to be? You remember the Moten, I mean the liquid metal, the breeder reactor --

CHAIRMAN CORRADINI: Yes, yes. The Clinch River. Clinch River did that.

MEMBER KRESS: They did that. They did that, yes.

MR. CHAKRABARTI: That's a new state of the art thing that is coming up.

MEMBER KRESS: Yes.

MR. CH AKRABARTI: And base isolation is being introduced in the design. But these are conventional nuclear power plants.

MEMBER KRESS: This is the way -- so you're being conservative by increasing the effects of the --

MR. CHAKRABARTI: I understand. If it slips, it cannot transfer the --

DR. WALLIS: Did you lubricate the molten lead by putting water on it?

CHAIRMAN CORRADINI: They haven't had Graham review it. They haven't.

(Simultaneous discussion.)

MR. BRAVERMAN: Excuse me, excuse me. I just realized there was another consideration that may answer your question about a dry soil or saturated conditions, because really GE could have identified any fee factor which determines the coefficient of shear fail in the soil.

The reason for that is there's in Table 1, Table 5, a requirement that at the site, the COLA has to demonstrate that they satisfy this fee, equal, I think, 30 or 35 degrees, which gives you a .7 value.

So that could be confirmed later on at the site, to make sure the soil conditions, whatever it is, saturated, dry, satisfies that minimum coefficient of friction. So that's another check that can be done down the road.

MR. CHAKRABARTI: Yes, and like during the process of review, there have been many enhancements to the DCD from the way it was originally submitted.

The status of the review. All issues identified during the review have been resolved. The PCCS, we still haven't had any issue with PCCS, but this is being addressed in Section 6.2.2.

DR. WALLIS: It's actually in the SCR, is that?

MR. CHAKRABARTI: In the SCR? No, we had

started discussing about the PCCS because it --

DR. WALLIS: But it disappeared. I couldn't find it, a discussion later on.

MR. CHAKRABARTI: I think at the end of RAI 3.8-117, we had introduced discussion of the PCCS. But then we have referred it to Section 6.2.

DR. WALLIS: It seemed to be referred to early on, and then it never appeared later on in detail. But maybe I -- it was such a long document.

MR. CHAKRABARTI: I know. At the end of RAI 117, we had discussed the issue of PCCS, because we were reviewing at that time. But then we decided it is better to address the issue under 6.2 and close it.

DR. WALLIS: Oh, I see. Okay.

MR. CHAKRABARTI: So we moved it to 6.2.

DR. WALLIS: Oh, that's where you put it. Okay, okay.

MR. CHAKRABARTI: Yes. The way I have planned the presentation like, you know, last ACRS presentation we had talked about a few issues relative to various RAIs, and GEH, I think, did a good job in talking about the same RAIs in this more bigger scope of what the RAI was about.

All of these RAIs really started with many questions, but I'll go over the issue that was open or that were open during the last ACRS meeting, and address those.

In 3.8-107, the issue that we had open on this one during the last meeting was significant non-linear behavior of the containment structure due to thermal loading.

What we have noticed, that the thermal stresses had caused significant cracking in the concrete sections, and we had a notion that we are using this cracked section analysis results and superimposing them with the elastically computed stressors from other mechanical loads.

Was it practical to do it, because all those loads will be acting together and due to thermal load cracking and the forces and moments we've computed elastically, they'll be redistributed and it's still okay.

GEH performed an analysis where they considered in a sample case the mechanical loading, also considered the non -linear behavior with cracked sections, and they demonstrated that in the main critical areas or in the majority of the areas, the elastic analysis superimposition was still okay.

There were certain areas where the

resultant stresses were exceeded because of redistribution, but those areas were located in areas where stresses are not critical. Based on that, we accepted the method of superimposing elastic analysis results for mechanical loads with the non -linear thermal results, and -- results.

In RAI 3.8-79, this was about the Seismic Category 2 or non-seismic structure GEH described. They're all designed to Category 1. During the last ACRS meeting when we had, this was not involved at that time because GEH was planning to design them to meet the seismic criteria. But finally, we agreed that to demonstrate there will not be any unacceptable interaction.

DR. WALLIS: What kind of unacceptable seismic interaction are you thinking about?

MR. CHAKRABARTI: If these Category 2 structures are not designed u sing the SSC or the seismic forces, there are a few things. First of all, the seismic input motion. If we do not follow the Category 1 design, the seismic input motion can be derived using other codes that may not be prevalent.

In the design approach, the Category 2 structures don't need to design, need to be designed to remain stable or anything. As long as it does not hit the other structure. By the seismic interaction, we mean like if you have a non-Category 1 structure, during a seismic event it collapses and hits the Category 1 building.

DR. WALLIS: Okay.

MR. CHAKRABARTI: So if it his the Category 1 building, it might be still okay. But we have to --

DR. WALLIS: There's an impact --

MR. CHAKRABARTI: Impact, yes. We have to take into consideration impact. It is more difficult to analyze those for with an impact than are easier to make sure they don't impact. That's what by following, by following the design methodology in which Category 2 structures will be designed, using the same criteria used for Category 1 structures.

DR. WALLIS: So that they won't collapse.

MR. CHAKRABARTI: They won't collapse.

DR. WALLIS: You start thinking about what happens if they actually collapse. That gets pretty difficult.

MR. CHAKRABARTI: It gets pretty difficult.

MEMBER KRESS: That raises another question. These are all done for say a shut -down earthquake.

MR. CHAKRABARTI: Yes.

MEMBER KRESS: Now if you're going to do a PRA, you would look at earthquakes greater than that. Did you look at what sort of earthquake might cause one of these problems to collapse and give you an issue? Did you look at the frequency of those?

MR. CHAKRABARTI: I'm not -- I did not really go into the --

MEMBER KRESS: I guess that's a PRA issue.

MR. CHAKRABARTI: Yes.

MEMBER STETKAR: They didn't do a seismic PRA. They only did a seismic margins analysis, so they don't' know.

MEMBER KRESS: So you wouldn't know that. Okay. Thank you.

MR. CHAKRABARTI: So that's how we resolved this. Then RAI 3.8 -94. There were many issues in the original RAI that GEH went through, but the issue that we had open with us in the last few days, the bearing pressure demands concluded by GEH appeared to be very high, and we had questions.

How are these high bearing pressure demands going to be met? Like for medium soil, the bearing pressure demand was calculated to almost 150 gifs (ph) per square feet, and we did not think that it would have soil that could take that kind of bearing pressure.

So we wanted t o see what was the reason for this and how are you going to account for it, and during our review, it was found that if bearing pressure demands calculated by GEH were done very conservatively, and in fact while we had accounted the vertical loading multi ple times, and that's what really led to that high bearing pressure.

Subsequently, GEH revised the analysis. They used the SASSI result, results in computing the bearing pressure, and the bearing pressures came down significantly, like the value that wa s 150 gifs per square feet were in the 50 gifs per square feet, almost one-third, and those were the results.

In RAI 3.8 -96, this is all the sliding evaluation and GEH was really having difficulty demonstrating sliding stability. The basic reason for this was the amendment of the structure, which really was not considered, and it was attempted to demonstrate sliding stability was in friction only. That didn't work.

Then the amendment was considered and the passive resistance of the soil was used for sliding stability, but the embedded walls were not quite designed for the passive resistance. Also, there are many issues like at one time the correlation was considered to resist sliding.

So we went over this, through many iterations, and finally the method that GEH just described, that is what we found and we were able to demonstrate.

CHAIRMAN CORRADINI: So adding the wiggle -- adding the corrugation and the key, the shear key --

MR. CHAKRABARTI: The shear keys were going --

CHAIRMAN CORRADINI: Satisfied or gave you confidence?

MR. CHAKRABARTI: In addition, we took the passive resistance of the wall. Not full passive resistance, but to the extent that it is needed to demonstrate 1.1 factor of safety against sliding.

So with all these and considering friction on the side walls, GEH was able to demonstrate sliding stability. All of the calculation was done using the time history, like the sliding stability was calculated for each time stake. I mean you could not qualify it.

MEMBER ARMI JO: You say that the foundation walls weren't designed for full passive soil pressure. To resolve this problem, were the foundation walls thicker or --

MR. CHAKRABARTI: Yes. Reinforcement had to be increased.

MEMBER ARMIJO: Okay.

MR. CHAKRABARTI: Yes. I don't think we meant the walls taken out.

(Simultaneous discussion.)

MEMBER ARMIJO: Can I hear that from GEH?

MR. CHAKRABARTI: Yes.

MR. NIOGI: Thickness of the wall was not changed. We increased the reinforcement.

MR. CHAKRABARTI: Yes.

MEMBER ARMIJO: Okay.

DR. WALLIS: What kind of analysis did they do to show that it is acceptable? Was it computer analysis of some sort? How do all these wiggles and roughnesses and you can use whatever you called them? What sort of analysi s was done? Was this some kind of a computer that analyzes how the soil responds?

MR. CHAKRABARTI: I do not believe it was done, based on practically, but Sujit may be able to explain on that.

MR. NIOGI: Well, we didn't do any calculation that is a practical application, and for roughening the surface of the concrete, it's bar code SCR Code 249, which will allow you to do that. But roughening of that would be -- introducing the trough in the soil is more like practicing --. We didn't do that. The re's no calculation. There is no calculation.

DR. WALLIS: There's no calculation on it?

MR. NIOGI: No.

DR. WALLIS: I just wondered how you figure out that it works?

MR. CHAKRABARTI: I don't know if you have established the details of that one.

MR. NIOGI: We have not done that.

MR. CHAKRABARTI: Well, that can be done really. What can be done, like you design the trough spacing so that if you push against the passive resistance of each segment, and also calculate the shear failure for that portion --

DR. WALLIS: Determine how it fails?

MR. CHAKRABARTI: I mean how it fails. So the feet can be decided.

DR. WALLIS: And then this is a hand calculation?

MR. CHAKRABARTI: By hand calculation you can do it, yes.

DR. WALLIS: And you've reviewed all that?

MR. CHAKRABARTI: The details of the trough has not been established.

MR. BRAVERMAN: Samir, this is Joe Braverman. To a large extent, I think we relied, though, on the shear keys around the periphery of the foundation, because if the shear keys are low enough, that will lock in the section of soil underneath the base mats.

So the effectiveness of that roughening is really kind of secondary. All that ensures the roughening of the shear keys is that failure plane will, if it d oes occur, will occur below the shear keys.

DR. WALLIS: So you consider that the keys just move the whole soil with them?

MR. BRAVERMAN: Exactly.

DR. WALLIS: And then the shear that fails is below that level?

MR. BRAVERMAN: Exactly.

DR. WALLIS: And that's just a simple hand calculation?

MR. BRAVERMAN: Yes, because one can calculate the resistant force achievable from the shear failure of the soil. As mentioned before, that's tan of fee (ph), where fee, you know, will be verified by the COLA to achieve a .7 value.

MR. CHAKRABARTI: I think it can be done.

CHAIRMAN CORRADINI: You can go ahead, if you'd like.

MR. CHAKRABARTI: Okay. Next is 3.8 -120. The only issue we had open on this, I mean we talked about 120, the use of that ma terial in the FSC wall and everything.

At the time of the last meeting, we had resolved all that, but only open issue was it was also used in containment liner, and it was not an approved material for ASME code. But since then, ASME has approved it, and the issue was closed.

MEMBER ARMIJO: What was their main reason for using a higher strength material for the liner?

MR. CHAKRABARTI: For the liner, you probably --

MEMBER ARMIJO: A-709.

MR. CHAKRABARTI: Yes, it was -- as I remember, it was used for attachment of the structural beams and stuff.

MR. NIOGI: Right. This is Sujit Niogi again. Those structural beams are attached to this thick plate, and that's transferring the forces and moments to the wall. So we have to use a thicker plate as an embedment, and then on the top of that, we have the buttering, which is stainless steel liner on the -- surface.

So we need to have this higher strength code, and also weldability. 207 is weldability. We don't need to do any pre-heat treatment, you know. So we, that is the best material we found. It certainly will --

MR. CHAKRABARTI: And on the liner on 1380 --

MR. NIOGI: Only the inside the areas where --

MR. CHAKRABARTI: Where there are attachments?

MR. NIOGI: Exactly, where you h ave the attachments, yes.

MR. CHAKRABARTI: And then 3.8 -125. I think we already went over these, and basically where we were trying to look at, because what we got from the analysis is the fuel racks were anchored, and the design was changed to a free-standing. So we wanted to see how it affects this design. GEH demonstrated that from the analysis of the spent fuel racks, the dispersements and all --

DR. WALLIS: They're free -standing? That means they just sit there? They aren't attached?

MR. CHAKRABARTI: Yes.

DR. WALLIS: So they're very free to move around.

MR. CHAKRABARTI: Very free to move around, and they ran the analysis of the fuel racks, and determined the maximum dispersements that it can have. Accordingly, we made sure the base plates on which these legs are standing, they're big enough so that it will not roll over into the containment liner area, and also it does not hit the spent fuel pool wall. So that was our main concern --

DR. WALLIS: Would you remember the actual numbers for the displacement?

MR. CHAKRABARTI: I remember for the base plates, we had at least one inch margin beyond the maximum sliding, and I can't vouch, but I think for the side walls also we had similar margin, whatever is the maximum calculated, a bolt in each wall. Misty will confirm. I think GEH has an action to get back to you with those numbers.

MR. BRAVERMAN: I'd like to address a little, because a question arose a number of times about sliding. It's not as if the racks are in air, where they would likely slide a lot. They're in water, and if you have a very deep glass, the bottom portion of the water's not going to allow the racks to move too much, because it would have to push and displace the water a lot.

DR. WALLIS: This is the add ed mass effect?

MR. BRAVERMAN: Yes.

DR. WALLIS: The concern I had with the PCCS was I didn't see a correct treatment of the added mass as being a relative motion between the structure and the water. They just seemed to add some mass to the structure, which is not the way to do it.

MR. BRAVERMAN: We were involved to some extent a while back regarding the PCCS analysis, and my recollection, I believe, they made a finite element model at that time. It's an older analysis, and they added water as added mass to the finite element model, the PCCS, and that is an industry-accepted methodology to estimate the --

(Simultaneous discussion.)

DR. WALLIS: --just add mass to the solid. As you were saying, the water actually helps to restrain. It's a re lative motion between the structure and the water that matters.

MR. BRAVERMAN: Yes, but the difference is in the fuel racks, it's free to move, so you get the structure-fluid interaction.

DR. WALLIS: Right.

MR. BRAVERMAN: In the case of the PCCS that's anchored. It's restrained.

DR. WALLIS: Right, but it still wiggles.

MR. BRAVERMAN: Well, that's where the added mass --- there have been tests done that when you have a rod vibrating in air, versus a rod vibrating in water, they would vibrate an equivalent amount if you add this much mass to it.

DR. WALLIS: It's in an infinite pool. But if you have walls and stuff, it gets more complicated, because the waters restrain.

MR. BRAVERMAN: Yes.

DR. WALLIS: So anyway.

MEMBER ABDEL-KHALIK: Is this statement correct, that the spent fuel pool concrete floor is 5-1/2 meters thick?

MR. NIOGI: Yes.

MEMBER ABDEL-KHALIK: It is?

MR. DEAVER: This is Jerry Deaver with GEH. I have the dimensional information on the gaps, if you would like to get that.

CHAIRMAN CORRADINI: Yes. This is a good time for it.

MR. DEAVER: Okay. We have the two directions. One direction we have -- in the north - south direction, we have full racks all the way across, and the gap between the rack to the wall is 92 millimeters initially, as a minimum. And then after seismic and thermal expansion, which aren't likely to occur at the same time, we have a minimum gap of 47.5 millimeters.

DR. WALLIS: Is it bigger?

MR. DEAVER: Pardon me?

DR. WALLIS: Bigger than it was before?

MR. DEAVER: No. It started with 92.

CHAIRMAN CORRADINI: 92 to 47.

DR. WALLIS: Oh, I'm sorry. I misheard you. Thank you.

MR. DEAVER: Okay, and then in the east-west direction, where we have latitude deceptive dimension, because we have a lot of empty space in the other end of the rack or the pool, the initial gap is

60 millimeters and the minimum gap is 8.4 millimeters. That's with seismic and thermal.

DR. WALLIS: That's the closer one, yes.

MR. DEAVER: Pardon me?

DR. WALLIS: That's the closer one.

MR. DEAVER: That's the closer one, but remember, for a different meeting where we were here, they have total freedom to put that anywhere they want, because that's the reason where they've got the open area. Remember the open area, FLUENT calculation from a couple of meetings ago?

DR. WALLIS: I guess yes. There's a big open area.

MR. DEAVER: There's a big open area.

DR. WALLIS: And a strange FLUENT calculation, I must say, yes.

MR. DEAVER: Not strange, just not as well- described as one would like. That's my characterization.

MEMBER ARMIJO: That's not much left to the six millimeters or nine millimeters. It's not much --

MR. DEAVER: 8.4, but --

MEMBER ARMIJO: Sounds like this --

MR. DEAVER: --without the thermal

expansions, it's 12 millimeters, so we could set that as larger, based on as-builts when we actually --

MEMBER ARMIJO: So that's your worse case?

MR. DEAVER: Right. This is worse case, minimum dimensions.

MR. CHAKRABARTI: Okay. So that's how we have closed all our open issues, and if there are any other questions for us?

CHAIRMAN CORRADINI: None?

(No response.)

CHAIRMAN CORRADINI: Okay. Thank you very much. I think we want to continue now with Section 3.9, and no w GEH is going to come back up to talk about 3.9, is that correct?

(Off mic discussions.)

<u>Chapter 3 - Section 3.9 RAIs/GEH</u>

MR. DEAVER: Okay. I will continue with Section 3.9, Mr. Jerry Deaver, GE -Hitachi. I'd like to go to the next slide. There were several open items, open issues in this section, but we're going to cover five of the more significant items that were resolved.

So going to the next slide, 3.9-75. There was an open issue related to the reactor internal classification with respect to Reg Guide 1.20, and there was some confusion about prototype versus non-prototype.

We initially were classifying ESBWR as a non-prototype, because there were a lot of similarities with the ABWR plant, although we recognized that the chimney and the st and-by liquid control line were new components.

So we were kind of mixing up the situation by classifying them as prototypes, but the others, all the other traditional components we were saying were non-prototype. That was very confusing to the staff, and so we ultimately agreed that it would be best to classify the initial reactor, ESBWR reactor internals as prototype, and then the subsequent reactor vessels and internals would be classified as non-prototype.

So we had clarified that in the DCD and in the LTR that we have on reactor internals. So, okay.

Going to the next issue, 3.9 -96, this question had a lot of different aspects to it. This was asked at a time when we were still talking about prototype and non -prototypes, and we were relying on ABWR data in some areas, particularly the bottom head area, as to why we didn't need to have instrumentation.

But ultimately, we agreed to the prototype classification, and we provided in our response a complete description of the reactor internal vibration program, and identified the number and location of sensors that would be used.

We have 46 separate sensors in the program. Many of them are related to the steam dryer. But we also have sensors that are on the steam separators, the chimney, the shroud and on the stand-by liquid control line. So we have a comprehensive program that includes accelerometers, pressure transducers and strain gauges to -- in key positions, to obtain the vibration data.

DR. WALLIS: This is a kind of full-scale experiment really?

MR. DEAVER: Well largely what we're doing is a confirmatory thing. We've analyzed all the --

MEMBER ARMIJO: For your first of a kind start-up?

MR. DEAVER: This is typical for Reg Guide 120. It's a confirmatory --

DR. WALLIS: But you have certainly analyses.

MR. DEAVER: Yes, and we have to meet the criteria when we take the data --

CHAIRMAN CORRADINI: I think, if you

remember, this was the analysis where we were asking questions relative to the difference in the structure, and then they agreed to do this to their --

MR. DEAVER: Okay, and we've described the methodology, you know, once we get the data, how we're going to process that data and evaluate it against the limits that have been established, and we've justified the components that will need instrumentation.

Some of it's confirmatory. We really established the program based on risk base, you know, where we've had problems before. But also for new components that we haven't had experience with, then we need new data to substantiate that they're going to be acceptable.

So we've completed our description of the program, and NRC has a good understanding of what that is now.

Okay. Going on to 3.9 -81, this question relates to the postulated break in the steam line and feed water lines, and is there any dynamic amplification of loads in the reactor internal core structure components, core support structures?

The components that are -- the core structure components that hold the fuel are the CRD housings and the control rod guide tubes in the vertical direction, and these are modeled as axial beam elements, and they represent the assembly of the control rod housing and the guide tube in the vertical direction in this primary structural model.

From that model, we find that in the vertical direction, there's no frequencies, fundamental frequencies below 105.4 hertz, and the associated loads from a main steam line and feed water break do not provide any extra type excitation on those components.

So we -- so that actually demonstrated that no amplification would occur on these vertical --

DR. WALLIS: How do you predict the unsteady pressures in the break, when a break flow comes out? I mean we talked about this. You're going to do a fluid analysis of the jets that impinge on things --

MR. DEAVER: That's external, yes.

DR. WALLIS: And they had fluctuating pressures in them, don't they, which presumably would be available to excite what you're talking about here, by working back through the system. Or would they not?

MR. DEAVER: Well, the actual blowdown phenomena, which I think Wayne understands a bit better than me.

(Simultaneous discussion.)

DR. WALLIS: Which they can't transfer back, because the mark number is bigger that one?

MR. MARQUINO: It's chok ed, right. It's choked at the nozzle and the fluctuating pressure is due to the vortices, I believe --

DR. WALLIS: Outside. They're all outside.

MR. MARQUINO: --in the discharge side.

DR. WALLIS: There's no way they can transfer back to the interior?

MEMBER KRESS: So the interior effect is just the increased flow?

MR. DEAVER: Right. You're going to have the initial flow and then it's going to gradually decay down. So it's going to be a more stable blowdown phenomena inside the vessel, because of the large volume that's in there.

Okay. So we revised the DCD to address this issue, and so we're confident that we've handled the loads properly.

Okay, moving on to 3.9 -177, at one point we had a COL item listed in 3.9, which required that the ASME code design specs and design reports be made available for the NRC staff to audit.

Actually, the ASME code requires that these documents be made available at the site, that when the ship the components to the site, that these documents are required to be on site and available.

But we felt like with the ITAAC requirements that we were putting in Tier 1, that it was not necessary to have the COL item as a separate commitment by the applicant, because we already had it covered by an ITAAC in T ier 1, which, like I mentioned, ASME requires that reports be made available anyway.

The second part to it that gave the staff confidence that we were capable of preparing design specs, they had an audit where we prepared design specifications for the ma jor reactor internals, the vessel, other ASME components including valves, and the RTNSS -type or items that were considered risk - significant.

So we had five binders' worth of documentation that we prepared, and so they came and audited those documents. There, we demonstrated that we covered all the requirements that would be required in a design spec. So we demonstrated our capability and largely have most of the design specs that are required for ASME components.

Okay. The last issue is 3.9 -254, an d related was 255. These dealt with the qualification of piping programs for piping analysis. We have the PISYS and ANSI -7 programs that are the computer programs that we use, and there was some confusion over Reg Guide 192, Rev. 1 versus Rev. 2.

When we benchmarked the programs, we used Reg Guide 192 Rev. 1, because it -- associated with the Reg Guide is a NUREG 6049, which is has the cases that we've benchmarked previously to, and so we found it more convenient to use that benchmark case.

If we were to use the Reg Guide 192 Rev. 2, we would have had to benchmark against alternate pipe cases that we hadn't established previously.

So we found it more convenient to work the Rev. 1, and in fact Reg Guide 192 Rev. 2 actually allows you to use Rev. 1 , and the way we're using the Reg Guide 192 Rev. 1 fully complies with the -- what's, you know, stipulated by Rev. 2.

So in the process, we have an understanding now that the qualification that we ran is acceptable. We also included environmental effects caused by or on fatigue, as stipulated by Reg. Guide 1.207. These were fully incorporated into ANSI-7.

We had an audit of both of these programs, and during the audit, there was one comment made regarding the methodology of how to establish the temperature coefficient, which we subsequently resolved. So the final audit of the computer programs have now been completed.

Also what was required by the NRC was we had to accomplish a Level 2 status on the programs. Previous to this, we had Level 2, but it was the prior versions that, you know, were not applicable for ESBWR.

So the Level 2 now makes it possible for us to run the analysis without doing alternate calculations and so forth. So those have been fully demonstrated, fully documented at this t ime, so we're ready tod o analysis.

So in summary, we've demonstrated that we have a comprehensive vibration program for the reactor internals, and fully defined for the first prototype plan. And then we've also been able to demonstrate our capability t o prepare and do ASME code documentation and define requirements.

So that's all I have today. If you have any questions.

CHAIRMAN CORRADINI: So the only committee

I have on the left side, so go ahead.

MEMBER STETKAR: Yes. In August, when we were talking about tech specs, I asked about functional testing of the squib valves, and I was instructed to wait until we talked about Chapter 3. So I waited. So now I'm going to ask about functional testing of the squib valves.

MS. CUBBAGE: Excuse me, John. The staff can't hear you.

MEMBER STETKAR: Oh, okay. Sorry.

CHAIRMAN CORRADINI: What did you say Amy?

MS. CUBBAGE: Staff can't hear you in the back.

MEMBER STETKAR: Let me repeat. In August, when we talked about technical specifications, I asked about functional testing of squib valves. At that time I was instructed to wait until we talked about Chapter 3.

So I have patiently waited, and now we're talking about Chapter 3. So now I'm going to ask about functional testing of squib valves . in Table 3.9-8 of DCD Rev. 7, just to make sure we're on the right revision, the technical specifications explicitly state that the squib valves need not be fired as part of the surveillance requirements.

The bases for the tech specs say that "Operability of the squib valves is verified by continuity tests and the in -service test program for squib-actuated valves. The in -service testing requirements in Table 3.9 -8 say that squib valves for the SLC injection, GDCS injection, GDCS equalizing and GDCS deluge squib valves, and the ICPCCS full crosstie valves are fired and replaced per paragraph ISTC-5260." Please tell me what that functional testing does, and how frequently it's performed?

MR. DEAVER: Okay.

MEMBER STETKAR: I'm specifically concerned also, because in the final draft, the draft final SER, there was a staff concern about possible external missile injection from -- ejection from squib valves when they're fired, and in response to an RAI, I think it was RAI, I don't have the number here.

I think it was 3.5 -6, but I'm not sure about that, the staff's conclusion was "The staff finds that these squib valves are actuated by the booster assembly that causes an explosion inside the valve assembly, and the explosive pressure is just adequate to push the piston that opens the valve outlet."

Now if the pressure is "just adequate," I want to make sure that it's adequate. In order to have the pressure adequate, I need to functionally test those valves with design differential pressures across those valves, and make sure they work.

MR. DEAVER: Yes.

MEMBER STETKAR: So that's another reason for my question about how will they be functionally tested and how frequently.

MR. DEAVER: Well, let me describe first of all that squib valves are l argely a commodity that isn't off the shelf at this point and has to be developed. So we recognize that -- up front hat for these different valves of different sizes and different kind of arrangements, that we've got to individual qualify, have our suppli ers qualify these valves.

And not only the igniter, but the plunger part that shears the cap, that then opens the valve up. So --

MEMBER STETKAR: I understand the qualification. It's the same thing we do with qualifying motor -operated valves and air-operated valves and pumps and pieces of pipe in hangars and all that kind of stuff. But we also functionally test motor-operated valves and air-operated valves and pumps to make sure they operate under as-built, as-installed, as-maintained, as-aged conditions.

MR. DEAVER: Right.

MEMBER STETKAR: So I'm asking about the latter, not the former.

MR. DEAVER: Right. Well, what we're planning to do, the igniters is the commodity that is subject to shelf life and degradation over time. So we have a program that every outage we go in and we take out the igniter and replace it and test it.

MEMBER STETKAR: This would be like removing the motor from a motor-operated valve and putting it on a bench and make sure the motor works?

MR. DEAVER: It's really just the igniter part.

MEMBER STETKAR: No, but I mean it's logically equivalent to removing the motor from a motor-operated valve, to make sure the motor works on the bench, but you never know whether it will operate the valves.

MR. DEAVER: So the plan is, on a rotational basis, every outage, to remove certain igniters, take them out --

MEMBER STETKAR: I understand that. I'm asking about how and how frequently will you actually explode a squib-operated valve under actual installed differential pr essure conditions, to have some confidence that indeed the igniter will ignite, the explosive will fire, the pin will shear and indeed the valve will open? That's what I'm asking about.

MR. DEAVER: Okay. Well, our plan right now is not to destructively test a valve.

MEMBER STETKAR: Ahh. That's the answer I was hoping not to hear, but expecting to hear.

MR. DEAVER: Okay.

MEMBER ARMIJO: I think that's what --

MR. DEAVER: Can I ask --

MEMBER STETKAR: Because actually in this table, I'm led to believe that it says "fired and" -- read the quote in the note here, so that I'm not misquoting something.

MEMBER ARMIJO: It says "fired and replaced."

MEMBER STETKAR: It says "fired and replaced." It doesn't say igniter bench-tested. It says the valve, "it applies to explosively-actuated valves." It's Note X in the table, parenthesis "(paragraph ISTC-5260)," and the frequency is Note E-2. It says "fired and replaced" per paragraph ISTC-5260.

Now I don't know what ISTC -5260 is, so that's why I was curious what it tells me to do.

MR. DEAVER: I'm not familiar with that code.

MEMBER STETKAR: Okay. Well since it's in the table in DCD Rev. 7, and referenced as the only reference that might pertain to any type of functional testing, I'd be really curious what it is.

MR. SCARBROUGH: This is Tom Scarbrough with the NRC staff. I heard your question, and you're exactly right. ICC for squib valves in the ASME code only deals with those initiators.

MEMBER STETKAR: Oh, is that right?

MR. SCARBROUGH: Yes. No effort to take the valve out, and the reason is historically, squib valves are these little things that we use in SLC systems, S -L-C, and they have very little safety significance. In the new plants, the new reactors, it's much different.

MEMBER STETKAR: EPV valves are 13 inches, I think, in diameters.

MR. SCARBROUGH: Yes. They're very large and have very large diameters.

MEMBER STETKAR: GDCS valves are eight inch, I think.

MR. DEAVER: Six inch.

MEMBER STETKAR: Six inch?

MR. DEAVER: But the throat part of BPVs is about eight.

MEMBER STETKAR: Oh, about eight? Okay.

MR. SCARBROUGH: So one of the things that we've been working with, because in this area the AP-1000 reactor design is ahead of ESBWR, and we're working with Westinghouse on their design. Because of the increase in size, they've had to change the design significantly for these things.

They've had a lot of challenges regarding that. One of the areas that we've been dealing with is how are you goi ng to monitor these now very important valves during surveillance? So the ASME code, we've already talked to ASME about the OM code is inadequate in this area.

So what we've done is we recognize that because of the early design phase, and when we audited GEH, we did talk to them about their squib valves, and they indicated the design is still on the table. They really haven't decided what design they're going to go with yet.

CHAIRMAN CORRADINI: What does that mean, just so I understand what you mean by "on the table"?

You mean they have various possibilities?

MR. SCARBROUGH: Yes. They've talked about the various ones. They're sort of monitoring what AP 1000 is doing, and there's a lot of work going on in that area. So they're sort of following that process and seeing where that leads. Because there's a couple of different designs being used by AP 1000.

So what we did in the SER for the ESBWR is we indicated that the fact that this, the AS -OM code only really focuses on the initiators, and it's the CO applicant will need to be -- will be responsible for establishing appropriate surveillance activities for the squib valves.

MEMBER STETKAR: Yes. I noted that. It says "appropriate surveillance activities." It doesn't say "functional testing," though. So --

MR. SCARBROUGH: Yes, because we're not quite sure, to take these large valves out and fire them, it would be very difficult. There's a lot of possibilities going on for much more specific detailed in-service monitoring, where you monitor the internals of the piston rod and different aspects of the internals of the squib valve, to make sure that it's functionally intact and ready to fire.

MEMBER STETKAR: I guess my concern is

that they are new valves, and if indeed there is some very careful design, as implied by the pressure as "just adequate" to break the piston loose, given our experience with, you know, 20 years of problems with things like motor -operated valves not being properly sized, designed and maintained for in-service conditions for differential pressures, discoveries that we really needed to completely re -look at not only the design criteria but how we test those valves, to make sure that they're going to work, that's sort of the genesis of my concern here.

MR. SCARBROUGH: Yes, and we're following the AP -1000. We're attending their design review meetings. We're watching -- we watched their blowdown test that they just did recently on their prototype. So we're monitoring what they're doing with those, and we recognize exactly where you're coming from, because they're following the QME -1007 approach for these qualifications.

They know they have to demonstrate that these valves are very reliable, and then after that, they're also working with the United Kingdom, because that's part of the process there, in terms of making sure that the surveillance process for these is adequate.

Until they really finalize the design, they won't really know exactly the right way to be able to monitor them.

MEMBER STETKAR: Until they fail.

MR. SCARBROUGH: But it definitely is something that is going to be followed very closely by the staff.

CHAIRMAN CORRADINI: So can I say it back to you a different way, just so I'm -- because I'm, I'm listening. I was expecting him to ask the question, just not now.

(Laughter.)

CHAIRMAN CORRADINI: Eventually, this question today, under Chapter 3. So what I hear you say is because these designs are paper designs and small valves have been produced, manufactured, tested, and large valves a re still in the process of being precisely designed and tested, you're leaving it to the COL applicant to demonstrate, besides the firing off-line, as Jerry was explaining to John per the current code, you're expecting the COL applicant at this point to ta ke on the responsibility to prove it for that design under those conditions?

MR. SCARBROUGH: Yes sir, because really the operating program is the COL applicant's responsibility. The design certification applicant, they include a lot of information that the CO applicant incorporates by reference in their FSAR. But the responsibility lies with the CO applicant.

CHAIRMAN CORRADINI: Okay, right. So that's Clarification 1. Clarification 2 is to me, let's say that the COL applicant decides to want to do what he calls functional testing on site. Is there a valve line that one can do that with this design?

MR. SCARBROUGH: If I understand it, your question was okay, I have a COL applicant. They're a relatively conservative bunch. They want to do it every once in a while on site, in location, and then replace all the --

CHAIRMAN CORRADINI: --guts of it, once they successfully do it. Is that possible, by the design as we have it?

MR. BEARD: Alan Beard with GE -Hitachi, and Jerry, correct me if I get this wrong. But we do include provisions in the design of the pipes that house these valves, such that we could establish the necessary differential pressure across them using test type of set-up. We could fire those and we could go in and replace th e internals to that valve with the parts that have been --

CHAIRMAN CORRADINI: Okay, and then re - establish it online. Okay.

MR. BEARD: I don't remember. I think there is. There are tabs when you get differences in pressures.

MEMBER STETKAR: Th ere are test connections, there are isolation valves that you can close, that you can --

CHAIRMAN CORRADINI: Okay. I just didn't know, because I think -- I mean my point is that this is a generic question that has popped up here. I haven't looked bac k in AP -1000. I'm sure those previous members of ACRS that were excellently asking questions at the time asked the same sort of questions, because I would expect this is a generic thing with all of these plants.

And now it just -- this is since we have GE folks here that might remember the ABWR, aren't there large DPVs in the ABWR design also?

MR. MARQUINO: No. The answer to that is no, there are no DPVs in the ABWR.

(Simultaneous discussion.)

MEMBER STETKAR: One other observation I want to make is --

MEMBER ARMIJO: But smaller.

MR. DEAVER: In the SLC, yes.

MEMBER ARMIJO: Only in the SLC?

CHAIRMAN CORRADINI: They're more of the standard SLC squib valve.

MEMBER STETKAR: Well, that's what I was trying to understand.

MR. DEAVER: Right. One thing I wanted to clarify is that we did qualify or test the DPV valve in the early 90's. We had a test program where we actually built the valve and tested it. So we have that.

MEMBER STETKAR: No that I understood, and the DPV valve design hasn't changed?

MR. DEAVER: No.

MEMBER STETKAR: The squib valves, we used to have drawings of the squib valves in an earlier version from GE.

CHAIRMAN CORRADINI: I was waiting for you to say this.

MEMBER STETKAR: --and we don't have those anymore. So the squib valves are right at the moment basically unknown.

MS. CUBBAGE: What do you mean by "the squib valves"?

MEMBER ARMIJO: Is it a design requirement for these valves, that they testable and repairable? I guess replace the internal s, or is this just impractical?

MR. DEAVER: Well, I mean they could be physically removed and taken into a test assembly or, you know, and tested or I guess my perspective is that the plunger, the piston that comes in and shears, all of that is all mech anical, you know. It's related to material properties, degradation.

MEMBER STETKAR: It happened in an accident this summer.

MR. DEAVER: Really, we're going to use corrosion-resistant materials. So largely it's a mechanical function that, you know, if we share it and says "yes, it broke." But that's fine. We know that one broke, but what about the new one coming out?

MEMBER ARMIJO: So your argument is that just testing the detonators or whatever these things are called, the charges would be suff icient to ensure that these things will work, in addition to the qualification --

MR. DEAVER: I guess the point I'm trying to make is that if you get, establish a load from the igniter, then the mechanical parts are going to function properly.

CHAIRMAN CORRADINI: But I think where we're coming, where he's coming from, it's his issue, but I sense where he's coming from is when you put this sort of thing into play, there are examples in analogous industries where these things didn't work.

MR. DEAVER: Well, they were a little more complicated, the motor-operated valves.

CHAIRMAN CORRADINI: Granted, but I guess my only point is under actual pressure conditions, I think, is that where he's coming from.

MEMBER STETKAR: I mean we've had problems with simple solenoid -operated valves that haven't worked, you know. Plungers, you know, are -- they can get minor corrosion, they can get minor deposits, they can get, you know. You don't know what's going to happen.

MEMBER KRESS: A little philosophy here. To me, to test one of these valves say in place, or to even take it out and test it in little bits, is a useless test, because the replacement --

CHAIRMAN CORRADINI: Useless or useful?

MEMBER KRESS: Useless. The replacement, you don't know wheth er it's going to work or not, because that one doesn't tell you anything. What is needed --

(Simultaneous discussion.)

MEMBER KRESS: In my mind, excuse me, what is needed is a bunch of tests offline and under the right conditions, to give you some re liability for a fleet of these, and use that reliability to make a judgment on how good they're going to work.

CHAIRMAN CORRADINI: So your argument, though, would be that would be the qualification test program, once they pick a design. That's your point?

MEMBER KRESS: That's right. That's my point, exactly. Whereas to test them online is just -- other than the igniters, I think that's worthwhile and but I think it's a useless test otherwise, to actually test the whole valve.

MEMBER ARMIJO: I th ink his issue is really on aging effects. A new valve is likely to work, but you know, if they've been in-service for a long time, is there other things that might happen --

MEMBER KRESS: You might be able to spec for aging effects. I don't know.

MEMBER ARMIJO: Yes. Other things that happen that will make the valve jam, you know. The powder blows, the thing breaks, but some --

MEMBER KRESS: Well, you might be able to make that part of your offline qualification test.

MEMBER ARMIJO: Yes. That's where I would do it.

MEMBER STETKAR: The only problem about qualification testing for data is the predicted reliability of these things --

MEMBER KRESS: You have to have a lot of data.

MEMBER STETKAR: You have to destroy so many valves that --

MEMBER KRESS: You have to have a lot to do that. Yes, that's -- that is the --

MEMBER STETKAR: The first ones are going to cost you an awful lot of money.

MEMBER KRESS: I agree with that.

MEMBER STETKAR: That's the problem. The *in situ* testing or the not necessarily *in situ* if you take it out and have an appropriate test bed.

Absolutely doesn't tell you anything about the valve, the new valve being installed. However, it does at least give you some level of confidence about if it works, i t doesn't tell you anything. But it gives you a bit of confidence.

If it doesn't work --

MEMBER KRESS: This year.

MEMBER STETKAR: It gives you a lot of

information.

DR. WALLIS: Well, isn't one way to ensure that it's more likely to work to have a margin in this pressure, so that --

MEMBER STETKAR: Well, that's -- and I don't know. I think this is probably a staff paraphrase, because they're trying to justify the fact that there's no concern for external missiles. But it tells me that apparent ly it's some, you know, obviously it's some sort of design charge.

Looking at the design of, I think it's the DPV valves, that you basically blow something that shears something --

(Simultaneous discussion.)

MEMBER STETKAR: Well then it flops over, kind of like a check valve, and most of the time check valves work, and sometimes they don't. Sometimes they bind up because the flopper thing kind of binds up.

MR. DEAVER: Yes, it's mainly the shearing effect that's going to make it work or not. The flop-over part is not that --

MEMBER STETKAR: The earlier design of the GDCS valves was a very different valve, because they had a more -- it was a piston driven down into a little well or something like that.

MR. DEAVER: Yes. That's a case where the pressure is from one side but the flow has got to come in a different direction. We recognize that that's a different-type valve.

MEMBER STETKAR: So I think staff at least answered -- you know, I understand the current situation, which is what I didn 't understand in August. So --

MR. DEAVER: Okay.

CHAIRMAN CORRADINI: Questions. Additional questions for Jerry?

MEMBER ARMIJO: Just one last thing. Is GEH going to pursue the development of these valves with some suppliers?

MR. DEAVER: Oh yes.

MEMBER ARMIJO: It's not the COL?

MR. DEAVER: No, no. We will supply this equipment and we'll fully --

MEMBER ARMIJO: And you'll work with your valve suppliers to qualify and do all the testing?

MR. DEAVER: Right, right.

MEMBER ARMIJO: Bu t it's your current intent not to do destructive testing online on the --?

MR. DEAVER: That's true, right. Yes, we have there suppliers that we're currently working with or discussing test programs and such. Okay.

CHAIRMAN CORRADINI: Other questions for Jerry?

(No response.)

CHAIRMAN CORRADINI: Okay, thank you. Right. So at this point we're going to take a break until 10:30.

(Whereupon, a short recess was taken.)

CHAIRMAN CORRADINI: All right. Let's get started. David, you're up.

Chapter 3 - Section 3.9 RAIs/Staff

MR. MISENHIMER: Okay. I'll have my presenters get up here. My name's Dave Misenhimer. Again, I'm the Chapter PM for Chapter 3. We have two folks that are going to do the presentations this morning on Section 3.9, Yuke n Wong and Tuan Le, and Yuken will start out.

MR. WONG: My name is Yuken Wong from NRO Division of Engineering, Engineering Mechanics Branch II. I'm going to talk about the review of open items in Section 392, dynamic system analysis and testing of system component structures.

For Section 392.4, pre -operational flow induced vibration testing of reactor internals, the regulations and regulatory guidance are GDC -104, Regulatory Guide 1.20 and SRP Section 392 and 392. Reg Guide 1.20 is related to the re actor internals comprehensive vibration assessment program.

In RAI 3.9 -75, the staff asked the applicant to clarify the use of both terms "prototype" and "non-prototype" for reactor internals components in the DCD and in topical report NEDE -33259, reactor internals comprehensive assessment program report.

In the response, GEH clarified that prototype applies to the components that are different from the ABWR reactor internals, such as the chimney and stand-by liquid control structures. The ESBWR reactor internals as a whole are classified as non-prototype Category 2.

Separately, the staff questioned the classification of the ESBWR reactor internals as non-prototype Category 2, considering there's substantial differences between the ESBWR and ABWR reactor internals, and GEH agrees with the staff's finding and later reclassified the ESBWR reactor internals as prototype and supplement the response to RAI 3.9-75. This resolved the issue.

In RAI 3.9 -96, the staff request the applicant to explain the basi s for selecting the reactor internals components for testing for the first

ESBWR plant. In the response, GEH provided an item by item discussion of why each component is selected for analysis and testing, or why was it was considered adequate without fu rther analysis testing in the topical report, NEDE-33259.

The staff finds their response acceptable, and meets the acceptance criteria in Reg Guide 1.20, and this resolved the issue.

In Section 392.5, dynamic system analysis of reactor internals in the forward conditions, the regulations and regulatory guidance are GDC 214, NCFR Part 50, Appendix S, SRP Section 392 and 395, and ASME Code Section 3, subsection NG.

In RAI 3.9 -81, the staff asked the applicant to demonstrate there's no significant dynamic amplification of the loads on the reactor internals, as a result of the main steam line and feed waters of line breaks.

In the response, GEH compared the frequency of the blowdown loads to the natural frequency of the core support structures, and the spatial description of the blowdown loads to the core support structures, and concluded that there's no dynamic amplification of the blowdown loads.

DR. WALLIS: So when do they -- how do

they get the periods of the loads from the blowdown? I mean blowdown, there's a -- I think there's a quasi-study process, or is there a process? How do you get that, periods of the loads from a blowdown?

MR. WONG: In the response, GE did not get into details as to how those --

DR. WALLIS: Well, I noticed that they looked at the natural period of the structures. They looked to see if there was a resonance. But I'm interested in the exciting. What's the exciting mechanism from the blowdown?

MR. WONG: In the response, GE did not get into details on how those --

DR. WALLIS: How did you satisfy yourself it was okay, if they didn't get into the details?

MR. WONG: I would defer the reviewer, the contractors for this section.

DR. WALLIS: There's a contractor who reviewed this?

MR. WONG: Yes. I mean I to ok over this section recently, so I mean this review has been going on for several years, so I would --

DR. WALLIS: I can't remember. I know we've seen something before, but I can't remember.

MR. WONG: Yes, they -- Vic and Tom, are

you on the line?

MR. SAH: Yes. I think what we found --

CHAIRMAN CORRADINI: Can you identify yourself please?

MR. SAH: This is Vic Sah (ph) at the Argonne National Lab. I think in the -- this particular section, that is, what is 3.9.2.4. I think partly we were supported by the, some of the NRC staff, and what we understand that the update components in the lower part of --, it goes much higher than 100 hertz. That was the reason that there will not be any dynamic amplification because of the blowdown.

DR. WALLIS: That was the conclusion. I remember that, but how do you know what the period of the loads is, the imposed loads. In order to see whether 100 hertz is okay, you have to know it was a driving force at 100 hertz or not.

MR. WONG: That is true. Well, what it implies that the driving force was much lower than 100 hertz.

DR. WALLIS: How do you determine that driving force?

MR. WONG: I think we relied on the --if

you recall, I think we worked with Jay Rodgen (ph) from NRC. He reviewed these.

CHAIRMAN CORRADINI: Yes, I remember.

MR. WONG: We had a discussion on that. I think what we were talking about it, the contractors. Vic Shaw on the phone now. We did not review this subsection of 392.

DR. WALLIS: So if GE states something, it's okay without review that it has a proper basis?

MS. CUBBAGE: I think what we're saying there was another staff member. Maybe we could get Jay?

CHAIRMAN CORRADINI: I'm sorry. Is it a staffer, is it Argonne? Is it your contractor that assisted you?

MR. WONG: The contractor, Vic, we just mentioned. He did not review this subsection, 392.5 of the SSE, and this subsection was reviewed by a member of the staff who is no longer --

DR. WALLIS: Well, how do you determine the driving force from the blowdown.

MR. WONG: He was responsible for this section. I mean we find it acceptable, based on the evidence presented. The natural frequency of the loads and the core support structure do not coincide.

I mean I --

DR. WALLIS: I understand that , but there's a --

MR. WONG: There's a question. Why did we solve, I mean --

DR. WALLIS: There's a break in the steam line up here somewhere, and it sent some loads into the vessel, and it shakes things at the bottom. But you have to somehow, in or der to know how this load comes in and shakes things at the bottom, you have to know what the driving force here is up at the top here presumably.

MR. WONG: Yes. I think that level of the analysis, from my understanding in reading the SC, it was not audited. It's not reviewed in that detail.

DR. WALLIS: So it's a mystery how they -- it's a mystery to me at this point how they determined the driving force?

MS. CUBBAGE: Okay. Unless GE has anything to offer at this time, I'd like to take this issue back and try to get you an answer.

CHAIRMAN CORRADINI: GEH, do you guys have something to say relative to the forcing function that was used?

MR. MARQUINO: This is Wayne Marquino.

We'd like to take that offline and get back to you at the break.

DR. WALLIS: Thank you.

CHAIRMAN CORRADINI: Okay. Why don't we keep on going?

MR. WONG: Okay.

DR. WALLIS: I remember some discussion on this, but I can't --

MR. WONG: Based on the sustainment in the GR IR response, because the periods, the fr equency of the loads and the frequency of the core support structure do not coincide, and the spatial dispersion of the blowdown loads and the motion of the core structures are not compatible, therefore, you know, there's no potential for amplification of dynamic loads. This is basis for resolving this RAI. And we will take this question back and get back. This concludes my presentation.

CHAIRMAN CORRADINI: So just to be clear, what I'm writing down that we're going to get from staff and from GEH is the basis of the forcing function and what staff did to convince themselves that it was acceptable relative to the response, okay? Other questions for Mr. Wong? Other questions for Mr. Wong before they move on?

(No response.)

CHAIRMAN CORRADINI: Oka y. Why don't you go ahead?

DR. WALLIS: Well, that's all this slide's about really isn't it?

CHAIRMAN CORRADINI: They're moving on to another RAI, but the question was -- go ahead.

MR. LE: Good morning. My name is Tuan Le. I'm the reviewer of Section 393, which is an SME, S-1, 2, 3 component, component support for support structure.

Today, I would like to present the RAI 3.9-177, which is request, the staff request the applicant to restate the COL information item regarding the availability of the estimate design report, and the design specification. Originally listed in the DCD Section 393 and Section 399, or the applicant address the information in Item 2 of the ITAAC.

As a result of the staff question for this RAI, the applicant respond, and the applicant committed to develop an ITAAC for review of the design report prior to the fuel load, and a commitment of the completion of design specification for this significant component prior to the certification.

On that, the staff in July 20, 2009, staff subsequently did the design specification audit at the GE site, and during this audit, the staff find a number of items, follow-up items to be respond for the staff, regarding the finding.

After that, the finding was resolved and the GE have respond to all the follow-up items. Based on the information review, the staff found that the design document review components reflect the methodology and the criteria contained in the DCD, and met the requirement of the ASME Code Section 3, Article in SE-3000.

Therefore, this issue was closed after resolve all the follow-up items of the audit report. This concludes my presentation for the RAI 3.9 -177. I'll be open to any questions. Any questions?

CHAIRMAN CORRADINI: Questions from the Committee?

MR. MISENHIMER: That's it for this section. I should mention that 3.9 -254, 255, we didn't talk about that yet. We will have a presenter talk about when we get to 3.12.

CHAIRMAN CORRADINI: Okay. Wayne, did you want to clarify or give us some information?

MR. MARQUINO: Yes. This is Wayne

Marquino of GE with Jerry Deaver, and my understanding is the question was about high frequency loads on structures like the guide tubes in the lower plenum.

The phenomena that's causing the loads is the depressurization of the vessel, caused by a pipe break. So we have phenomena like voiding formed in the lower plenum, water moving up because of that -- liquid moving up because of that voiding, and to define the differential pressure, we do calculations with the TRAC -G code, to determine the differential pressure on different parts of the internal structure.

But those phenomena develop over the course of seconds, not 100 hertz. So the phenomena that's producing the loading, its character is a lower frequency than the --

DR. WALLIS: It's way off scale. I mean it's the order of several hertz, one hertz or less or something, rather than 100. I just wondered why you were even worried about 100 hertz?

MR. MARQUINO: I think it's because it's the natural frequency.

DR. WALLIS: That's its natural frequency, but I couldn't see any mechanism that would drive that sort of frequency anyway.

MR. DEAVER: Right. I think -- this is

Jerry Deaver with GEH. I think, you know, the simplistic argument is that it has such a high natural frequency that you could never excite it, and the phenomena --

DR. WALLIS: If you would explain that the driving forces are of the order of one hertz or less.

MR. DEAVER: Yes.

DR. WALLIS: That would perhaps have helped to explain where they came from, because I thought you were thinking of this pipe up here that's break, sort of producing a sonic kind of noise, that goes down and excites stuff down below, and that's not what you're thinking about.

MR. DEAVER: No. This is just a mass energy release phenomena.

DR. WALLIS: Yes, okay.

MR. DEAVER: So I don't see how that frequency could -- any kind of high frequency context could enter into the vessel.

DR. WALLIS: So it's the voiding and the motion of the liquid?

MR. DEAVER: Right. It's the water level changing and BP changes that are really slow in nature.

DR. WALLIS: But that's lower than 100

hertz, isn't it?

MR. DEAVER: Pardon?

DR. WALLIS: Okay, thank you.

CHAIRMAN CORRADINI: Okay, thank you. John, I'm sorry.

MEMBER STETKAR: I wanted to ask the staff one thing, John, still tracking the squib valve. What assurances do I have that the COL applicant or the COL holder knows that they need to develop some type of enhanced surveillance program for th ese squib valves, other than firing the igniters? You know, we had the discussion. It's my understanding that right now the only requirements are that they fired the igniters.

If I read the SER, there's a paragraph in here, and I don't want to quote the whole paragraph. But the paragraph basically reiterates the concerns that we've heard this morning, that indeed they're large valves, they're very, very important to safety, and that the design hasn't been finalized.

The COL applicant -- it says "CO L applicants referencing the SBWR design will be responsible for establishing appropriate surveillance activities for squib valves." Yet in other places, it says that the general descriptions of the IST activities are acceptable, which leads me to kind of a gap.

How do I know? If we certify the design, we're certifying -- in the design, we're certifying the testing program that's specified in the design, which is only firing the igniters.

MR. SCARBROUGH: This is Tom Scarbrough with the staff.

MEMBER STETKAR: Hi Tom.

MR. SCARBROUGH: Yes. This is sort of the extension between the signed certification review and the CO applicant review. We actually don't approve the IST program --

MEMBER STETKAR: Until --

MR. SCARBROUGH: As part of the design certification.

MEMBER STETKAR: So there's no -- what I'm asking for is there's no need for specificity in an ITAAC related to the testing program at the design certification stage, to the hook dysfunctional requirement.

MR. SCARBROUGH: Well, a long time ago it was decided by the agency that we would not have ITAAC for operational programs. This IC is one.

MEMBER STETKAR: Okay, thank you.

MR. SCARBROUGH: So we deal with it

through the CO applicant, and they know that they need to do this and --

MEMBER STETKAR: I mean there's a flag in the TAC text here, you know. If people don't read the DCD 2, you know, Level 2 --

(Simultaneous discussion.)

MR. SCARBROUGH: It's there, right. For the CO applicant to know, and we've already started interactions definitely with -- for the AP -1000 with the CO applicant, and here, we'll be interacting with the CO applicant for the SP to bear as well, that they need to -- this is something that's very significant.

Because of the uncertainty in the design of the squib valves, they're going to need to decide exactly the debate that's going on. Do they set it up to be able to fire these valves in place, which they're designed to do multiple times, or do they have a very detailed surveillance, internal surveillance program, so they can verify the integrity, no degradation, you know, no, you know, type of oxidation or something that might cause a problem.

So all of that debate is something that's underway.

MEMBER STETKAR: Yes. That I understand. For current purposes, my only question was do I need some sort of additional assurance at the DCD stage in the form of ITAAC, that would, you know, more explicitly express those concerns. The answer that I've heard is no, because that's considered an operational program.

MS. CUBBAGE: Right, and the rule will specifically exclude operational programs from finality. To the extent they may have been described in the DCD, they still don't have finality.

MEMBER STETKAR: Yes, yes.

MS. CUBBAGE: So that there's no -- the CO applicant can't say they have finality.

MEMBER STETKAR: Yes, okay. I understand that. Thanks.

DR. WALLIS: But until you test a full valve, you don't really know the modes of failure, do you, the way in which things can go wrong? You sort of assume that by keeping it clean and all that and watching for corrosion, you can assure yourself that it won't go wrong. But you don't really know what can go wrong until you test it.

MR. SCARBROUGH: Yes sir. During the initial phase of th e testing for the AP -1000, we're learning a lot about the valve and how things can go right and go wrong, yes sir.

DR. WALLIS: Now doesn't the explosive deteriorate with time? There's chemical effects that go on in there.

MR. SCARBROUGH: Well, that's what they're going to --

MEMBER ARMIJO: That's what they're going to test.

MEMBER STETKAR: Firing the igniters will do that.

(Simultaneous discussion.)

MEMBER STETKAR: The mechanical part, the *in situ* or the DP across whatever type of intern al valve design they have, with an actual DP, having had the valve sit, you know, in whatever environment it sits.

DR. WALLIS: If it's leaking explosive or something, which is --

MEMBER STETKAR: Well, or minor leakages of, you know, water or, you know, impurities.

DR. WALLIS: But there other ways --

MEMBER STETKAR: Corrosion or you don't know.

DR. WALLIS: There are other things like mechanical binding and so on.

MEMBER STETKAR: And depending on the

valve design, they may be more or less su sceptible to that.

CHAIRMAN CORRADINI: Okay, thanks. So now we're going to have GEH come up and we're going to talk about Section 3.12; is that correct?

(Off mic discussions.)

Chapter 3 - Section 3.12 RAIs/GEH

MS. CUBBAGE: While we're switching, w e just wanted to follow up from the previous section. Sounded like no additional on the squib valve issue. Was there additional action on the other topics, or did GE's response address that?

CHAIRMAN CORRADINI: We're talking about the vibration?

MS. CUBBAGE: Yeah.

CHAIRMAN CORRADINI: No, I don't think -- I think we're fine.

MS. CUBBAGE: Okay, thank you.

MEMBER STETKAR: Actually Amy, I can't speak for everyone else. I'm not sure at the DCD stage now that there is additional action on the squib valves. I mean, you know, I personally certainly have a concern about them, but all I'm hearing is that it's delayed to the COL.

MS. CUBBAGE: I meant additional action

for me.

MEMBER STETKAR: Well no.

MS. CUBBAGE: To satisfy --

CHAIRMAN COR RADINI: Go ahead. Finish what you were saying.

MEMBER STETKAR: Yes. I was going to say I'm uneasy, but I don't think that there's anything else at the DCD stage, for this particular activity that we're involved in here, that there's any more benefit from doing anymore.

MS. CUBBAGE: Okay.

MEMBER STETKAR: I understand the problem, and I understand that it's basically pushed off the COL, and that, you know, we'll telegraph it. We'll certainly be interested in it at the COL stage, but that's later.

MS. CUBBAGE: Okay, thank you.

MR. DEAVER: Okay. This is Jerry Deaver with GEH again. I'm going to cover the open issues associated with 3.12. Actually, we don't have a 3.12 in our DCD, but topics relating to piping, pipe supports and the compute r programs were covered in this series of questions.

We have three RAIs that I'll cover. The 3.9-254 and 255 are really related to the topics in this section, but I've already covered those.

The first issue is 3.12 -3. In the NUREG 1061, it's very prescriptive in the use of the ISM method. It says that the absolute sum shall be used, and historically for ABWR, we had, we were allowed to use SRSS. But in looking for the records and the justification we couldn't find it.

So we were challenged by the staff to basically prepare justification if we were wanting to use the SRSS method. So what we did is we prepared analysis related to the main steam and feed water piping, which we were already calculating for the benchmark purposes, and what we actua lly did was we compared time history response methods against the response spectrum method using SRSS.

So the objective was to show that using the SRSS method, that the amplifications and stresses associated with that would be higher than the time history case. What we found was that virtually all cases were above the time history case, but there were six separate locations in the feed water system that did go below the time history results, and the maximum ratio was 1.08.

So in discussions with the staff on this, it was agreed that because of this potential of selected areas being worse than -- we agreed to a ten percent adder when we used this analysis. For independent support motion analysis, and this only applies to piping in containment.

So it 's typically piping that goes from the RPD to the containment, and where we're using the ISM method. We would do the analysis and then add a ten percent stress onto it as a conservative margin factor.

DR. WALLIS: You have a problem with English here, t hat I mean you have to say in all cases, the deviations above the predictions were below ten percent or something, because "in all cases were below ten percent" doesn't mean anything.

MR. DEAVER: Some of the wording in here is not correct.

DR. WALLIS: Is incomplete.

MR. DEAVER: Yes, yes.

DR. WALLIS: But what you're saying is that in the worst case, your prediction was above the data. Was below the data. The data was above the prediction by eight percent in the worst case.

MR. DEAVER: Right . We had the deviation of eight percent.

DR. WALLIS: You didn't bound it quite,

because some of them escaped through the limit by eight percent?

MR. DEAVER: That's correct.

DR. WALLIS: And so you agreed to a ten percent correction.

MR. DEAVER: Added to bound any potential case.

DR. WALLIS: Yes.

MR. DEAVER: So in doing the ISM analysis, we also had discussion about how many groups of, you know, for different supports, and it was determined that we were only going to be allowed to use two support groups. One either associated with the vessel or associated with the containment, and within that structure, and we would use the limiting of response vector for the groups.

So with that, we added words to the DCD and this item has been resolved.

MEMBER ARMIJO: I guess I don't understand. If you did the analysis both ways, why don't you just use the absolute sum and --

MR. DEAVER: Well, the time history approach is more labor -intensive. We don't always have the data for every support point. So that's just a more labor-intensive way to do analysis.

MEMBER ARMIJO: So you're just saying you picked a more efficient way and you just accepted a ten percent adder because --

MR. DEAVER: Right, and we always have the recourse to go back. I f we have real issues, we can always go back.

MEMBER KRESS: And you know that ten percent is good enough for every location that you worry about?

MR. DEAVER: Yes. That's what we --

MEMBER KRESS: You know why it was eight percent above your simpl ified analysis? You know the reasons for --

MR. DEAVER: I don't think we totally understand the reasons. The other significant point is that those happen to be locations that were typically low stress. So you wouldn't normally be concerned about them anyway.

MEMBER KRESS: I'm not too concerned about them.

MR. DEAVER: I mean we didn't have the combination of high stress --

MEMBER ARMIJO: And a high deviation.

MR. DEAVER: Right.

MEMBER ARMIJO: Okay.

DR. WALLIS: But it's not data you're talking about. You're talking about SRSS predictions, right? Because data to me implies you measured something physically.

MR. DEAVER: No, no.

DR. WALLIS: It's actually comparing two predictions.

MR. DEAVER: These are all calculations, yes. Okay.

DR. WALLIS: Correct these slides when they become part of the record.

MR. DEAVER: We certainly could polish it up.

DR. WALLIS: We probably could, to make it clearer.

MR. DEAVER: Okay.

DR. WALLIS: I don't know if you're allowed to do that. We're not allowed to correct our verbal records that he's recording over there.

(Laughter.)

DR. WALLIS: That's mistaken in some way, then we're stuck with it.

MR. DEAVER: I'm okay with correcting, improving it if it's allowed. Okay. We'll s end that to you. Okay.

The next issue is 3.12-17. This topic is on the general use of SRSS for dynamic loading, and within ESBWR. There's a non-exceedance probability requirement of 84 percent that's required in NUREG 0484, and typically what we found is that through the course of BWR development that basically all structures, the vessels, the buildings and such, all have relative same response characteristics.

And we responded to this question in two ways. One was basically a qualitative justification that load events aren't likely to combine at the same time. The peaks, you know, as such would not occur at the same time.

Then the randomness of the amplitudes and phasing of responses, and then just the rapid variation of plus and minus variatio n and short durations of peaks, such as seismic responses and so forth, and other containment loca-type responses.

So that was the qualitative, but then we, for Mark II, we did a detailed study. We had 291 dynamic load cases that were evaluated with all the combinations of dynamic loads, and we demonstrated that there was an 84 percent non-exceedance.

So we met the criteria and we demonstrated for ESBWR that this prior work was applicable to

ESBWR. So in conclusion, we're in compliance with the reg, the NUREG 0484.

The last issue deals with the responses. In this case, we're talking about the uniform support method of analysis, and in the SRP 3.9.2, Section 22-g, it talks about using the absolute sum method or the USM method. In our DCD, we were not clear in the methodology that we were going to use for that. The simple solution in this case was that we would simply commit to the absolute sum method when we're using the USM method for analysis of piping.

So we have changed the DCD to clearly state that, and now we've demonstrated compliance with the SRP 392. So in summary, we've -- through I think there were like 38 RAIs in Section 3.12. Throughout the response to those and through the audits, we feel that, you know, our analysis methods and -- for both piping and supports, are consistent with the SRP requirements.

That's been demonstrated, and we've provided the analytical cases and such, you know, justifying the use of SRSS when it's appropriate, or the combinations.

DR. WALLIS: I'm try ing to understand. Maybe I'm stupid or something here. You've got just in 3.12-17, you are asked to justify using SRSS. I don't understand what GE EBWR Mark II is.

MR. DEAVER: That's referring to our containment design. That's --

DR. WALLIS: But that's not for the ESBWR, is it?

MR. DEAVER: They're similar.

DR. WALLIS: Because it's similar.

MR. DEAVER: It's very similar.

DR. WALLIS: You're arguing that it's similar, and it worked for this -- for the BWR Mark II. Therefore, it should be applied to ESBWR.

MR. DEAVER: Yes, it could be.

DR. WALLIS: That's what you're arguing.

MR. DEAVER: Yes.

DR. WALLIS: Close enough. I'm just a bit surprised that you could use BWR Mark II as an argument for justifying something about ESBWR, which is not the same thing.

MR. DEAVER: Well, in previous work, even the Mark I containments, which are quite different, at least as far as the suppression pool and such, even those were demonstrated to be generally similar. So that's --

DR. WALLIS: Are you arguing that the

method has been qualified as being used for other systems?

MR. DEAVER: Right.

DR. WALLIS: And there's nothing peculiar about ESBWR, which would mean that it would no longer apply?

MR. DEAVER: Right. It's not a drastic deviation or variation of what we've done in the past.

DR. WALLIS: Okay.

CHAIRMAN CORRADINI: Other questions please, for Jerry?

(No response.)

CHAIRMAN CORRADINI: Okay. Thank you, Jerry.

MR. DEAVER: Thank you.

CHAIRMAN CORRADINI: So we'll have staff join us for 3.12.

<u>Chapter 3 - Section 3.12 RAIs/Staff</u>

MR. MISENHIMER: My name again is Dave Misenhimer. I'm the project manager for Section 3. We're going to talk about Section 3.12. Kaihwa Hsu will be presenting this section. Go ahead.

MR. HSU: I'm Kaihwa Hsu, okay. I'm the lead reviewer for the Section 3.12, okay. I'm discussing all those existing open item. The first open item is related to the independent support motion measure response special method, and in the SRP 3.12 recommend the acceptance criteria that's listed in the NUREG 1061, Volume 4.

In the original, GEH opposed. They used the SRSS method for that, for those support group combination. However, in the 1061, which is very clearly stated if, unless this support grou p are from the different structures, otherwise if they are in the same structure, they can be shown as the phase uncorrelated, then they are allowed to use the SRSS.

However, according to all those seismic response, we understand if in the same structure it's always phase correlated, and based on this phase correlated, so staff asked the question, and the GEH, okay, proposed the study. The staff reviewed that study. The staff find they do have the phase correlation, and so staff limited that, based on that phase correlation, and based on their study.

If they only use two group of their study, they're allowed to use the SRSS with extra ten percent margin to cover their design. As far as the rest of the combination areas, combination structure locations, they have to follow the 1061.

GEH proposed they are following that. So

GEH's final position, which means their acceptance criteria, and they're listing the NUREG 1061, Volume 4.

So if nobody have a question, I'm going to go to the next one, which is talking about 3.12 -17, which is talking about SRSS method using the low combination of the dynamic loading, just like GEH just proposed the acceptance criteria which list in the NUREG 0464, Revision 1 for using the SRSS combination method.

GEH, okay, provide their justification, in their study, which means that the provisions of the NUREG 0464, Revision 1. So on that basis, open item was resolved.

DR. WALLIS: So what are these acceptance criteria?

MR. HSU: Those are non -exceedance probability of 84 percent of two independent, I mean two independent -- in time-dependent, okay, input.

DR. WALLIS: That's the only criteria?

MR. HSU: Yes. Okay, for the next IR we did n't talk about 3.47. This is load combination for seismic inertia response vector, and this one is SRP, okay, talking about you want to use the APS method. So GEH revised it from the SRSS to the APS. On the basis of it, this is a new staff recommendation of the SRP 392. So these open items are also resolved. No questions?

So I'm going to to the 3.92 -254 and 255. 3.92-254 and 255 deals with the piping stress analysis computer code. So one computer code is called the PISYS, and PISYS, which performs all the static and dynamic analysis for the piping analysis, and staff asks this question, is because when the staff reviews the basic document, okay, staff finds that there's an inconsistency with the DCD, because in the PISYS, in the DCD they're talking about they use 1.92 Rev. 2.

But however, they are benchmarked against NUREG CR 6049, NUREG CR 6049, which is for the benchmark of the Reg Guide 192 Rev. 1, and Reg Guide 1.92 Rev. 2 benchmark supposed to benchmark to the basic document for the 1.92 Rev. 2 Reg Guide NUREG, which I think is the NUREG CR 6557 or something.

So staf f asked that question, and they identified. Actually, the computer codes are developed based on the NUREG, Reg Guide 1.91 Rev. 1. So we asked them to reflect that in their DCD. And also, the software document and QA status for computer codes were not completed.

So staff identified those problems and

performed the audit, and they revised that documentation, and they revised the package, and so staff accept the PISYS 08, and otherwise NC-7 is the post-possessor of the PISYS 08. And also NC -7 incorporated environmental assess fatigue evaluation into their code.

Staff had reviewed their V&V package, and the staff noted that their computer code temperature used in the calculation for the fatigue environmental factor, FEF, which is not consistent with the procedure stated in the NUREG CR 6909.

So staff identified all this, and they revised all those computer codes, and staff performed the final review of their documentation and evaluation package, and find that their code is completed.

The software -- their completed their software design document address all the staff concerns. Therefore, this issue was closed.

MEMBER ARMIJO: Was that temperature non-conservative, or just a simple error?

MR. HSU: Just a simple error, because NUREG, okay, 6909 talking about when you have -- when you calculate it, you see the fatigue is talking about range. So the whole range, you're supposed to use the average temperature. But they're only talking about they used the temperature, okay, for the down - trenching, and not consider about up-trenching, yes.

So that's not consistent with the definition of the NUREG CR 6909. On the basis, they are committed to follow the Reg Guide 1.207 and follow the 6909. So we identified all those issues.

DR. WALLIS: This PI SYS code, is that a GEH code?

MR. HSU: Both PISYS code is GEH proprietary.

DR. WALLIS: It's a GEH proprietary code.

MR. HSU: That's not a commercial code.

DR. WALLIS: Okay. I just wondered about that.

MEMBER ARMIJO: So now those have gone through the GEH Level 2 process there and verified and you're happy with it?

MR. HSU: Yes.

MEMBER ARMIJO: Okay.

DR. WALLIS: It's interesting that the code is there before the design documents are written and completed?

MR. HSU: Because --

DR. WALLIS: It often seems to be the case that you've got the code, and then someone figures out we'd better have a design document, so you write it. It seems backwards to me, but that's --

MR. HSU: Because this is a -- this code is like a little bit conf used, okay. They have a PISYS 05, PISYS 06, PISYS 07, PISYS 08.

DR. WALLIS: An evolving thing.

MR. HSU: Yeah, and then when we look at that, okay, like ANSI 714, they say you have to use the PISYS 08 as the input. You're not taking the PISYS 07 as the input. So previously -- so that's the reason, okay, they clarify for us which version they have to be used for us.

DR. WALLIS: Like these documents I get from the government, which are always in some updated computer code that I can't read on my machine.

CHAIRMAN CORRADINI: Questions?

(No response.)

CHAIRMAN CORRADINI: Okay, thank you. What we're going to do is we're going to continue and take a topic from this afternoon, Chapter 4, and discuss it now. So --

MS. CUBBAGE: And it should be quick and uneventful.

CHAIRMAN CORRADINI: Well, let's not -- we don't want to make any --

MS. CUBBAGE: Right. We don't have the technical staff here. We're going to just do -- it's a high level presentation. If there are any questions on Chapt er 4, we'll have the staff here at one o'clock, if need be. But we'll go ahead and do that real quick and --

CHAIRMAN CORRADINI: Just to remind everybody. Most of the -- most, I thought, we think, I thought all of the issues on Chapter 4 we dealt with back in May, when we went through all the topical reports again and the new issuance of them.

So what we're going to do is review, at a relatively high level, Chapter 4 discussion. But I hope you all have, you know, totally in your minds, the joys of May 17th and 18th that we see. Bruce?

MEMBER ARMIJO: Yes, I remember this stuff.

(Off mic discussions.)

CHAIRMAN CORRADINI: All set.

MR. BAVOL: Yep.

CHAIRMAN CORRADINI: Go ahead.

<u>Chapter 4 - Reactor/Staff</u>

MR. BAVOL: Okay. My name is Bruce Bavol. I'm the project manager for the Chapter 4 review, and everybody's had an opportunity to take a look at the safety evaluation for Chapter 4. Like Amy had mentioned, this is going to be very brief, high level.

A number of the significant RAIs a nd the issues that were a part of the Chapter 4 review were contained and discussed in previous Subcommittee meetings listed here on this slide here. Fuel assembly, fuel rod, control blade, mechanical design, nuclear design, gamma thermometer and back in October, critical power correlation and critical power testing.

Out of the approximately 258 technical RAIs that were closed for Chapter 4, and they're related to the appropriate sections here. The staff found no outstanding issues, and ACRS had no outstanding issues for us from the previous briefings.

So in conclusion, the staff finds that the ESBWR fuel assembly and control blade designs are acceptable, meets regulatory requirements, including applicable GDCs, and the analysis and testing has demonstrated conservative design. Like I said, this is very short, very sweet. Are there any questions for us or the staff that we can take away?

CHAIRMAN CORRADINI: Anything?

(No response.)

CHAIRMAN CORRADINI: Okay. John, I'm sorry. I didn't mean to -- do you have anything?

MEMBER STETKAR: No.

CHAIRMAN CORRADINI: Okay. So with that, why don't we break for lunch and be back here at 12:30. Is that allowable? I'm assuming it's allowable. Amy?

MS. CUBBAGE: To what?

CHAIRMAN CORRADINI: Start at 12:30?

MS. CUBBAGE: That's up to you all.

CHAIRMAN CORRADINI: Okay, good. We're breaking for lunch. Back at 12:30.

(Whereupon, at 11:23 a.m., a luncheon recess was taken.)

A F T E R N O O N   S E S S I O N

12:31 p.m.

Chapter 9/GEH

CHAIRMAN CORRADINI: Okay. We'll come back in session, and we'll start off with Chapter 9 and GEH presentation for auxiliary systems.

MR. DEAVER: Okay. We'd like to -- this is Jerry Deaver with GEH. I'd like to kick off the Chapter 9 discussion . The agenda will cover several topics. The first one will be related to spent fuel pool to K heat, and associated analysis with racks.

Then we'll cover spent fuel uncovery. Then we'll cover gas accumulation in the FAPCS system. At this point I'll turn it over to Mike Arcaro to cover auxiliary system RTNSS functions, plant service water, RCCW, chill water system and instrument error and service error.

CHAIRMAN CORRADINI: I believe it was in one of the prior meetings where we -- there was some discussion about the heat load in the spent fuel pools, and I think there was an inconsistency that you were going to check on and get back to us, if I remember correctly.

MR. DEAVER: Well, what we found is, you know, there was this discussion about the 3 0, you know, using a heat load that was at the 30 day point after a restart of an outage. That comes directly out of SRP 9.1.3 Rev. 1. It talks about doing the calculation at that specific time frame.

So I guess at that time, we were in fact consistent with the NUREG requirements, although what we found is, and I think the implication in that SRP is that that's the limiting case. We, in our subsequent analysis, found that that is not necessarily the limiting case.

So as a result of that, we've now reanalyzed using the maximum loads for a full pour-off load and with the prior loads that have been discharged. So we're using the latest decay heat methodology.

So this is the most accurate means of calculating decay heat, in accordance with the ANSI Standard 5.1, 1994 edition. It includes all the actinide issues and the activation product issues that have been, you know, previously required for analysis purposes.

DR. WALLIS: So the requirement is these two together, the one full core vector and one refueling load is equal to both together.

MR. DEAVER: Well see that's -- that's not even very conservative, assuming you have multiple loads of fuel coming out.

DR. WALLIS: That's right. I'm puzzled.

MR. DEAVER: Right. So there is a more recent SRP, which was issued in March of 2007, which you know, wasn't in effect when we docketed. But really I think in effect we're working to the latest SRP now as far as this issue is concerned, as far as doing the current methods analysis.

Because associa ted with that Rev. 1, there was a branch technical position, ASB 9-2, which provided a methodology. But it was not as rigorous as what we're doing today. So the next slide actually shows, as a --

MEMBER ABDEL -KHALIK: So this actually includes more than one discharge?

MR. DEAVER: Oh yeah. Well, in our analysis.

MEMBER ABDEL -KHALIK: In the current analysis. So it corresponds to essentially late in the life of this facility, where you have a lot of spent fuel accumulated in the core, and then you have a complete core offload after 36 days or something like that, plus one refueling load ignot?

MR. MARQUINO: Yes. It's ten years of operation, two year cycles, so five batches of spent fuel in the core offload.

MEMBER ABDEL-KHALIK: Okay.

DR. WALLIS: The thing that interested me is it depends how quickly you offload, doesn't it?

MR. DEAVER: Of course, yes.

DR. WALLIS: If you offload instantaneously, you've got 200 megawatts or something like that.

MEMBER ARMIJO: Fortunately, you can't do that. I don't think you can do that.

DR. WALLIS: But you have to take your time; otherwise, you're stuck with 50 megawatts or something like that, which you can't handle. So you take days to do it.

MR. DEAVER: Yes. That's the other part that's interesting here, is that the SRP talked in terms of 150 hours.

DR. WALLIS: That's right.

MR. DEAVER: Which is six and a quarter days. But we've always been analyzing to five days, you know, which was still a conservative early time frame to start looking at heat load.

DR. WALLIS: So how long does it really take?

MR. DEAVER: To get to the point where you're discharging --

DR. WALLIS: To offload this whole core.

MEMBER ARMIJO: To offload. Listen, you've got a lot of bundles in this.

MR. DEAVER: Well, to do a full core offload, that's 1,132 bundles, and you know, we're not going to be at a point where we're fully disassembled, you know, take the containment head off, vessel head, internals, cool down to the point where we can get 1,132 bundles out in five days. That's not going to happen.

DR. WALLIS: When do you start to take them out when you've taken off the head and cooled down? When do you actually start to offload?

MR. DEAVER: As soon as the -- in our case, we'll be removing the partitions, chimney partitions. So that's after the dryer separator and chimney partitions.

DR. WALLIS: So you'll be -- how long after shutdown will you start to offload, actually offload fuel?

MR. DEAVER: Do you recall, Allen --

MR. BEARD: I was going to say, the best case we would look at is about 42 hours before we actually start to remove fuel from the RPD itself.

DR. WALLIS: Forty-two hours. The choice, the 42 hour, you put it in. You put it in and it's decaying as you put it in. S o you've got to sort of integrate this whole thing really, if you've got a proper answer.

MR. DEAVER: Right. The next slide gives you a little perspective of -- well actually, it's the next one after. But this slide gives you the perspective of what the actual heat rate is in a given point in time in a cycle. So you can see that in the start of this curve, the blue line is approximately the 36 days. That represents the core offload.

DR. WALLIS: This is the same curve you give us for the PCCS heat removal.

(Laughter.)

DR. WALLIS: It's the same curve.

(Simultaneous discussion.)

MR. DEAVER: --I guess. But you can see that the heat load, core offload, the heat associated with the core offload increases in time, and the decay heat on the bot tom curve from the old batches is declining. So when you add the two together, you get the total and you can see that at about a year, you're not really changing the amount of total heat that could potentially be, you know, available for the cooling.

DR. WALLIS: This is the heat when you've just finished the offload, so the maximum --

MR. DEAVER: This is at five days. This would be the heat load at five days.

DR. WALLIS: It's the maximum when you actually finish the offload, or some time during t he offload, because this stuff's aging as you go along?

CHAIRMAN CORRADINI: I think, I mean he keeps trying to ask you the same question and you're not answering it. Are you assuming once you hit five days it instantaneously appears in the spent fuel pool?

MR. MARQUINO: Yes.

DR. WALLIS: It doesn't. You're offloading it step by step.

CHAIRMAN CORRADINI: Yes, but if they did that, you'd ask them what's the assumption on the offload rate. So they're just saying at five days, it goes from point --

DR. WALLIS: They don't know that, because as you put it in, the early stuff is hotter, and then the decays --

CHAIRMAN CORRADINI: But it's only one -one thousandths of a full core. So what do I care?

DR. WALLIS: No, but it may be that half a core aged -- half a core aged three days is worse than the whole core at five days. I don't know.

CHAIRMAN CORRADINI: No, no.

DR. WALLIS: Have you broken it down?

CHAIRMAN CORRADINI: Not at that point.

DR. WALLIS: You've actually done the integral of all this over time?

CHAIRMAN CORRADINI: Well, it goes as the minus .2 power of time after about a minute.

DR. WALLIS: Yes, that's right.

MR. DEAVER: Let's go to the next slide. This gives you perspective of the decay.

MEMBER ABDEL-KHALIK: But before we -- how much difference has this correction made?

MR. DEAVER: Well, previously we were using 17.3 megawatts, and now we're at, rounded up, it's 18.1. So we're .8 megawatts higher in our calculations now. What we've actually done in our spent fuel pool, boil off and our rack calculations, we've actually added margin on top of that, because we didn't want to be right at the limits.

CHAIRMAN CORRADINI: So the difference from what we heard previously and what we had now is .8 megawatts?

MR. DEAVER: Yes.

CHAIRMAN CORRADINI: Okay, uh-huh.

MR. DEAVER: Right, okay.

DR. WALLIS: That takes kind of all the stuff that's in the fuel pool already?

MR. DEAVER: Yes.

DR. WALLIS: Which is fuel -- is at the bottom there. Okay.

(Simultaneous discussion.)

MR. DEAVER: Okay. Now going to the next slide, this shows you that the K rate after shutdown, and the green line, which is the bottom line, was the prior analysis at the 36 day case.

DR. WALLIS: So why are the old batches decaying so fast? I mean they're old batches, aren't they? Why are they decaying so fast? I would think they'd be pretty constant by then.

MEMBER ABDEL-KHALIK: Well, this is the core that was just offloaded.

DR. WALLIS: It was just offloaded? That's the old stuff that's within that core?

(Simultaneous discussion.)

DR. WALLIS: The spent fuel that was taken in the fuel pool.

MEMBER ABDEL-KHALIK: In the immediate prior cycle.

DR. WALLIS: It's not the stuff that's already in the fuel pool?

MR. DEAVER: This is the total heat.

CHAIRMAN CORRADINI: It's the sum of all of them.

DR. WALLIS: Including what's already in the fuel pool?

MR. DEAVER: Yes.

DR. WALLIS: Where is that on here?

MEMBER ARMIJO: On this case, it's a 20-year case. So there's several lines that contribute to this composite line.

CHAIRMAN CORRADINI: I think that's the point, Graham. That bottom line is the sum of maybe five batches, and most recent batch is probably dominating the other four, and that's falling off over time.

DR. WALLIS: How recent is it, though? It's years old, isn't it? It's been in there for some time.

(Simultaneous discussion.)

MEMBER ARMIJO: Two years.

DR. WALLIS: So it can't be decaying at this rate. This rate is far too rapid for any batch that's been in there for a while.

MR. MARQUINO: So this is the accounting of different batches' contribution.

DR. WALLIS: So batch number --

MR. MARQUINO: You see the oldest batch is a small fraction of the most recent batch, and also here you can see the contribution of the spent fuel batches versus the full core discharge.

MEMBER ARMIJO: You can see the contribution just dropping off.

MEMBER STETKAR: I'm a little confused. This isn't decaying. I don't know anything about decay heat. I just know about counting years. This seems to indicate you did the analysis with ten years and five previous cycles, plus the offload, which is what you said orally.

The curves and the text in the DCD claim that it's done with 20 ye ars' worth of fuel, ten cycles.

MR. DEAVER: Well, let me explain.

MEMBER ARMIJO: That's why it took 20.

MEMBER STETKAR: Well, this only counts up to five cycles --

CHAIRMAN CORRADINI: Let Jerry try to illuminate us.

MR. DEAVER: What we've done, and I think

I've explained it before, but I'll go over it again, as far as the number of fuel cells that we're actually providing in this licensing submittal, it's ten years' worth. But we have a pool that will accommodate 20 years.

So from a desi gn perspective, we're designing our systems, the FAPCS system and our buildings and structures, to handle the full 20 years' worth of fuel. So when we're talking about a systems situation like boil -off and such, we're using 20 years. But when we're talki ng about racks and the rack certification, then we're talking ten years.

And so it makes it a little confusing, but the numbers are not that much different. The contribution of the ten to twenty year is only .68 megawatts. So it's not that much different. But what you're seeing on here is the ten-year batches.

MEMBER STETKAR: But on the slide that we jumped to this one from, your Slide No. 5 --

MR. DEAVER: Right. That's a 20-year.

MEMBER STETKAR: That's a 20-year?

MR. DEAVER: Yes, because this is associated with the full boil -off calculation. This is what we're using --

MEMBER STETKAR: For full boil-off?

MR. DEAVER: For full boil-off, from a FAPCS system perspective.

MEMBER STETKAR: Okay.

MR. DEAVER: Okay, and what just -- why don't we go back to that curve, Wayne? Okay. So what you see on this curve is the green line is the prior one, which was basically done at the 17.3 megawatts.

The blue line represents the new calculated value, and the red line is the bounding number that we're actually working to in our calculations. So we've got margin in our calculations at this point.

CHAIRMAN CORRADINI: The bounding number that you're working to. Can you say that again? I'm sorry, I don't remember what that means.

MEMBER ARMIJO: Is the designing capacity, you know?

MR. DEAVER: Well --

MR. MARQUINO: That's a number that has some conservatism over the EOC case.

MR. DEAVER: Well, it includes the 102 percent power level, and so far it's got all the adders associated with it.

MEMBER ARMIJO: But your spent fuel pool cooling capability is at 20 megawatts or 22 or --

MR. DEAVER: Well, at -- we have to talk

about normal case and abnormal, okay. For the normal case, what we've really just got the ten years of new, you know, we discharged the current cycle and we have the five discharges. That's the normal case, and we have an 8.3 megawatt heat exchanger that can accommodate that load.

But when we're considering the abnormal case of a full core offload in addition, then where we're at is we're using two heat exchangers, and we're also allowed to have the pool temperature go up 20 degrees. So now we really have a heat exchanger capability of more like 29 megawatts, up in that range.

So it's the capability of our heat exchanger system is increased significantly.

MR. MARQUINO: Jerry, they're asking what the number is. It's 19.1 megawatts, is the value on this curve at 150 hours. They're asking what number do you use for the design versus the ANS calculated number.

MR. DEAVER: Okay.

DR. WALLIS: So this boiling is just subcool point.

CHAIRMAN CORRADINI: Well wait. Let him answer this question before you give him another question.

MR. DEAVER: Yes. John Burns, I believe, is on the line. What's the actual heat load at the time that you start the boil-off calculation?

MR. BURNS: This is John Burns. The actual heat flow at the start of the calculation. Let's see. At the 150 hour point -- hang on, I'm pulling that up.

MEMBER ARMIJO: So we can read it off this chart.

MR. DEAVER: I know at the five-day point, I believe John, you were at 20.1.

MR. BURNS: That's correct.

MR. DEAVER: But at the 150 hour point, I'm not sure what you're at. It's something lower.

MR. BURNS: I've got some figure s I know here.

MEMBER ARMIJO: It's a red curve?

CHAIRMAN CORRADINI: The red curve looks 19-ish to me.

MEMBER ARMIJO: 18 something, 19 something.

CHAIRMAN CORRADINI: Something like that.

MEMBER ARMIJO: Close enough.

MR. BURNS: Yes. Down around the 18 mark.

MR. DEAVER: Okay. Is there another question?

CHAIRMAN CORRADINI: Yes, Graham.

DR. WALLIS: You say "boiling." Does it actually get -- the whole pool doesn't get up to the boiling point, does it?

MR. DEAVER: Well, what we're assuming is that for a 72 hour period, we have no cooling. So when you cut off the FAPCS system --

DR. WALLIS: No pumping.

MR. DEAVER: Right.

DR. WALLIS: Okay. That's what you're assuming?

MR. DEAVER: Yes.

DR. WALLIS: So it does boil off?

MR. DEAVER: It does boil off.

MEMBER ABDEL -KHALIK: I guess I have a question about the previous Slide No. 4. I'm looking at the blue line, which corresponds to the decay heat from the core offload, and this graph starts, the first point is at 36 days, and you're plotting this as a function of time into the cycle.

Now tell me what this means. This curve is really at points in time at the five day cool-down point? In other words, if I offload the core at 36 days, after it had been running for 36 days, and allow, give it five days to offload --

MR. DEAVER: Yes.

MEMBER ABDEL-KHALIK: Then my decay heat from that offload would have been 14 megawatts?

MR. DEAVER: Yes.

MEMBER ABDEL-KHALIK: And if I -- if that core had been operating for 180 days instead of 36 days.

MR. DEAVER: Yes.

MEMBER ABDEL-KHALIK: And I offloaded in five days, the decay heat associated with the -- would that full core that had been operating for 180 days would have been 15.8 megawatts. Is that what this means?

MR. DEAVER: Yes. That's exactly what it means.

MEMBER ABDEL-KHALIK: Okay. So these are really different scales, right?

MR. DEAVER: Well --

MEMBER ABDEL-KHALIK: Of time into the cycle. Okay. That's fine.

MR. DEAVER: It's time into the operating cycle, but it's consistent in that it's at five days' discharge time.

MEMBER ABDEL-KHALIK: Right.

DR. WALLIS: So this 72 hours after your core offload you're talking about, this 72 hours?

MR. DEAVER: Wait. Which one are we talking about now?

DR. WALLIS: The thing is boiling off. There's no water supply for 72 hours. That's after you've offloaded?

MR. DEAVER: Yes. At the time, 150 hours to 222 hours.

DR. WALLIS: And there's no water flow?

MR. DEAVER: There's no water flow, and we're at the worse case conditions.

DR. WALLIS: Your FLUENT calculations seem to show water coming in all the time, the different calculations.

MR. DEAVER: That's the rack cooling part.

DR. WALLIS: Or something else.

MR. DEAVER: Or something else, yes. Now moving forward, now I have a slide that relates to the boil-off analysis that's performed.

So again, this is a system calculation, so it's at the 20 year worth of spent fuel. So we have the obligation to look at a cooling or a boil -off for 72 hours, and the bounding case we find that the evaporation is 1962 cubic meters of volume of water, and this drops the water level in the pool by 10.26 meters.

DR. WALLIS: That's a lot of water.

PARTICIPANT: That's 30 feet.

MEMBER STETKAR: The minimum pool level -- well, let me ask you a question. Is there any way that you can drain the water down to the bottom of the slot, so that the -- between the pools? I had a question eons ago about what the height of that?

MR. DEAVER: Well, we h ave a weir that said 14.35 meters in the pool. So we're always, you know, bringing water into the pool. So it's always overflowing the weir.

MEMBER STETKAR: Okay. Is there anyway that you can cut off the water inlet? Is there any way that you can drain water below that level?

MR. DEAVER: Well, we have these anti-siphon holes that are in the piping.

MEMBER STETKAR: Yes. I understood for the supply water.

MR. DEAVER: On the inlet.

MEMBER STETKAR: And that's the only connections? I mean t here are no other connections that you can --

MR. DEAVER: Right. The pool has no other connections. It has two inlets and two outlets.

MEMBER STETKAR: Thanks.

MR. DEAVER: That's all there is.

MEMBER STETKAR: Thank you.

MEMBER ARMIJO: What happens with all that water that boils up? Where does it --

MR. DEAVER: It just magically disappears.

MEMBER ARMIJO: It's got to go somewhere.

MR. DEAVER: We know it's going to condense on walls and ceilings, and it actually ends up back in the pool in some form and so this is a very --

MEMBER ARMIJO: That's what I was trying to get at. Do you have some sort of a passive feature that would put that back into the pool --?

MR. DEAVER: I mean obviously it's somewhere in the building still, and it's going to condense and it's going to end up back in the pool, you know, because you've got such a large volume of water. That's a lot of water.

MR. MARQUINO: And some of it would escape the building also.

MEMBER ARMIJO: Can it escape the building?

MR. DEAVER: Well, we've had a recent exchange with the NRC staff about venting and preventing the building from pressurizing.

DR. WALLIS: You don't want it to condense on some important equipment.

MEMBER ARMIJO: Yeah. That's what I was getting at.

MEMBER STETKAR: Yes, I was -- I'm going to have another question after we finish boiling water. Is the floor level, you know, whatever you call it, the refueling building floor level, where you can stare into the pool, is that leak -tight from l ower elevations in the building, or can water -- we're talking about water condensing, you know, and where does it go?

Can it condense on building surfaces and flow to lower elevations in the building? Stairwells, access? Is there any requirement -- let me ask you this. Is there any requirement that it's leak-tight?

MR. DEAVER: No, no, it isn't.

MEMBER ARMIJO: Okay.

MR. DEAVER: We're at grade. Our floor, you know, our refueling floor or the fuel building floor is at grade.

MEMBER ARMIJO: Yes.

MR. DEAVER: But the water can seep down.

MEMBER ARMIJO: Back down into lower elevations in the buildings.

MR. DEAVER: To lower elevations, yes.

MR. MARQUINO: And we have a floor drain

system in the building. So the -- most of the condensate would flow to the floor drain system and be collected.

DR. WALLIS: Does it set off fire alarms and things like that? I expect it would, because it's steam going everywhere and --

MEMBER ARMIJO: It's not a smoke detector involved.

MR. DEAVER: I don't know. Mike, do you have -- you have that part of the question.

MR. ARCARO: Yeah, I would have to look at that. But I think for areas where you have steam, they use a different type of detector.

DR. WALLIS: Okay. Well --

CC I don't think the temperature is going to set it off, if that's what you're asking.

MEMBER STETKAR: You typically use an ionization detector or something like that.

MR. ARCARO: Yes, right.

MEMBER STETKAR: It would be a heavy humidity situation --

MR. DEAVER : I don't think 100 percent humidity would ever set it off.

DR. WALLIS: Well, it's an awful lot of water. It's going somewhere.

MR. DEAVER: Yes, that's right.

DR. WALLIS: That's right.

MEMBER ARMIJO: That's why you have some flooding somewhe re, that you don't want it to flood? It all goes into these floor drains and in the tanks or other pools?

MR. DEAVER: Yes. It would go back into our water systems, and so we wouldn't necessary lose the water.

MEMBER ARMIJO: So you don't worry about any kind of flooding that would come from condensation of --

CHAIRMAN CORRADINI: I just want to make sure we're not deviating. This is a design basis calculation they're required to do. So I -- if we're going to ask them to be realistic.

MR. DEAVER : Yes. In the real case, if we're starting to lose pool water, we're going to start using fire water and other sources to refill the pool.

MR. MARQUINO: And also you're talking about investment protection versus safety, because --

MEMBER ARMIJO: Oh , I understand. I'm just curious. Right.

MR. DEAVER: Okay. So as a result of this, we just recently, based on the new heat calculations, we've updated the DCD sections. We have more boil-off than we had previously, and that affected some of the tech spec requirements. But what we've shown is that even under these severe cases, we still have fuel cover.

MR. MARQUINO: 30 feet of water.

MR. DEAVER: And, you know, that we never uncover the actual stored fuel. Okay. So that's the boil-off analysi s. Then we get into the rack thermohydraulic analysis.

DR. WALLIS: But it's boiling pretty vigorously then, if it's giving off -- I'm trying to figure out what's the sort of state of the pool. But there's quite a velocity of steam coming off that pool, isn't there?

I'd have to calculate it. But this huge amount of water, even in three days, it's still a pretty rapid --

MR. DEAVER: You're going to have some active boiling going on.

DR. WALLIS: It looks like the staff would be interested in what happens to all this great plume of steam and where it goes and what it does. Even though it's a design basis action, you'd be looking for consequences.

MR. DEAVER: Right, okay. Okay. As a result of the heat load calc, revised heat load calc, we also had to look at the fuel storage rack thermohydraulic analysis, and we -- in this case, it's the ten years' worth of fuel, and we assumed a heat load of 19 megawatts, which was greater than the 17.3 that we previously had in our licensing topical report.

But what we've done is we had a prior analysis where we looked at 29 megawatts. That was a very early point in time after shutdown of the reactor, and very conservative. So we have a bounding case, is what it amounts to. So we're modifying the LTR to introduce again the 29 megawatt case, to look at the critical parameters associated with the fuel pool.

So we have the exit temperature is an issue, and the amount of temperature that exits the racks.

DR. WALLIS: What do you mean by the rack exit temperature? This is the maximum rack exit temperature?

MR. DEAVER: This is the maximum exit temperature, and again --

DR. WALLIS: There's a distribution of

temperature. This is the maximum.

MR. DEAVER: Right.

DR. WALLIS: Okay, because it just say s "rack exit temperature." It doesn't say "maximum."

MR. DEAVER: Well, yes, and we assumed the worst case conditions. We put the hot bundles at the farthest point in the pool, you know, furthest away from the cooling flow. So this is the temperature coming out of the top of the racks.

DR. WALLIS: So this is the maximum predicted by FLUENT or something, when you look across the spectrum.

MR. DEAVER: The CFT program, right. So the calculated value for the 29 megawatt case was 80.9 degrees Centigrade, and the limit is 121. So we have a lot of margin still in this case. The other thing we look at is the fuel cladding temperature. In the 29 megawatt case, it was calculated to be 97.12 degrees Centigrade.

So the real criteria is it has to be belo w 100, and but again we'll be -- this is a bounding number.

DR. WALLIS: We'll presume it's more than 100, because of the depth of water to increase the pressure. So all --

MR. DEAVER: Yes. Our real limit is something above 100.

DR. WALLIS: That's right.

MR. DEAVER: And then the -- then the last bullet is there's no condition within the fuel assembly that causes boiling. Therefore, nuclide boiling is prevented.

So as we've gone through this case, with this bounding point on megawatt cas e, we've demonstrated that this fully satisfies all the requirements that we would have at the 19 megawatt case. Okay. Any questions?

DR. WALLIS: I was wondering why you did the 29 megawatt case, which is so much bigger?

MEMBER ARMIJO: They just did.

MR. DEAVER: That was actually an earlier point in time, a couple of years ago. So we were being very conservative at that point. Okay. Going to the next slide, last, I believe it was the last meeting or the one before, we had some discussion about the streamline effects.

And so when we went back to our, the people who did our analysis, what we found is that the domains in the racks were actually blocked, so that we couldn't see the flow.

DR. WALLIS: Well, the very interesting thought was not in the figure at all.

CHAIRMAN CORRADINI: It was calculated. It didn't go in the figure.

MR. DEAVER: There are three things, I think, that the comments revolved around. One was we had a hard time understanding the figures you gave us. Second was you guys told us there was some blockage factor, and third was the fact what Graham said, is that all the streamlines that were shown were outside of the racks, or patterns, whatever they are.

So what we've had them do is just turn on the domain where the inlet flow and one of the hottest racks is shown, as far as the streamline effects. So now you can see the cooling coming in through the bottom of the racks, and then the flow as it goes through the rack itself.

DR. WALLIS: There's a big vortex or something above the rack, something that swirls around?

MR. DEAVER: Yeah. It's probably just the normal flow of heat that's being discharged off the top of a hot source.

MEMBER ARMIJO: There's no cross-flow within these domains or the racks?

MR. DEA VER: No, no. The actual racks prevent flow. So these are real silos, you know, or chimneys.

MEMBER ARMIJO: Okay.

MR. DEAVER: So we think, you know, this is a much better piece of information as regarding how the flow really occurs. So we've inclu ded this already into our LTR revision, and --

DR. WALLIS: Now where it goes up to 73 degrees, is that what I conclude from this?

MR. MARQUINO: Yep.

MR. DEAVER: Right.

DR. WALLIS: And that's Fahrenheit. No, no. It's C, C.

MR. DEAVER: That would be degrees C.

DR. WALLIS: Okay, uh-huh.

MR. DEAVER: So we think this helps explain the streamline effects, you know, and this is reasonable. Okay. Moving on to one of the RAI topics, this RAI 19.1 -128 SO-1. This dealt with the question of could we uncover fuel or have it drain down in the actual vessel cavity?

Our configuration is such that we have a refueling bellows that is a 360 degree structure that goes around the vessel, and it separates the upper cavity from the dry well, and it pr otects people from down below.

So that's a design we've had in all of our BWRs going back, at least starting with BWR -2s. So we've had a very good history of operation with that type of bellow seal. It's got a lot of flexibility in it to accommodate vessel expansion and so forth.

So in this question, we address the issue of, you know, reliability of this refueling bellows. We discussed issues with plugs that we use for the steam line and IC system and so forth, and address the general issue of inadvertent drain down of valve configurations during outages and the potential for --

DR. WALLIS: These are the seals that leaked in some of the Mark I's that --

MR. DEAVER: I only know of one plant that had any leakage in the bellows, and it was very minor. But they did have to address it. That happened to be in Spain. So in general, these bellows have been very reliable, and they actually have the ability to block it off. Well, we have a leak detection system that's in operation all the time.

DR. WALLIS: You have somewhere that if it does leak, it's directed out into a suitable drain or something?

MR. DEAVER: Right. If there's actual leakage in the bellows then yeah, there is a drain line that goes off to a sump. So we think, you know, through the addition of information in the DCS or DCD, and with the response to the questions, we've you know, adequately responded to the potential for drain down.

We have nothing really different than prior BWRs, and we haven't had an issue with drain down.

DR. WALLIS: What does this "not credible" mean? I mean I'm sure we've had this discussion before, but I'm always puzzled by what is credible. To a scientist, almost everything is credible. Without it, it would violate the second law.

CHAIRMAN CORRADINI: What are you looking at Graham? I'm sorry.

DR. WALLIS: It says "fuel uncovery is not credible." I'm just saying to a scientist, everything is credible. It's just a question --

CHAIRMAN CORRADINI: We're engineers, though.

DR. WALLIS: --of how likely it is, and even to engineers. I can conceive of it and it's believable, but I'm just -- it's very unlikely is what you mean, right?

MR. DEAVER: Right.

DR. WALLIS: Then that calls the question of how unlikely it is.

MR. DEAVER: That's why they said credible.

DR. WALLIS: That's right, so you don't have to give a probability. There's no experience with it. It hasn't happened before. Therefore, it's very unlikely to happen again. That's what you're saying.

MR. DEAVER: Well, I don' t know many years of reactor operation we've had with this configuration, but we've never had an issue with it.

DR. WALLIS: That's right.

MR. DEAVER: And even if we had some leakage --

DR. WALLIS: Well, TMI was incredible until it happened.

MEMBER ARMIJO: You'd have to have a massive leak.

MR. DEAVER: Yes. I mean you'd have to be asleep while it happened.

DR. WALLIS: That's right.

MR. DEAVER: Yes. Okay, then moving onto the next RAI is 9.1 -155 SO -1. This dealt with the potential for gas accumulation in the FAPCS system, and you know, and the issues were water hammer, gas binding in pumps and inadvertent leaks --

DR. WALLIS: Gas is what kind of gas?

MR. DEAVER: Well, that's part of the answer is that it's not reactor non -condensible gas, because it's not connected with the reactor system.

DR. WALLIS: So it's air or nitrogen or something?

MR. DEAVER: It would have to be that, and the most likely problem would be in servicing, where somehow you didn't fill the system, and you left a volume of air in the system, and then the system would start up.

DR. WALLIS: That has nothing to do with the accumulation of other gas from the reactor?

MR. DEAVER: No, no. We don't have that issue, and that was our response, is that it's a low pressure system. It doesn't come in, you know. It's not connected to the reactor system's primary coolant boundary, and therefore it has no ability to, you know, to collect these non-condensibles.

Then our second bullet is associated with the line slope of vents and drains and such, that with adequate piping of the system, then we minimize the gas accumulation. And then with maintenance procedures, then we take care of any of the --

DR. WALLIS: These vents are automatic? They automatically vent, or do they set off an alarm?

MR. DEAVER: No. These are all manual vents.

DR. WALLIS: So someone has to come and open them up?

MR. DEAVER: Right. I mean they're just for servicing purposes.

DR. WALLIS: But there is an alarm, isn't there, on the vent? I think there is an alarm on most vents like that.

MR. DEAVER: I don't think so. These are just manual valves.

DR. WALLIS: They are? You just have to remember to go and check them or something?

MR. DEAVER: Well, that's all part of th e maintenance procedures. You've got to be able to validate the valve positions after you, you know, and the fact that the system's been vented.

MEMBER ARMIJO: So we've --

(Simultaneous discussion.)

DR. WALLIS: --talking about the GDCS line and stuff. There were vents there which were actually alarmed. Maybe I'm wrong.

MR. MARQUINO: Well, we haven't determined exactly what alarms are going to be set by what conditions. That's part of our HFE commitment. We have a lot of instrumentation and indications in the plant. But in terms of what is important enough to alert the operator, that hasn't been finalized.

DR. WALLIS: When you are really concerned about gas, you have an alarm on the vent.

MR. DEAVER: Yes. The GDCS is, yes, a different situation. But with air, we mainly -- we have ITAACs now that go in and establish that the proper slopes have been established, and that's not going to change after you've built the plant. So the ITAAC should take care of any future operating conditions.

So at any rate, we don't think we have a gas accumulation issue. Okay.

MEMBER STETKAR: Before you go to RTNSS, this is a bit off the wall, but that's what your tax dollars pay me to do.

(Laughter.)

MR. DEAVER: And we appreciate it.

MEMBER STETKAR: And at the moment, they're not paying me to be anything, but that's a different issue. I was looking at the FAPCS system, thinking about some other things. The reason I asked things about drainage of water earlier is the nice little drawing, t he one -line drawings of the fuel and auxiliary pool cooling system in the DCD, I think it's Figure 9.1-1, is not an elevational drawing.

The tops of the spent fuel pool floor is at great elevation, as I think you said earlier.

MR. DEAVER: Yes, uh-huh.

MEMBER STETKAR: That's the bottom of the suppression pool is at great elevation; is that right?

MR. DEAVER: Yes. I think that's not correct also.

MEMBER STETKAR: The bottoms of the GDCS pools are substantially higher than that.

MEMBER STETKAR: Now during normal operation, according to the system description, one train of the fuel and auxiliary pool cooling system is normally a line for cooling the, not surprisingly enough, fuel, spent fuel pool.

MR. DEAVER: Right.

MEMBER STETKAR: It says that the other train can be aligned as necessary for cooling or clean-up of the suppression or, if necessary, the GDCS pools. You can align it anywhere. If I look at the system design, and if I have the system operating with one train circulating the sp ent fuel pool, and I line up the other train to the -- some of the other pools at a higher elevation, if I have one valving error, I can drain the suppression pool or the GDCS pool into the fuel pools, overflow the spent fuel pools, and where does the water go?

How fast can I do that? There's no check valve that I can find in the suction line that prevents reverse flow. So I just have a basic gravity drain through the system.

MR. DEAVER: But we have cross-tie valves that don't allow you to switch f rom one system to the other.

MEMBER STETKAR: Yes. I said with one valve error. I can drain -- so the question is, and if I do that, because the fuel and auxiliary cooling pumps are at the bottom elevation of the fuel building, if the fuel pools can ov erflow and flow down into the bottom of the building with a reasonable flow rate, they get flooded and I've lost my system, which has implications for RTNSS and, you know, also building flooding and all of that kind of stuff.

So I was curious. I do need either a valve failure or an operator error to do this to me?

MR. DEAVER: Yes.

MEMBER STETKAR: But I was just curious how fast it can happen and how far can I drain down? I'm a little bit concerned about if it does happen, how far can I drain down either the GDCS pool, if it's aligned that way, or the suppression pool, if it's aligned that way.

I don't know where the -- I have no, you know, isometric drawings that show where the suction lines come off those pools.

MR. DEAVER: Yes. I'm not sur e that that's a --

MEMBER STETKAR: I thought there might be a check valve in the suction line that prevented that reverse flow back up into the fuel pools. But I couldn't find one.

MR. DEAVER: Yes. I'm not sure that that's possible when you're swit ching off between systems. What might be a correct check valve in one direction may not be good when you're --

MEMBER STETKAR: Well now you'd always want to take suction from that line.

MR. DEAVER: Okay.

MEMBER STETKAR: You know, it's the drain line out of the, whatever you call them, the skimmer overflow pool or something like that.

MR. DEAVER: Right, surge tanks.

MEMBER STETKAR: There's a -- yes. There's a drain line that goes down to the suction of the cooling pumps. You'd never want to pump water back up that line for any reason.

MR. BEARD: Alan Beard with GEH. At least one point that I'd like to make is that the system that we use for cooling and purifying the GDCS pools is its own dedicated system. It is part of FAPCS that it doesn't share IC stuff that --

MEMBER STETKAR: IC-PCC pools, according to the DCD, is it own separate system. I have a separate question about that one. That's the only single --

MR. BEARD: Your concern, yes.

MEMBER STETKAR: GDCS pool and --

MR. BEARD: Yes.

MR. DEAVER: Right. The IC system, we wanted to keep it clean.

MEMBER STETKAR: I'm going to ask you about that when we get to RTNSS. But I was just curious about it. I don't know the line sizes. I don't know the drainage rates.

MR. BEARD: What you're worried about is GDCS draining back through?

MEMBER STETKAR: I'm worried about a couple of things. I'm worried about either GDCS or suppression pool draining back through overflow. You know, what would happen is the spent fuel poo ls would just fill up and overflow.

CHAIRMAN CORRADINI: So I'm not sure. I understand the GDCS. I'm not understanding that one. That's the one I didn't understand, because I thought they were at the bottom. Both were the same.

MEMBER STETKAR: The bottom, I'll use the graphic. The bottom of the GDCS pool is here; the bottom of the suppression pool is here. The top of the fuel pools is here.

CHAIRMAN CORRADINI: Oh, I thought the bottom of the fuel pool was there.

MEMBER STETKAR: No, no.

CHAIRMAN CORRADINI: So what he said is correct?

(Simultaneous discussion.)

MEMBER STETKAR: I can gravity drain with one valving error. I can gravity drain water from here. But I don't know where the suction lines take off. I'm assuming they're close to the bottom, because I'd like them to be there. But I don't know that to be true.

CHAIRMAN CORRADINI: Right, okay. Now I get it. Thank you.

MEMBER STETKAR: And it's a question of draining that volume, because that's water that I'd like to have for other purposes, and where does the overflow from the fuel pool go, because my fuel and auxiliary pool cooling system equipment that I'd like to have for other purposes is down in the basement.

I mean this is a large line. I mean I know you have floor drains and things, but --

MR. DEAVER: Well no, but what --

MEMBER STETKAR: A two-inch floor drain might not handle a ten-inch line.

MR. DEAVER: No, but what should happen is that any excess flow should go over the weir, and go into the surge tank. So --

MEMBER STETKAR: I'm coming up that way, though. That's the water -- the water is flowing out of the surge tank up. That's my water. That's my inlet. That's my source. It's coming back through the suctions of the pumps.

I mean if y ou can think of, you know, the cartoon, up that line, flooding back into the skimmer lines and out over the tops of the pools. It's, you know, if you had a make -up on your swimming pool and left it on overnight, it would be what was flooding your swimming pool for you, from the suction of your pumps.

MR. DEAVER: Yes. I don't think we have an immediate answer for you on that topic, unless --

MEMBER STETKAR: Okay. But I mean the two concerns is how fast, you know, how fast can I drain those, the safety-related pools if you will, the GDCS pool or the suppression pool, because I don't know the line size basically.

CHAIRMAN CORRADINI: But you know that. What is the pipe diameter for the FAPCS?

MR. DEAVER: They vary throughout the system.

MEMBER STETKAR: They vary and I haven't found conclusive numbers, so I'm not quite sure. I think they're fairly large lines, but I'd like to know what they are.

And then the question is, the reason I asked earlier when we were talking about the steaming, is if we do overflow the fuel pools through, you know, flooding up over the tops of the skimmer line, where does that water go? Does it just flood over and down into the bottom of the, you know, the basement of the fuel building, in which case you'd flood out --

MEMBER ARMIJO: Your pumps.

MEMBER STETKAR: Your pumps. It's not a

design basis, I will fully admit that.

MEMBER ARMIJO: It would be nice to know.

MEMBER STETKAR: But it's -- if I can do it with one valving error, I might be able to do it some time. Or there might be a check valve in that suction line from the skimmer, whatever you call them, the surge tanks or something like that. It just doesn't show up on the single one line.

MR. DEAVER: We have a relatively new system engineer working on that system.

DR. WALLIS: Can you trace the line --

MEMBER STETKAR: You might want to, you know, check back with him. I'm glad we talked about this today, because we still have tomorrow.

DR. WALLIS: Can you trace the line for us on Figure 36 or something, is that too hard?

MEMBER ARMIJO: Your backup slides.

MEMBER STETKAR: Oh, the backup slides? Oh. I didn't --

(Simultaneous discussion.)

MEMBER STETKAR: Yes, okay.

MEMBER ARMIJO: You have cooling mode and all sort of the --

MEMBER STETKAR: Go to that. I didn't realize there was --

DR. WALLIS: The elevations are wrong, but the lines are right.

MEMBER STETKAR: The elevations are wrong. I mean the problem is this is similar to the figure in the DCD. You're led to b elieve that the fuel pools are higher in elevation that the GDCS, which isn't true. It's actually reversed. But the flow path would be just line up the suction line from the GDCS pool or the suppression pool, coming out of this -- there's two check valve s. There. You have your little hand there, through those two little checks, yes, however that is.

Through those two little check valves, out to the suction of the pump, and then just because you can line, align either pump train to either flow path, I need to have one of those normally closed suction valves misaligned.

Such that I line up the suppression pool, let's call it suction flow, back through that common suction header now, because they're cross -tied, up through what's highlighted on this figure, the green line, back up -- you see there's no check valve in that line. Back up overflowing the skimmer surge tanks to the skimmer lines, and out into my building.

DR. WALLIS: But aren't the check valves

that you just showed us that are in between the reactor building and the containment?

MEMBER STETKAR: They are. They're designed to work the way I want the water to go.

DR. WALLIS: Oh, so they don't help you at all? They work --

MEMBER STETKAR: They help me. They don't help this problem. I mean those check valves you want to work that way, because it's -- when I thought about it, if there were a similar check valve in that green suction line, such that it would allow water to flow from the skimmer surge tank to the suction of the fuel and auxiliary pool cooling system, and not allow reverse flow back up into the skimmer surge tank, I wouldn't worry about this.

CHAIRMAN CORRADINI: So you're saying, you're saying the -- you're saying the green line coming out of the skimmer surge tank should have a check valve, as does the suppression pool does?

MEMBER STETKAR: Exactly.

CHAIRMAN CORRADINI: I've got it.

MEMBER STETKAR: The suppression pool line, any way you can line up the system to something inside the containment, as a check v alve to prevent reverse flow in that direction.

MR. GELS: This is John Gels in Wilmington. I kind of -- I have access to more detailed diagrams for the system, and I can confirm that there actually are check valves on the exit of the surge tank.

MEMBER STETKAR: Ahh.

MR. GELS: Yes. But additionally, the suction lines from the suppression pool, those lines have valves that are safety-related and normally closed. They only open when we're in the suppression cooling mode, and they will close again if the pumps trip.

MEMBER STETKAR: But in this case, the pumps wouldn't trip. I don't know if you were listening to the whole thing. I walked you into this during normal operation.

We're not talking about accident conditions or anything. Normal operation, when for some reason, you need to align one of the trains of FAPCS to either cool or clean up or whatever the suppression pool or the GDCS pools.

So it's not an accident condition or anything. It's just a normal operational alignment of that system, which can in fact be simultaneously operated in parallel, provided the valves are aligned correctly.

But the answer is, though, you confirmed that there are indeed check valves in the suction line from the skimmer surge tanks?

MR. GELS: That is correct.

MR. DEAVER: Yes. This is a simplified diagram.

MEMBER STETKAR: Thank you. That answers my whole question.

MR. DEAVER: Okay.

MEMBER STETKAR: Thank you very much.

MR. DEAVER: Thanks, John.

DR. WALLIS: So we learned once again th at the devil's in the details. If the details aren't shown, you don't know them.

MEMBER STETKAR: No.

MEMBER ARMIJO: That's always the case.

MEMBER STETKAR: Thank you.

MR. DEAVER: I think that finishes my part. I'll turn it over to Mike to go into RTNSS.

MR. ARCARO: Mike Arcaro. I'm the principle engineer for the balance of plant side of ESBWR. What I wanted to do today is just go through some of the auxiliary systems, and key on the RTNSS functions, and then also talk about some of the other design features associated with plant investment protection.

The auxiliary systems support RTNSS functions. We had an RAI that talked about providing a description of those functions in Tier 1. So we did that. So in the DCD, you'll find Tier 2 d escriptions of all the RTNSS functions, and corresponding Tier 1 ITAAC associated with those functions. Okay, next slide.

Going through, this table came out of 19 Alpha of the DCD, and it's got an overview of the RTNSS functions. I broke it down into j ust the BOP systems associated with RTNSS. So we'll go through, you know, the first couple of items there have to do with the fire protection system. Fire protection system for ESBWR is supporting the RTNSS-Bravo function, which is a safety function after 72 hours.

This is part of the fire protection system that's providing water to the ICPCCS pools post -72 hours for make-up. The piping going to the, from the CAT-1 fire protection tanks to the connections at the reactor building are CAT-1 piping in a CAT-1 trench.

This part of the system is completely separate from the FAPCS pool cooling system. So it's a separate.

MEMBER STETKAR: Quick, before you get into it. I really appreciate this presentation, by the way. Just to make sure I'm oriented ri ght, anything that's RTNSS-B is in a seismic Category 2 building; is that correct?

MR. ARCARO: CAT-2 or better.

MEMBER STETKAR: Yes, CAT -2 or better. But C is non-seismic, right?

MR. ARCARO: C would be --

MEMBER STETKAR: Unless it's for other reasons in a CAT-1 or CAT-2.

MR. ARCARO: That's true.

MEMBER STETKAR: Okay.

MR. ARCARO: And then 19 -- there's also a table that tells you the housing for RTNSS.

MEMBER STETKAR: But I mean the general principle is if it's written as B, it's got to be CAT-2 or better. If it's written as C, there's no --

MEMBER ARMIJO: No requirement.

MEMBER STETKAR: There's no requirement, strictly from a RTNSS perspective.

MR. ARCARO: Right, that's correct.

MEMBER STETKAR: Okay.

MR. ARCARO: S o the fire protection system components that we're talking about are in the fire pumping closure area, which is a CAT -1 structure. So along with the tanks, these pumps are in a CAT-1 structure.

The next function there is FAPCS. We've talked about that , fuel pool cooling. On the RTNSS side is supporting low pressure, coolant injection and spent suppression for cooling. So this RTNSS function is to support, shut down cooling, RWCU operations.

So if for whatever reason you don't have that, this RTNSS will get you up to the NRC goals by using this active system.

MEMBER STETKAR: May I ask you, we had a good lead-in earlier. There's another train that's generically associated with the FAPCS system, but it's actually a separate little cooling lops that's got its own pump and -- pumps and pipes and valves and heat exchanger, and I guess filters.

MR. ARCARO: Filters too.

MEMBER STETKAR: I don't remember where there are filters in it, but that can be aligned to cool the PCCS, the ICPCCS pools. What assumptions are made as far as temperatures of the water in those pools, and doesn't matter?

In another words, is that system required to operable, not a legal text spec sense, but do you need that system to actually keep those pools cool during normal operation, to satisfy any design basis accident assumptions on temperature of the water in pools, and in particularly obviously I'm interested in --

MEMBER ARMIJO: ICPCCS.

MEMBER STETKAR: --the ICPCC, the PCC function.

MR. DEAVER: I don't know the answer. I think it's more of a functional thing. You don't want water boiling off and having to make up water all the time. You'd like to keep it cool enough so that you don't get that heavy evaporation, is my first guess.

MEMBER STETKAR: Well, but I mean your accident analyses must start with some assumed pool water temperature, right?

MR. DEAVER: Yes.

MEMBER STETKAR: And I guess my question is, is that system relied on to maintain that water at that temperature?

MR. DEAVER: Yes.

MEMBER STETKAR: So why isn't that system a RTNSS system, or that train or this train?

MR. MARQUINO: Because if it didn't work, it would be -- if it didn't work, it would depend on other conditions in the plant, in terms of whether you got to the tech spec LCO, and then if you got to the tech spec LCO, you'd be taking the action through required actions.

MEMBER STETKAR: Is there a tech spec LCO on pool temperature?

MR. MARQUINO: Yes.

MEMBER STETKAR: Is there? Okay, I don't remember.

MR. MARQUINO: I'll check on that.

MEMBER STETKAR: Check that. I honestly don't remember. I mean I didn't try to dog it that far. I was just trying to think about what function this, that other little train provided, and whether or not it should be -- it certainly shouldn't be safety-related, but at least RTNSS is a support function.

MR. DEAVER: John Gels, do you have any comment on that?

MR. GELS: I'm sorry. Can you please repeat the question?

MR. MARQUINO: Is there a tech spec limiting condition for o peration on the PCC -IC pool temperature?

MEMBER STETKAR: Temperature.

MR. GELS: I don't know if that is an LCO, but I can check on that.

MR. MARQUINO: Would you please, so we can get an answer?

MR. GELS: Yes.

MS. CUBBAGE: PCCIC, not spent fuel.

CHAIRMAN CORRADINI: I'm sorry Amy.

MEMBER STETKAR: No, this is PC -- this is ICPCC.

MEMBER ARMIJO: Pools.

MEMBER STETKAR: Pools. This other little train only cools those pools. Okay, thanks.

MR. ARCARO: So we'll find out about that. Let's see, going through the rest of the items on this list, we talked about the fire protection water tanks, their function. Also, all the support systems that provide support, fire protection system for this RTNSS-B Bravo function are in there.

So the ventilation system, the diesel supply to the fuel for the diesel fire pump, those are all part of the support for that.

MEMBER STETKAR: Mike, in the description of the fire protection system, it talks about -- there's two, I think they're called primary fire water pumps, and two, I don't remember whether they're called secondary or two other pumps. Those other pumps and the piping aren't shown on any of the drawings in the DCD.

Do they tie into the primary part of the fire protection system that's shown on the DCD, or if they do, where? And how are they protected? I'm thinking about seismic failures. How are piping breaks in that obviously non-seismically qualified part of the system protected from diverting flow from this function?

MR. ARCARO: Okay. So this function here has its own dedicated line coming from the primary fire water storage tanks to the reactor building, to the manual valves for filling these pools. The secondary loop of fire protection is provided by the site.

So in the 951 of the DCD, you'll see COLA items that talk about in addition to the primary system, you have to provide a secondary system. It's 550,000 gallons of fire water for the secondary loop, and that's in order to support design basis fires for the turbine building and for other buildings throughout the plant.

MEMBER STETKAR: And is there a requirement somewhere specified that that will normally remain isolated from this primary side, or do you simply take credit because this is a 72-hour event? I'm thinking about, you know, a seismic event, where you can break the non-seismically qualified section of piping that may or may not be normally connected to the primary side.

MR. ARCARO: Right, right.

MEMBER STETKAR: And can you drain your primary water stored, you know, your tanks during that interim period, 72-hour period before you need it?

MR. ARCARO: Right, right. If you look at Figure 951 of the DCD, it will show you the primary loop and then the secondary loop is from yard piping. And going into th e nuclear island, there's check valves. So the system is designed so that you can feed from the secondary side for a fire, but not, you know, invalidate the primary loop, water provided.

MEMBER STETKAR: Yes, got it, got it. Thank you.

MR. ARCARO: O kay. I guess the other thing on this slide is the oversight and, you know, how we verify functionality of the system. So for these, all these functions here in the availability control manual, there's actual LCOs that we do to verify that the system can operate the support the function.

MEMBER STETKAR: LCOs in your, not tech spec LCOs?

MR. ARCARO: Correct, correct.

MEMBER STETKAR: Yes.

MR. ARCARO: Availability LCOs.

MEMBER STETKAR: ALCOs, ACLCOs.

MR. ARCARO: So next slide, we're talking about the support systems again, ancillary diesel generators, standby diesel generators. Ancillary is supporting the Bravo function. So it's safety system functions post -72 hours. This is in a CAT -2 structure.

This, the loads are shown in Chapter 8 of the DCD, but it's supporting the fire pump, the motor-driven fire pump, PCCS fans, control room habitability, recirc air handling units and the cooling unit. Also emergency lighting and Q -DCIS for post-accident monitoring.

Standby diesel generators. These are the large diesel generators that are supported by service water, RCCW. These are 15 megawatt generators. The ancillary diesel generator is a 850 to 1,700 kW diesel. So a difference in size there.

Standby diesel generators also have availability LCOs to ensure operation. Here we see for the ancillary diesel, the HVAC is supporting the functions, so it's also listed as a RTNSS system. Standby diesel generators are supported by the electric building HVAC. So that's also supported.

For the systems that are normally operating, where the availability controls the maintenance role rather than availability of controls LCO.

MEMBER STETKAR: The standby diesels are in the electrical building?

MR. ARCARO: That's correct. Yes, the have separate bays in the electric building.

MEMBER STETKAR: Is the electrical building a non-seismic structure? I don't remember.

MR. ARCARO: I believe it's a CAT-2.

MEMBER STETKAR: Is it a CAT-2?

MR. ARCARO: A CAT-2 structure.

MEMBER STETKAR: I remember your seismic. You don't need to consider soil liquefaction under CAT-2 buildings though, right, for your seismic qualifications?

MR. MARQUINO: We lost our single structural representation.

MEMBER STETKAR: Again, thinking of earthquakes, if I have a liquefaction problem, I think there's a COL item that they have to address liquefaction under CAT-2 buildings.

CHAIRMAN CORRADINI: That's a COL item?

MEMBER STETKAR: I think so, if I recall.

CHAIRMAN CORRADINI: Can we save that for the staff?

MEMBER STETKAR: I need to go back and look at my -- yes.

CHAIRMAN CORRADINI: Let's save it for the staff.

MEMBER STETKAR: You may want to look that up. I have to go back and look at my notes from another chapter, but I think that's true.

MR. ARCARO: Okay, next page. Okay. CAT or RTNSS-Charlie functions here. So now we're providing functions supporting the diesel generators, the RCCW, the cooling, that's supporting the FAPCS RTNSS-Charlie functions for suppression for cooling and low pressure injection.

So reactor building has functions to cool N-DCIS for a FAPCS system. Turbine building has cooling, local cooling for the FAPCS that in the turbine building, you have the RCCW pumps. RTNSS - Bravo control room habitability air handling units. So for control room habitability, RTNSS-Bravo function that is supported by the recirc air handling units and the auxiliary cooling units.

Then also that air handling unit and auxiliary cooler supports the post-accident monitoring heat loads in the Q-DCIS. Next slide.

Reactor component cooling water, like we said, supports standby diesel generators, which supports the FAPCS RTNSS -Charlie. Also, nuclear island chill water subsystem is RTNSS, and that's supporting the building, the ventilation systems.

Service water is supporting the RCCW for RTNSS, and it's also providing cooling for the turbine building component cooling water heat loads that are plant investment protection, but not RTNSS systems.

Okay, so going through the RTNSS cooling systems, the NRC conducted an audit of the cooling systems, specifically wanting to look at the, you know, the aspects of --

MEMBER STETKAR: Before you get into the RAIs, because you're going to go off, you know, on those focused things. I think I as ked this before, and I don't recall the answer, and I couldn't find it anywhere. But why didn't the main condensate feed water systems show up as at least a RTNSS-C-type system, you know, from the PRA perspective?

MR. ARCARO: I think Chapter 19 talks about that a little bit.

MEMBER STETKAR: Does it? Okay.

MR. ARCARO: From that I understand, you know, the reliability is such, you know, you have a triple redundant feed water system that pointed it out.

MEMBER STETKAR: It just didn't pop up above the screening criteria that you're using.

CHAIRMAN CORRADINI: I knew you were going to get to that. I was waiting.

MEMBER STETKAR: But those screening criteria are different than most other applicants are using. They're a factor of two to two and a half times higher, in terms of numerical importance, than essentially all the other applicants that are currently in play are using.

I mean we've sort of raised this general question before, but I --

MS. CUBBAGE: We really don't have anybody here that's --

MEMBER STETKAR: Yes. No, I understand that.

MS. CUBBAGE: That's not what we --

MEMBER STETKAR: I just wanted to make sure that it was -- they were screened out based on PRA considerations. You have no idea how close to the margin they were?

CHAIRMAN CORRADINI: We know we have to come back and discuss this.

MEMBER STETKAR: I just wanted to -- anyway, it's on the record.

CHAIRMAN CORRADINI: Got it.

MS. CUBBAGE: The condensate.

CHAIRMAN CORRADINI: The feed and condensate system?

MEMBER STETKAR: Yes, the condensate and feed water system primarily, and it's -- you know, the basic question is if it was screened out based on the numerical values from the PRA.

MS. CUBBAGE: From the perspective of reliability and availabilit y, those are on all the time when the plant's operating. No? Yes? I'm not sure what would happen differently, to ensure availability for a system that's continually operating.

MEMBER STETKAR: The FAPCS system is also normally running. So I don't wan t to get into what's normally running and things like that. I'd be interested to see, you know, if it was screened out based on the numerical criteria, how close you were to that margin. I mean, you know, if you're a factor of five below it, I don't care.

MR. ARCARO: Okay. Yes, I know in the PRA it was broken up into sections for different systems.

So I think we can find those numbers.

MEMBER STETKAR: Okay, thanks.

MR. ARCARO: Okay. So RAI 9.2-24 was asking a question about RTNSS systems. Th ese systems are relied upon to achieve cold shutdown, and are backing up passive systems. So the issue was we want to make sure that they're highly reliable and capable of achieving cold shutdowns.

So in that venue, we had an audit of the cooling water systems, and we spent some time with the NRC, and we went through the calculations and the design basis of the systems, and the few slides is follow up from that, from that audit.

Okay. The cooling water systems high level requirements, they perform non -safety functions with defense in -depth requirements. Since during normal operation, they're significant contributors to availability and plant investment protection by design.

They're highly reliable and provides features for plant investment and defense in -depth, including seismic ruggedness, redundancy, fire and missile protection and flood protection.

The RTNSS -Charlie functions provide post -72 hour coolant, but cooling also have requirements associated with redundant trains, separation, seismic requirements and missile and flood protection, okay.

The first system is service water. Just big picture, go through some of the features and the functions. The clouded area is conceptual design information. This is our heat removal facility. So the re ference plant, we've got a mechanical cooling tower, mechanical draft cooling tower with a basin.

That basin is providing the heat removal capability for PRA for RTNSS functions, and that has an interface requirement and an ITAAC for water capacity. As you can see, the service water system is broken up into two trains.

So you've got two redundant 100 percent trains, two pumps on each train. You've got three rafter component cooling water, heat exchangers, two turbine component cooling water heat exchangers. Same heat exchanger. They're plate heat exchangers.

Also have a bypass line for cold weather operations or for providing flow while you're in minimal heat load operation. That's probably the main features of the system. It's designed as a one percent exceedance system, so the safety -related systems are zero percent exceedance. The service water is designed for one percent exceedance design conditions.

Okay, next slide. Okay. Now we're looking at the reactor component cooling water system. Okay. So again, you can see we've got redundancy, we've got separation. The pumps are powered from separate PIP buses, so there's both physical and electrical separation.

Normally run the system cross -connected, under a condition where you need to split the trains out. The cross -connect valves will shut. Heat exchangers, you've got three heat exchangers on each train. The heat exchangers are cooling the RCCW and then providing the water, the flow.

You can see the diesel generator, the standby diesel generator has its own loop. You also go into the turbine building loads for the NI chillers, and in the reactor building you're supporting loads for RWCU, shutdown cooling, sampling system, FAPCS heat exchangers we've talked about before, CRDM pump heat exchangers. So those are all in either the fuel building or the reactor building.

Normal operations, one pump, one heat exchanger per train. It's adjusted so that depending on the heat load, you can run multiple pumps, multiple heat exchangers. Okay, next slide.

Okay. Chill water system. Again, the redundancy and separation, you can see that. The top part of that drawing is the nuclear island chill water. The bottom part is the balance of plant chill water. So on the nuclear side, it's sepa rated with manual valves for the balance of plant.

The balance of plant chill water system could be used to support the nuclear island heat removal functions, but normally it's not cross-connected and we don't credit it for any scenario.

Chillers, again they've got different PIP power. So electrical separation and mechanical separation. The train, redundancy is in the components. So you could see on the supplies, we're going to, you know, control building Alpha or Bravo trains, which supply ventilation systems for redundant trains also.

Okay. Some of the design features were service water, the design criteria a single train failure during cool down results in the highest heat load on the service water train, and that's 80.8 megawatts. These are in Table 9.2 tables of the DCD.

To test that, during a refueling outage we could, during cool down, we could put, you know, that kind of load on a single train to do testing for the heat exchangers. So one of the only things that we learned for servic e water is to provide instrumentation, and design the system so you could test it during refueling, shutdown cooling operations, to simulate the design loads.

Lots of margin going into the system designs. One of the points is while it's designed for one percent exceedance, we're making sure the system's capable of operating at zero percent exceedance. So one of the issues from customers was, you know, we want to make sure that there's not going to be any operational perturbations for a couple of days a year during the summer time, which has been an issue with patent systems.

So we have the capability of that margin in the components, to make sure we don't trip out chillers and effect the operation of the plant. We also have margin between the heat loa ds of the system and what the cooling towers can do.

So in the DCD, we provide a margin above the maximum design heat removal for the system, so that there's margin there and then, you know, the individual plant will provide additional margin on top of that.

Okay, next slide. The RCCW system, let's see. The most limiting condition here is loss of power with single train failure. We looked at that, and that's -- that operation still gives us the capacity to bring the plant to cold shutdown in 36 hours.

MEMBER STETKAR: 36 hours is the time for that?

MR. ARCARO: That's correct.

MEMBER STETKAR: Thanks.

MR. ARCARO: Okay, the heat exchanger design. The limit of the heat exchanger is 59.8 megawatts between two, so half of that, and one of the things we use in plate heat exchangers is we also have margin built in if we want to add additional plates. We can give ourselves a couple of degrees margin on the temperature. Again, designed for one percent exceedance, but can operate under zero percent exceedance conditions.

Okay, next slide. Nuclear island chill water system. Again, the criteria is 24 hours, either 24 or 36 hour cool down conditions. The total heat load of the system is 19,110 kilowatts. The chillers are sized about 1320 tons per chiller, and again we're using common chillers between the balance of plant and the nuclear island site for standardization.

Two trains for the nuclear island, redundancy, separation. If you lose power for one train, the other side will pick up the l oads. Again, significant margins both on the chill water side for design, and on the ventilation side. We use the ASHRAE design margins for air flow and for heat load.

Okay, next slide. Any questions on coolant systems? I went through that pretty fast. Okay.

All right. Instrumental and service error. There were some issues about the ability of the system to support the loads, and you know, the impacts of operating experience on contamination of water, of effects of degradation in the air systems.

So some of the points that we have for ESBWR is one, the air system is designed for a three micron particulate rating, right. It's, you've got service air compressors that are oil -free, so oil's not going to be an issue with our air. Stainless stee l components and piping, a three micron limit compared to the standard, which is a 40 micron limit.

Also, we have dew point requirements in the dryers, to maintain the dew point over minus 40 degrees, to minimize corrosion due to water. Two 100 percent trains. So if we lose half of the system, the other system can support the whole load. They are PIP loads. They're coming off the standby diesel.

The receivers are sized to give you 10 to 15 minutes of operation, based on past experience with plant tr ansience due to lost instrument air. Instrument air and service air is not safety -related, and it's not RTNSS. So components that are required for operation, that are either air-operated or nitrogen-operated in the containment, have safety-related accumu lators or are fail safe. So -- go ahead.

MEMBER ARMIJO: I just had a question. Is this the same kind of system for these -- that you've used in the ABWRs, or is this upgraded from that?

MR. ARCARO: I'm pretty sure this is upgraded from ABWR.

MEMBER ARMIJO: That's my guess.

MR. ARCARO: Yes. We've gone through a couple of iterations of this. We started with three compressors; now we have four, four compressors, two --

MEMBER STETKAR: You started with a completely different system design.

MR. ARCARO: Yes, right.

MEMBER ARMIJO: But I mean as far as the three micron particulate filters, you know. It seems like a lot of improvements over what used to be the old systems.

MR. ARCARO: Right, and I think a lot of that is technology, too. You know, that now, you know, the compressors and the dryers and the filters are such that, you know, you can get those levels.

MEMBER STETKAR: Mike, were you going to talk about high pressure nitrogen?

MR. ARCARO: Probably not, because it's a safety-related system and you're focusing on RTNSS stuff here, or non-RTNSS in this case.

MEMBER STETKAR: I noticed in, I think it was DCD Rev. 6, fire revisions listed the MSIVs as a load, if I can call it that, from the high pressure nitrogen system, and DCD Rev. 6 and Rev. 7 has removed the MSIVs from that list.

Are they no longer, does the current design no longer have a pneumatic supply to those valves, or can you explain why they were removed?

MR. ARCARO: Yes, I'm not -- maybe Jerry can help me out, but they still show up in Table 9.38 of the DCD, with nitrogen demand requirements. So MSIVs, SRVs, ICS isolation valves are in the DCD.

MEMBER STETKAR: In Table 9.38. Huh. Because there was a list in Section 9.38 -1 that lists supplies from the high pressure nitrogen system. It's kind of a bulleted list, or I don't remember whether it was a bullet or a paragraph, you know, and they weren't in there.

MR. ARCARO: I believe they're still loads on the high pressure nitrogen system.

MEMBER STETKAR: Okay, I'll find it.

MR. ARCARO: And I'm not sure why we got rid of those --.

MEMBER STETKAR: There were notable though, you know, in terms of things inside the containment. They were sort of notable in their absence. But they're in that table, so I'll find it. Thank you.

MR. ARCARO: I know we did, in Rev. 7 I think we went through this table and clarified some of the numbers. But this table --

MEMBER STETKAR: I didn't even bother looking at the table. We could, I don't know wheth er I looked at it or I missed it. Thanks.

MR. ARCARO: So that would be an example of a system that's got an accumulator that's sized to provide the safety function. Okay. There's the instrument air system. You could see four compressors. The interface between instrument air and service air is toward the dryer. You have 100 percent redundancy on the dryer, so first you would take a dryer out. You could provide the functions, the cleaning/drying functions on the other train, and you know, this is a maintenance rule system. So it still has, you know, the requirements for maintaining the system function.

Okay in summary, we went through the decay heat calculations and analysis for total decay power curves, talked about the OE experience for ESBWR related to spent fuel uncovering gas accumulation for FAPCS system; talked through RTNSS functions for the balance of plan auxiliary systems; describe the overview for service water, RCCW and the nuclear island chill water system; and talked through some of the design details associated with the instrument air and service air system for ESBWR.

CHAIRMAN CORRADINI: Questions for Mike?

MEMBER ARMIJO: I don't know if it's a question for Mike or for Jerry, but in your backups, you must be careful never to include backups.

CHAIRMAN CORRADINI: A lot of information that you know.

(Laughter.)

MEMBER ARMIJO: But you didn't talk about it, so I'm going to ask you about Slide No. 34.

That's my -- you probably heard from me before on hydrogen water chemistry. So I'm going to go over it now.

CHAIRMAN CORRADINI: Oh, Sam, Sam, Sam.

MEMBER ARMIJO: You included this in the package for some reason. What was it a backup to?

CHAIRMAN CORRADINI: This is Mike's backup.

MR. ARCARO: Yes this is --

(Laughter.)

MEMBER ARMIJO: Big mistake. It was to back up some other point, I guess, or some other chart, and I just wanted to see, you know.

MR. ARCARO: Yes. No, I know this was an issue. I was reading through the transcript. So I just wanted to have a talking paper here.

MEMBER ARMIJO: Okay. Well you know, I think the issue there is you've already made a decision of what you were going to include in the DCD and the certified design and the staff agreed with you. But I think there are some points here that are -- you do recommend that people use hydrogen water chemistry. That's -- the bulk of the BWRs around the world, with a few exceptions, are using hydrogen water chemistry, and GE recommends it.

It seems like a lukewarm recommendation. In your second bullet, you say if utility prefers to begin its operating life without this hydrogen or noble chem, the consequences for the foreseeable future are likely small. I think that's an overstatement. The stress corrosion cracking is a time-dependent thing, and the assumption you're making that it's not likely to occur for some period of time.

But nucleation really, nobody knows exactly when it starts, and so that -- I think that's an overstatement. I think there are consequences. And you're r elying on better materials and better processing and fabrication. I don't disagree with that, because I know there are better materials, but they're not immune.

My best example is you cite the ABWR operation in Japan. It's been successful but not too much inspection. But there have been the best materials we know how to make, 316 nuclear grade components, that have failed by stress corrosion cracking in Japanese reactors that did not use hydrogen water chemistry, and that's a shroud.

And they, and that's really the best material we have for BWR applications. I know they didn't fabricate it the way I would have, but you know, it's the whole idea is to have a belt and suspenders approach, of better materials, better fabrication and the best water chemistry you can have.

So I'm still, I guess I'll use the word "disappointed" that GE just doesn't take a stronger position, or the staff doesn't take a stronger position, because I think this should be the reference water for the volume water reactor.

I don't think -- I think the old so -called pure water chemistry is -- it should be put on the shelf as a bad experience, and not rely just on better materials. Because I know there are better materials; I helped develop them, but they're not immune, and I know there's better ways to fabricate, but people don't always make things perfect, and you've got some very important components on a long life system that is not protected with the optimum water chemistry for the BWR.

So I'll just leave it at that, an d but I'd ask you to downplay your chart here, this thing. I don't think the consequences are small, and I suspect there might be a few people at GE that feel the same way. But --

MR. DEAVER: No, we're committed to hydrogen.

MEMBER ARMIJO: Well, wh atever the customer you've got, you've got to turn them around. Who wants to make a multi-billion dollar bet?

CHAIRMAN CORRADINI: We better have a break. So with that, I think John has a question. But before I allow John to ask just the one little question, the staff found the LCO on the water pool temperature. Amy, can you just --

MS. CUBBAGE: 110, yes. It's Surveillance Requirement 3714, verify average water temperature available, in available ICPC pools is less or equal to 110 degrees Fahrenheit every 24 hours.

MEMBER STETKAR: That's a surveillance requirement. Is there a LCO?

MS. CUBBAGE: For the LCO that it feeds into would be operability of the PCC-IC pools.

MEMBER STETKAR: Okay, and what was the reference Amy?

MS. CUBBAGE: It' s tech spec surveillance requirement 3.7.1.4.

MEMBER STETKAR: 3.7.1.4.

MS. CUBBAGE: Yes.

MEMBER STETKAR: Thank you.

CHAIRMAN CORRADINI: John, you're up.

MS. CUBBAGE: Okay, wait.

MEMBER STETKAR: Wait, wait. Amy?

MS. CUBBAGE: Mark Ca ruso's here to be able to try to answer some additional questions you may have on RTNSS, and Samir Chakrabarti is either back or going to come back to help talk about liquefaction. There was a question on that. So if you'd like to repeat your question to Mark.

MEMBER STETKAR: Liquefaction cap B.

MS. CUBBAGE: No, the feed water.

MEMBER STETKAR: The feed water? Oh, the question was -- the way I led into it is why isn't feed water listed as a RTNSS -Category C system, you know, condensate feed wate r from the PRA perspective, and the response was well, it was screened out as being, you know, not risk-significant according to the criteria.

The observation is that the ESBWR screening criteria for risk significance, if I look at plessel vesseling (ph) importance as a factor of two higher than any of the other current applicants for design certification are using, and for risk achievement worth is a factor of 2-1/2 times higher, they're using plessel vesseling importance greater than .1, and risk achievement worth greater than five, whereas other current in play applicants are using plessel vesseling importance greater than .005, and risk achievement worth greater than two.

So the question is, my question was well, what is the inventory of SSCs that were screened out because they, essentially they lie in the difference between those numerical screening criteria to this plant? In other words, if something was screened out because it had a plessel vesseling importance of .009, let's say.

MR. CARUSO: Yes.

MEMBER STETKAR: I don't know what inventory might be.

MR. CARUSO: Well, plessel vesseling in raw values were not, are not screening criteria for RTNSS. There's the original --

MEMBER STETKAR: Okay, not for RTNSS, but --

MR. CARUSO: But I can address feed water specifically. The staff didn't agree. There's a statement, applicant made the statement that it wasn't risk-significant. If you look, feed water was considered in C under the, you know, if the non-safety system contributes to an initiating event, you need to look at three particular criteria. One, is it -- does failure of the event affect initiating event?

MEMBER STETKAR: But something like initiating events. Does it make you vulnerable to greater than some core damage criteria?

MR. CARUSO: Does that failure of those initiating events, does it contribute significantly to CVF and WRF (ph), and I think, you know, we -- this woman was on the line. It was on the line in the sense of the last criteria. But we felt that -- we looked at the arguments about why you really didn't need to have it in RTNSS, and in the end, in the end there's two, there's several arguments which are good ones, I think.

One is that we gave them credit for the fault-tolerant design of the feed water controller, you know. They're triple fault, you know, triple redundant, fault-tolerant. They're going -- they have a commitment to maintain a mean time of failure of 2,000 hours, and we factored that into their -- they have a lower initiating event frequency because of that.

So the initiators that take out feed water, that are most important, are losses of power, and the losses of power are in RTNSS. The diesels are in RTNSS. So we gave them credit for that. In addition, we said well, what are you going to do? Are you going to put availability controls on it? Feed water is always running.

Plus, you know, one of the big drivers of the maintenance rule was all the balance of plant failures you would get from feed water that would give you transience. Feed water is in the maintenance rule program.

MEMBER STETKAR: It is.

MR. CARUSO: Which is a big part of what the treatment is for RTNSS. So when all is said and done, I think you have a fair statement about, you know, hey why is -- this is important to risk, you know. I mean losses of feed water. But I think in the end --

MEMBER STETKAR: On this -- okay. On this plant, you probably have hit on it already. I just want to make sure I understand. Is the RTNSS list, and there are rules for what is RTNSS and what is not RTNSS, and then there's a reliability assurance program, which has a different set of partially related but slightly different criteria.

The reliability assurance program is also non-safety related equipment, but you're required to basically invoke the maintenance rule on it.

MR. CARUSO: Yes.

MEMBER STETKAR: Is the feed water system, condensate feed water system on this plant in their, the D-RAP list, for example? Or do they have the D-

RAP list yet? I don't know. Honestly, I get confused among the different designs, and I didn't have a chance to go back and check it.

MR. CARUSO: Well, yes. I would be -- I can't, I don't know off the top of my head, but I would be surprised if it's not. I mean it's scoped under the maintenance rule by the fact that it causes trips.

MEMBER STETKAR: Okay. So it's going to be controlled under that anyway.

MR. CARUSO: So you know, and you know, reliability assurance program really is basically -- it's implemented with all th e regular operational programs. It's connected with, you know, ISI and IST and maintenance rule and all these things, so --

MEMBER STETKAR: It's just those lists tend to be populated through the DCD and COL stages. So what's on that reliability assura nce program list tends to get handed over.

MR. CARUSO: To me, you know, availability is covered by the fact that feed water, you've got to have feed water to run the plant, and (b), reliability, you know, to me it's the maintenance rule. That's what it's there for. That's the main driver. So I don't know. I mean I felt like feed water's covered.

And we had a lot -- we did have a lot of discussion and arguing about this, you know. Shouldn't it get just, you know, technically, shouldn't it get thr own in, you know, according to that last, third criteria about its significance.

MEMBER STETKAR: Okay, thanks. That's good.

CHAIRMAN CORRADINI: Did you have another question?

MEMBER STETKAR: I don't --

MS. CUBBAGE: I think Samir is here to discuss liquefaction.

MEMBER STETKAR: Yes. I mean, yeah. I mean as long as we're answering those questions. I still have a question for GEH, but not on these topics.

MS. CUBBAGE: So could you maybe restate the question? Samir wasn't here.

MEMBER STETKAR: Yes. It was my understanding, and unfortunately my notes are over in my office on the liquefaction stuff, but it was my understanding that liquefaction must be considered for Seismic Category 1 structures, but not for Seismic Category 2 structures. Is that true?

MR. CHAKRABARTI: No. What we have in DCD 2, Table 2.0 -1, we have addressed liquefaction potential on the Seismic Category 1 structures. It says "none." Under footprint of Seismic Category 1 structures, it's something from the SSE.

MEMBER STETKAR: Right.

MR. CHAKRABARTI: And then it says "Other than Seismic Category 1 structures, see Note 14."

MEMBER STETKAR: Yes.

MR. CHAKRABARTI: And Note 14 says "Localized liquefaction potential and other than Seismic Category 1 structures is addressed by SRP 254 in Table 2.0-2."

MEMBER STETKAR: But that's by the COL applicant, right?

MR. CHAKRABARTI: Well, liquefaction potential is a COL issue.

MEMBER STETKAR: So as far as the DCD is concerned --

MR. CHAKRABARTI: It assumes there is no liquefaction.

MEMBER STETKAR: Pardon?

MR. CHAKRABARTI: It assumes there is no liquefaction.

MEMBER STETKAR: It assumes there is none?

MR. CHAKRABARTI: Yes.

MEMBER STETKAR: But it doesn't require that there is none. Under Seis mic Category 1 buildings, the DCD essentially requires that there's no liquefaction. Is that -- that's the way I interpreted that table.

MR. CHAKRABARTI: Yes. For Seismic Category 1 structures, it assumes there is no liquefaction potential.

MEMBER S TETKAR: And effectively requires that the COL applicant must prove that there is no liquefaction under --

MR. CHAKRABARTI: Category 1 structures.

MEMBER STETKAR: Category 1 structures.

MR. CHAKRABARTI: And for Category 2 structures, it states tha t the liquefaction potential is requirement is stated in Table 2.0-2. There it says "COL applicant to provide site -specific information in accordance with the SRP 254 to address localized liquefaction potential under other than Seismic Category 1 structures."

MEMBER ARMIJO: What does that mean?

MEMBER STETKAR: Well, that says the DCD allows liquefaction under Seismic Category 2 structures; is that correct?

MR. CHAKRABARTI: I don't read it that way. What I read --

MEMBER STETKAR: I read it that way, so that's why I was asking the question.

MR. CHAKRABARTI: The COL applicant will address. It may not be the same standards, but will address the liquefaction potential, localized liquefaction potential other than Seismic Category 1 structures.

MEMBER STETKAR: But I'm now going to try to become an attorney.

CHAIRMAN CORRADINI: Now?

MEMBER STETKAR: Yes. Just because the table in the DCD, if I'm now a COL applicant, to satisfy the DCD, I must prove that I have no liquefaction under Seismic Category 1 structures.

MR. CHAKRABARTI: That is very, very clear, yes.

MEMBER STETKAR: Okay. If I have a Seismic Category 2 structure, for example, my electrical building, I am not required to prove that I have no liquefaction. I am required --

MR. CHAKRABARTI: Address the issue.

MEMBER STETKAR: Address it.

MR. CHAKRABARTI: Yes.

MEMBER STETKAR: Which means I have to -- if I have liquefaction, I guess I need to do some analysis or something, right?

MR. CHAKRABARTI: I have not really read the requirements in SRP 254. It's a different section. But that's how I read it. Yes, it will be addressed.

MEMBER STETKAR: But essentially any -- I'm thinking about seismic events that now fail the electrical building, because it's a Category 2 structure, because of -- it's not going to fail it structurally because it's a Seismic Category 2, except for possible localized liquefaction at the site.

Any Category 1 structures are essentially protected by that through the design certification, the specs and the design certification that says "There will not be any liquefaction under Category 1 structures."

MR. CHAKRABARTI: That is correct.

MEMBER STETKAR: The design certification is essentially silent on liquefaction under any other buildings, in the sense that it says it needs to be addressed, but it doesn't say what you need to do about it.

CHAIRMAN CORRADINI: You guys are going back and forth. I want to clean this up. I'm trying to understand very quickly, it's your interpretation that it's got to be addressed, but by the COL applicant?

MR. CHAKRABARTI: That is correct.

CHAIRMAN CORRADINI: But as you read the same sort of thing, it's unclear to you?

MEMBER STETKAR: No, no, no. I just want to make sure that I understand that it' s a COL applicant responsibility, and that --

CHAIRMAN CORRADINI: Okay.

MEMBER STETKAR: --this is the way it's left at the design certification stage.

CHAIRMAN CORRADINI: But that's how I understand staff's interpretation of it.

MEMBER STETKAR: That is our interpretation.

CHAIRMAN CORRADINI: Okay, okay.

MEMBER STETKAR: Thanks.

MR. CHAKRABARTI: It is a site -specific issues.

CHAIRMAN CORRADINI: And then you had something for these gentlemen.

MEMBER STETKAR: Yes, on something completely different.

CHAIRMAN CORRADINI: Thank you.

MEMBER STETKAR: Heavy load lifts. You can take it away and come back to your heavy load lift people if you want. I had a question on why -- there's a discussion in Chapter 9 on various locations in the plant, where you do an evaluation of heavy load lifts and rocks, and there's a final concluding statement.

One of the notable areas in the plant where I have a really big crane that can lift heavy loads is the turbine building. The turbine building is not mentioned.

It's simply a statement that says "Outside of the containment, the main steam tunnel or the refueling floor, there are no safety -related components of one division train routed over any other portion of safety-related" yadda yadda yadda . That's yadda yadda yadda for the record.

"Therefore, inadvertent load drops cannot cause a release of radioactivity, a criticality accident, the inability to cool fuel within the reactor vessel spent fuel pool, or prevent safe shutdown of the reactor."

I'm concerned about why heavy load drops from the turbine building crane and a boiling water reactor cannot cause a release of radioactivity, if those are the criteria that you need to meet.

CHAIRMAN CORRADINI: We're talking in the refueling building?

MEMBER STETKAR: No, we're talking in the turbine building.

CHAIRMAN CORRADINI: Turbine building, I'm sorry.

MEMBER STETKAR: Has steam lines and turbines and things that have, you know, if you've ever been in a boiling water reactor, shielding is pervasive. So if those are one of the criteria for evaluating the potential consequences from heavy load drops, I don't, you know, any release of radioactivity. The other ones I'll grant you.

MR. DEAVER: Well, the traditional cases are where we're lifting components over fuel.

MEMBER STETKAR: Traditional --

MR. DEAVER: Over the core.

MEMBER STETKAR: Yes.

MR. DEAVER: And so those are readily addressed. But I'm not sure what circumstances you're thinking of in the turbine building that could actually --

CHAIRMAN CORRADINI: Are you asking the question is there going to be a crane movement wire at full power over the turbines themselves? Isn't that the point at hand?

MEMBER STETKAR: That's the point at hand, or steam lines or something that can, you know, go down. I don't know what the actual turbine building configuration is. We managed to drop something at a plant I operated at, that went down through a hatch and actually hit one of the main feed water pumps, for example.

Luckily, it wasn't something that broke the main feed water pump, but it actually tripped the main feed water pump. So I, you know, during plant operation. So indeed people move the turbine building crane for staging for outages and for, you know, just moving equipment around during plant operation. It's not parked like refueling cranes or things like that.

So the basic question is if the concern is any release of radioactivity, why isn't the turbine building crane addressed as a potential source of heavy load drops?

MR. DEAVER: Well, I just don't know of any events that, you know, if we fail a piece of equipment or guillotine break a steam line, then we're into a local scenario where we're going to isolate the containment and so forth.

CHAIRMAN CORRADINI: I think what John is asking, I think you want to take this one away. But what John, I think, is asking is I would have a release of the activity that's in the line.

MEMBER STETKAR: For example, you address things in the main steam tunnel, because apparently there's some, I don't even know what it looks like, some crane in the main steam tunnel. It's at least mentioned in this analysis.

CHAIRMAN CORRADINI: Without maintenance.

MEMBER STETKAR: But yeah. But in the main steam tunnel, a lot of your arguments about if I broke a steam line or a feed line or containment isolation valves, that would limit the amount of release.

MR. DEAVER: A failure in the turbine building, you have a steam leak, you have a release, and why isn't that treated?

MEMBER STETKAR: Why isn't that at least addressed?

CHAIRMAN CORRADINI: Right. That's the point.

MR. MARQUINO: I think we want to get the exact section that you're referring us to?

MEMBER STETKAR: Yes. It is section, it's a long section. I think it's 9.1.5.6, and it's -- that's the -- the title is "Other Overhead Load Handling Systems," and it's the last subsection in that. It's not a numbered. It's just a paragraph.

CHAIRMAN CORRADINI: And they've got to come back to us. Yes?

MR. MARQUINO: Yes.

CHAIRMAN CORRADINI: Okay. Other questions John?

MEMBER STETKAR: Nope.

CHAIRMAN CORRADINI: Other members of the committee?

(No response.)

CHAIRMAN CORRADINI: Hearing none, I declare a break. We'll come back at twenty of. We're still ahead of the game, because we're going to go into Chapter 6 this afternoon, just so we're clear, and staff will be back with their views of Chapter 9.

MEMBER ARMIJO: We're jumping ahead to tomorrow.

CHAIRMAN CORRADINI: We're going to six. We're go ing to control room habitability this afternoon. That's my plan.

(Whereupon, a short recess was taken.)

CHAIRMAN CORRADINI: Are you okay? All right. Let's get started. So Dennis will lead us off on Chapter --

MR. GALVIN: Nine.

CHAIRMAN CORRADINI: Nine.

MR. GALVIN: But we were going answer

Graham's question, but Graham's not here.

CHAIRMAN CORRADINI: Sure.

MR. GALVIN: Well, I guess we can start up with the other stuff.

CHAIRMAN CORRADINI: Hang on one second please. You guys go out side and have your conference call, or not.

MR. GALVIN: We only thought this would take five minutes, and we have some research. But I guess we can go back and just --

MEMBER STETKAR: Yes. Did you find Graham?

CHAIRMAN CORRADINI: Yes. Give us a minute. We don't want to leave out Professor Wallace. He'll feel left out.

(Off mic discussion.)

CHAIRMAN CORRADINI: This is for the fuel racks?

MR. GALVIN: What we're doing today is we're presenting Chapter 9.

CHAIRMAN CORRADINI: Right.

Chapter 9/Staff

MR. GALVIN: Related to Chapter 9, we picked three sets of topics. One is essentially 9 -1, which is FAPCS and the spent fuel pool. The other, the second set of topics -- and the water systems. We've also selected the instrument air system, because there a specific item on that in your letter to the Commission.

And we've also, we'd like to briefly talk about -- there was a question in the August 16th meeting about thermohydraulic analysis. So we're going to do that first, because we h ave assistance here from Research, Christopher Boyd.

CHAIRMAN CORRADINI: Okay.

MR. GALVIN: And it's just -- it should be a short presentation. So Jim Gilmer from DSRA is going to lead this discussion.

CHAIRMAN CORRADINI: And Graham, this is for you.

DR. WALLIS: This is for me?

MR. GILMER: So we're skipping to page 30 now of the --

DR. WALLIS: It's not for Sam?

CHAIRMAN CORRADINI: It's for you.

MR. GILMER: Yes, and actually you talked about it earlier with Mr. Deaver, about the new figure that's in backup Slide No. 31, and that shows the streamlines with the --

DR. WALLIS: I thought you sorted out the fuel pool, so maybe you should do it.

CHAIRMAN CORRADINI: They want to unsort it.

DR. WALLIS: They want to unsort it. They want to confuse it.

MR. GILMER: Since we have Dr. Boyd available, we wanted to --

DR. WALLIS: I saw him back there. I wondered about that.

MR. GALVIN: He's a new member to the team.

DR. WALLIS: I thought we'd already sorted that out. But anyway.

CHAIRMAN CORRADINI: This is for you.

DR. WALLIS: Okay. It's for me, so I'll listen very carefully.

MR. GILMER: Well, one thing I would add to Mr. Deaver's presentation is this figure will be added to the topical report --

DR. WALLIS: That's what they said in their presentation.

MR. GILMER: We just received it this week --

DR. WALLIS: It makes a lot more sense than the other figures.

MR. GILMER: Yes, and we'll provide it to staff and ACRS.

DR. WALLIS: Right, thank you.

MR. GALVIN: So I guess there's no need for me to walk through all the bullets. Do you have any specific questions?

MR. GALVIN: Jim, why don't we go to Slide 31?

MR. GILMER: 31. Okay. Just as a refresher, we didn't talk specifically about the way the COP c ode was modeled. The entire region of the racks was treated as so-called porous medium, with the heat load applied. That's the reason why we saw the streamlines, which appeared to be on the --

DR. WALLIS: The streamlines that were originally presented in the report seemed to go all over the place. I mean they came in and they wandered all over the place many, many times before they went up.

MR. GILMER: Right. I have that as a backup slide, because it didn't make it onto the --

DR. WALLIS: And t his is because of a big vortex in there or something? I was a bit confused why a few streamlines came in and wandered all over the place before they went out.

MR. BOYD: This is Chris Boyd from Research. On that particular issue, I think GE mentioned what happened there, and we spoke with a teleconference with GE. It would appear that what they did is turned off the streamlines in the rack, to make the figure clearer. They said if we turned on the streamlines in all 21 domains.

But by turning them off in the rack and not explaining that, it was a very confusing picture.

DR. WALLIS: But then the ones that didn't go through the rack seemed to go around an awful lot of times before they went out, which was a little strange. Did you have any commen t on that? I mean two or three came in, and then the whole thing is full of blue lines and two or three go out?

MR. BOYD: Right, and you don't know -- those were very low velocity. So what I would say is that this is -- when you're injecting in the bo ttom, you are going to set up just a slow circulation pattern in the pull. These streamlines are something that are just going to follow out through these slow velocity patterns.

DR. WALLIS: So it's the big -- it's the buoyancy that sets up the swirly flow?

MR. BOYD: The buoyancy would help set up that rotation with the steam rising and the -- but even the jets coming in from the bottom would kick the flow into a little bit of a recirculation pattern.

MR. GILMER: Okay. Then we also looked at the pressure drop assumed through the racks. It was based on the operating BWR spec. So that's what we were really talking about. That's a troubling model.

MEMBER KRESS: How did you arrive at the friction factor for the median, the appropriate friction factor?

MR. GILMER: That was based on the operating BWR.

MEMBER KRESS: Oh, you have data.

MR. GILMER: You have data for that.

DR. WALLIS: Do you have a figure then?

MEMBER KRESS: And it's actually conservative for the ESBWR because it was based on the -- numbers.

MEMBER ARMIJO: Rather than the --

MEMBER KRESS: Rather than the 10 foot.

DR. WALLIS: It looks like a very straightforward location of CFX.

MR. GILMER: That's right. We did not verify the calculation in a formal way, but we've done very similar calculations with data in the cask areas, and we found that these codes can do a very good job modeling fuel and predicting temperature rise through the fuel, with this porous medium approach.

DR. WALLIS: It's interesting. If you look at the figure which is supplied this time, the streamlines seem to come out of the rack and then they all go into the wall, which looks a little peculiar.

Maybe that's because only selected streamlines are shown, or it looks as if you've got all the streamlines going through the rack, and then they go right over to the wall. It's peculiar. You think they go straight up as a plume. That must be because of the strong vorticity. The strong vortex in there pushes them to the wall.

MEMBER STETKAR : That must be what's happening.

DR. WALLIS: Do you see what I mean Chris?

MR. BOYD: Yeah, I've seen things like this before. There could be, you know, some entrainment of the flow behind the -- between the plume and the wall, and then there's real ly no flow replacing that entrainment.

So that kind of tends to move the plume over towards the wall. I don't think it's a real -- I get the impression it's not a really strong vortex. I get the impression nothing's really strong going on --

DR. WA LLIS: But something really pushes that flow over to the wall, isn't it?

MR. BOYD: It does appear that there is flow across the tops of the racks that would go on there. We'd have to look at more of their velocity in profiles.

MR. GALVIN: Jerry, it looks like you just have one domain turned on, as far as the streamline, right?

MEMBER KRESS: Yes. This is probably just through one rack.

MR. GALVIN: I think it's just through one rack. That's what's driving that.

MEMBER KRESS: If you tried to show all of them, you'd have another mess.

MR. GALVIN: Right.

MEMBER KRESS: Yes. So that's --

MR. DEAVER: This is Jerry Deaver with GEH. This is strictly one rack, and so it's probably showing the flow associated with one rack.

CHAIRMAN CORRADINI: But I would guess it's also the limiting rack, given the temperatures?

MR. DEAVER: It's one of the limiting ones. It's got a full supply of fresh fuel that's come out of the reactor.

MEMBER ARMIJO: How many assemblies in that rack? How many fuel assemblies?

MR. DEAVER: There's 180.

MEMBER ARMIJO: In that.

MR. DEAVER: Right.

DR. WALLIS: By one rack, you mean one of these boxes shown here?

MR. DEAVER: Yes.

DR. WALLIS: So all the flow through that box goes over to the wall pr etty well, rises up the wall?

MEMBER KRESS: That's because there's flow coming out of the other racks to keep it open there, I think.

DR. WALLIS: So the flow from the other racks pushes it over there?

MEMBER KRESS: Yeah, I think so.

MEMBER ARMIJO: No, there's nothing coming out of the other racks.

DR. WALLIS: There's nothing coming out of the other racks.

MEMBER ARMIJO: Just because they just didn't show it.

CHAIRMAN CORRADINI: They're not just showing it. They're just simply turning on -- they're simply turning on one grouping of assemblies, to show you what's going on in one grouping.

DR. WALLIS: Right.

MEMBER KRESS: Now I'm intrigued by this use of porous medium. Do you have a different friction factor that's vertical compare d to horizontal, or is it the same friction factor the whole way?

MR. GILMER: My recollection is it was only the upflow. I could be wrong on that.

CHAIRMAN CORRADINI: No, but I think the -- well, they should answer the question. You understand?

MR. BOYD: I think GEH would have to answer this. I forget the details, but typically what you either do is you put in infinitely thin walls, or you put in loss coefficients in the lateral directions that are maybe a factor of 1,000 or 10,000 higher, to keep the flow aligned. I'm not sure which approach GEH used here.

DR. WALLIS: Yes. I think that we've got one figure. I tend to believe CFX and all that. As soon as you have one figure like this, then you begin to raise questions, and you've got no answers, because you've only got one figure.

So it would be good in the future to have several figures, that sort of anticipate questions about what's going on. So there's just one figure like that. But I'm prepared to accept it, since it's a straightforward standard calculation.

MEMBER ABDEL -KHALIK: Let me ask the question about the porous medium formulation. Is this an isotropic porous medium formulation?

MEMBER KRESS: Yes, that was my question.

MR. BOYD: No. They're not isotropic in the code --

(Simultaneous discussion.)

CHAIRMAN CORRADINI: Well, let's find out from GE.

MR. BOYD: Yeah. We would need to ask GEH how they applied it.

MR. DEAVER: One of our people on the phone would have to answer that.

CHAIRMAN CORRADINI: Okay.

MR. DEAVER: Dave Davenport, do you have the answer to that?

MR. DAVENPORT: I'm looking, but not immediately.

MR. DEAVER: Okay. You can get back to us with that. Thank you.

CHAIRMAN CORRADINI: So now that's one of three topics, right?

MR. GALVIN: Okay. So we are done with the, I guess, the conclusions? We had the same conclusions about the natural circulation. We were just trying to explain it, why we thought the model was reasonable. So we'll go back to our first presentation here.

So we're going to start with a discussion of the potential storage and fuel and auxiliary full COIN systems, and our presenter is Larry Wheeler.

MR. WHEELER: Could I have the next slide? Regulatory guidance is found in the SRP 9.1.2, 9.1.3, which includes the relevant requirements of the GDCs, which include 245.61 and .63.

Next slide. In this guidance, regulatory treatment of non-safety systems is found in SECY 94-84 and 95 -132, and the summary of those documents is RTNSS systems, to be highly reliable, within ES design qualities and reliability.

Next slide. The staff's review summary, the key open items. Rackability (ph), buffer pool on the spent fuel pool, decay heat and pool draining down. A follow-up to the RAIs. The staff previously f ound that the following was acceptable:

The potential drain pass that can drain the buffer pool or the spent fuel volume. The spent fuel pool transfer gates and buffer pools are safety - related, Seismic Category 1. Anti-siphon holes on submerged piping are no lower than 9.2 meters above the top of stored fuel assemblies.

Maximum bounding of the spent fuel pool heat loads. This was previously discussed with GE, excuse me, GEH. Bounding water make-up for the spent fuel pool is 200 gallons per minute.

Next slide. Pool level, the -- measures, collapsed water level. No false readings due to seeing vapor above the actual water level. The high level are key points to this summary. The buffer pool will remain --

DR. WALLIS: It's simply a pressure drop measurement, isn't it? The pool level measurement is simply pressure gauges, pressure sensors?

MR. WHEELER: I believe that's true.

DR. WALLIS: Right.

MR. WHEELER: The key points of the staff's summary is the buffer pool will remain 7.3 meters above the stored fuel assemblies during the loss of FAPCS for the 72 hours. The stored fuel in the spent fuel remains covered during the loss of FAPCS for 72 hours.

MEMBER ABDEL-KHALIK: What is the area footprint of the spent fuel pool roughly?

MR. WHEELER: I do not know that answer.

Maybe GE could answer that.

DR. WALLIS: So it's -- sorry.

MR. DEAVER: Go ahead. Dave might know that.

MR. GELS: We can look it up. It will just take one minute.

CHAIRMAN CORRADINI: I estimate about 100 square meters.

MR. DEAVER: Okay.

MEMBER ARMIJO: Is that 7.3 meters a staff calculation, or is that --

MR. WHEELER: It's a GE calculation.

MEMBER ARMIJO: And did you verify it by some independent calculation?

MR. WHEELER: There is an audit t eam from the NRC that did look at the methodology into those calculations.

DR. WALLIS: It's fallen about ten meters, according to GEH.

MEMBER ARMIJO: Yes. I'm a little confused. In the GEH presentation, they use minimum coverage height of 10.26 meters.

MR. WHEELER: What I wanted to do here is say that this is what the staff previously approved, and my next slide will go ahead and explain to you that there's been changes.

DR. WALLIS: It's changed. Okay. That explains it.

MR. WHEELER: N ext slide. So we're on number six. August 16th of this year, ACRS Subcommittee noted the issues related to the NEDO 33373, basis for the heat loads using the spent fuel thermohydraulics. GEH calculated, calculations for the decay heat were determined to be non-conservative. The spent fuel heat loads for the fuel core offload and discharge fuel decay used the 36th day into the fuel cycle.

The updated spent fuel heat loads for the fuel core offload and discharge fuel decay used the end of fuel cycle, an d was determined to be more conservative. Presently, the staff is looking at the new proposed tech spec for the spent fuel pool water level. So that effort is ongoing.

We got that information earlier this week, and the staff has not had enough time to draw a conclusion to the new numbers.

DR. WALLIS: Oh.

MR. GELS: This is John Gels from GEH. The dimensions of the spent fuel pool are 12.86 meters by 14.86 meters, which comes to about 191.2 square meters.

DR. WALLIS: Thank you.

CHAIRMAN CORRAD INI: A reasonably -sized house.

DR. WALLIS: But GE did present some numbers in their presentation, GEH, and they -- I thought that they said that the pool level dropped by ten meters?

MR. DEAVER: Yes, that's --

DR. WALLIS: And you still need ten meters above this. Don't they have about 20 meters when they start? That's an awful lot.

MR. WHEELER: Well, we looked at the audit and concluded that the boil-off was around 9.2 meters. With the new heat load, the new proposed number, it is closer to ten meters, and that's on their evaluation.

MR. DEAVER: Jerry Deaver with GEH. We used the same methodology. So the resulting number that we came up with was 10.35, as far as the total drop in water level now.

DR. WALLIS: And that meets your mi nimum coverage requirement, but not by very much?

MR. DEAVER: Yes, that's correct.

MR. GALVIN: My understanding, the drop is

10.26 meters and your normal water level would be 10.36 meters. So you have about 10 centimeters or four inches above that, above the -- level.

MR. DEAVER: That's the distance above the handle so, you know, if you were really considering where it would become critical, it would be down to the active fuel level, which is .55 meters is where it would really reach the fuel, the active fuel.

DR. WALLIS: So you're very close to the active fuel?

MR. DEAVER: No. We're .55 meters away under these theoretical --

DR. WALLIS: That's close compared with where you started from.

MR. WHEELER: Okay. On Slide 7, I want to talk about FAPCS and RTNSS. The staff found the following acceptable for FAPCS, for its RTNSS-B function. This is for long -term cooling. Fire protection system interfaces, which allows the isolation and condenser passive containment cooling system pools to b e filled with water, to extend cooling period from 72 hours out to seven days.

The piping interface is safety-related, ASME Class 3, and in Seismic Category 1. And as GE has said earlier, FAPCS does have availability controls in

3.7-2 and 3.7-3.

MEMBER ARMIJO: Could we go back to that prior discussion? I just want to make sure I understand. In the boil -off calculation, at what level did you start the calculation? Maybe it's for GEH. At the minimum pool level, and then you started the boil-off calculation, or at some other pool level? I mean it's not always constant.

MR. WHEELER: I think GE needs to answer that question. From what I remember looking at the calculation, they determined what the boil -off volume would be, and then from there, th ey backed up the LCL to maintain that during that 72 hour boil -off period, that the fuel assembly or the top of the bell handle would still have water to that point.

MEMBER ARMIJO: Yes. But there's a range at which a pool level, and I don't remember what it is. If you start the boil -off at one level, you have -- you can have a different answer.

MR. WHEELER: From what I remember, there wasn't more than a couple of feet between normal operating range and the new number, the 7.2 number. Of course now that's been raised.

MEMBER ARMIJO: Ask Jerry.

MR. DEAVER: Yes. This is Jerry Deaver with

GEH. We assumed the water level at the top, at the weir spillover point, which is 14.35 meters.

MEMBER ARMIJO: Well, that's your minimum, isn't it? Is t hat your minimum water level in the pool?

MR. DEAVER: Well, that should be your minimum, you know, considering that you have a flow over the wet weir in operation.

MEMBER ARMIJO: Yes, okay.

DR. WALLIS: So it's not much above that minimum?

MR. DEAVER: You can't go above --

DR. WALLIS: Can't go much above that?

MR. DEAVER: No.

DR. WALLIS: Because it flows over?

MR. DEAVER: Right.

DR. WALLIS: This level they're talking about is always a collapsed level? It's always a collapsed level they're talking about, when it was at boiling?

MR. DEAVER: Yes. It's the fundamental -- during boil-off, the level is the -- with the water evaporated.

DR. WALLIS: The collapsed level, because you've got voids in there.

MR. DEAVER: Yes, yes.

DR. WALLIS: So it's actually higher. The real level is higher. The surface of the water is higher than you say here, because of the bubbles in it?

MEMBER ABDEL -KHALIK: This is a simple inventory calculation.

DR. WALLIS: It's a simple inventory calculation.

(Simultaneous discussion.)

MEMBER ABDEL -KHALIK: --for the vaporization. That's all there is to it.

MR. DEAVER: Yes. It's not that high tech.

MEMBER ARMIJO: So you're actually evaporating 4-1/2 million pounds of water?

DR. WALLIS: That's a huge amount, yes.

MR. GALVIN: You would be correct. I mean if there's voids in the water, then actually the apparent water level would be higher, right?

MR. DEAVER: That's a true statement, yes.

DR. WALLIS: Well, we asked about where it went. Is the staff concerned about where all this water goes?

MR. WHEELER: I don't have an answer for your question. That's something we'll have to take back.

CHAIRMAN CORRADINI: This is a design basis calculation for the purposes of what? I'm get ting nervous about taking a conservative calculation and taking it somewhere it's not meant to go.

MR. WHEELER: I mean take your fuel plus the complete core offload.

MEMBER ARMIJO: For 72 hours.

MR. WHEELER: And then we add the 72 hour loss of FAPCS.

MS. CUBBAGE: Is there a safety concern with the steam?

DR. WALLIS: Well, you've got all this water going somewhere. Does it affect some other safety operation in some way?

MS. CUBBAGE: Well, I mean what's going on in that building is nothing, as far as --

DR. WALLIS: There's nothing in that building--

MS. CUBBAGE: You're not crediting any active make-up or cooling.

DR. WALLIS: There's nothing else in that building you're crediting?

MS. CUBBAGE: So the safety case is.

DR. WALLIS: That's a good answer. But

still, even if it fills with water, it can't do any harm?

MS. CUBBAGE: I'm just talking off the top of my head, but it would seem to me if we've already said that nothing active is working and we're in this worse case design basis situation where we're just steaming, I'm not sure what impact it would have.

MR. GALVIN: GEH told us there was no safety-related equipment in that building, so -- and they've also said that there's a -- right now, since Revision 7, they've added a, they've made events safety-related. The SRP guidance says if you allow your pools to boil, you need to have a place for the steam to go.

DR. WALLIS: So it doesn't affect pumps or pumps for this spent fuel pool, which are in the building?

MR. WHEELER: Well, there are. That's why you have the boiling --

DR. WALLIS: Would you start them up after 72 hours, or would you --? Do you bring in some other water up to 72 hours? What do you do?

MR. GALVIN: The fire pumps come on, the fire pumps, yes, in a separate building.

DR. WALLIS: So you don't care if those

pumps work?

MR. GALVIN: Yes.

MEMBER STETKAR: Where, and this is a question of GEH or of the staff. Where are the -- those are manual valves that you line up the fire protection syst em for make -up, is that correct? They're not motor operated or otherwise operated?

MR. WHEELER: I've got the simplified drawing. It appears that on their drawing that they are manual valve.

MEMBER STETKAR: Yes, I believe that's the case. Does the simplified drawing that I've lost show where those valves are located? Are they in the fuel building or are they outside of the fuel building?

MR. WHEELER: This drawing says that they are in the yard area.

MEMBER STETKAR: Okay, good. Thanks. That's part of the answer. Even if you flood out FAPCS, they take credit for make-up from the fire water system. As long as the valves are accessible, they can get the water in there. That's through that primary fire protection header thing, that's written as B.

DR. WALLIS: If you drive off all the steam and the outside temperature is below zero, you will get an enormous, enormous stalag types of ice forming around this pool. I don't know if that affects the operation of --

CHAIRMAN CORRADINI: So what are you -- I'm sorry. You're postulating a design basis action in the middle of dead of winter?

DR. WALLIS: Yes. Why not? It could happen at any time.

CHAIRMAN CORRADINI: We do a worse scenario.

MR. WHEELER: Now keep in mind, the FAPCS pumps are diesel-backed, so there's that reliability. That's part of their design.

DR. WALLIS: If you put a lot of steam out, and outside temperature is very cold, you'll make an awful lot of ice here, ice somewhere out there. This is of no concern on accessibility of the valves?

MEMBER ARMIJO: Not to me.

CHAIRMAN CORRADINI: Is that a question of staff?

DR. WALLIS: I'm just thinking about what might happen, if I had all this steam issuing out in the middle of winter.

VOICE: It would turn into snow.

DR. WALLIS: And wouldn't it, would it have some effect on accessibility? People have to go through an icy surface and an open valve's covered with ice.

(Simultaneous discussion.)

DR. WALLIS: If the fire pumps go on.

MR. MARQUINO: This is W ayne Marquino, GE. We do consider in our detailed design operator access to these areas, especially where there is RTNSS equipment. So we'll design platforms, steps, ladders to provide access.

The question about ice forming, that's a structural conc ern of the building and the roof system. It doesn't apply only to steam coming out of the building, but it would apply under winter weather conditions as well.

MR. GALVIN: Can we move on to the next topic?

MR. WHEELER: So concluding on Slide 7, we have the RTNSS -B function. Staff found the following acceptable for FAPCS and its RTNSS -C function. This is for the pressure coolant injection node. This requires a FAPCS pump to take a section from the suppression pool and pump it into the RPV by the reactor water clean -up and shutdown cooling loop, Alpha, and the feed water loop, Bravo.

Once again, FAPCS does have availability controls. This piping system is non-safety. However, it is Seismic CAT-2. All RTNSS structure, system and components are within the scope of the D-RAP.

Next slide. Moving on to the next FAPCS RTNSS-C function is the suppression pool cooling node. It requires water to be drawn from the suppression pool, cooled by FAPCS and returned to the suppression pool. Once again, avai lability controls apply. Piping is non-safety related. It is Seismic CAT -1 or 2.

Physically separated, 100 percent cooling trays, each with one FACPS pump and heat exchanger. Procedures are to ensure avoidance of water hammer and gas binding. That is a COL item, 13.54 -Alpha. Provisions are also provided to protect FAPCS components from fire, missile-generating events, internal flooding, seismic event, and that would be the SSE.

Once again, all RTNSS structures, systems and components are within t he scope of a D -RAP. That's for the suppression pool coolant routing.

DR. WALLIS: Did you analyze that the procedures to avoid water hammer and gas binding are adequate?

MR. WHEELER: Those are COL items.

DR. WALLIS: Oh, they're COL items, so we don't' consider them, at this point?

MR. WHEELER: At this point, that's correct. Slide 10. The staff found the following acceptable for FAPCS, for its RTNSS -Charlie function, that they do in fact are diesel -backed by the standby diesels, and that's availability controls 3.81 and 3.82.

Moving over to operating experiences, the staff found the following acceptable related to two RAIs: Gas accumulation that could enter the system and results in components or system damage was adequately addressed. The gas accumulation is possible from the high pressure interface between the reactor water clean-up and the shutdown cooling.

Interface through check valves and the motor-operated valves. The staff concludes that there is a pressure relief valve that is located between the check valve and the MOVs. In addition, FAPCS is not immediately placed into service for a low pressure injection, or alternate shutdown cooling nodes.

Therefore, there's adequate time for proper venting if there was a gas bubble in the system.

Moving on to the second item, the refueling cavity bellows. Postulated failures were adequately addressed. The bellows is a permanently installed

CAT-1 component, stainless steel component designed for a life of 60 years. This bellows includes a secondary seal, which is monitored for leakage. The drain down event for the refueling cavity is not likely to occur.

Also level indications and alarms are provided to alert operators to any leakage out of the cavity that would develop.

Next sl ide. Staff review concludes for FAPCS, for this RTNSS -Bravo and Charlie functions are highly reliable, meets the single failure criteria, and are subject to enhanced design, quality, reliability and availability provisions. Once again, the staff is still looking at the spent fuel pool heat loads, and that's considered an open item.

DR. WALLIS: Why are you still looking at it, when it seems such a simple calculation?

MR. WHEELER: Well, it just came in on Monday, and we didn't want to rush through thi s, just to say we had a closed item.

DR. WALLIS: Okay, because it does look like a pretty simple thing. It's just energy and an energy out for the thing.

MEMBER ABDEL -KHALIK: He's calculating the heat flow.

MR. WHEELER: Right.

DR. WALLIS: The heat flow.

MR. GALVIN: Well, I mean since there was confusion with it the first time, and then of course there's a ten year heat load and a 20 year heat load, so we want to make sure we -- at this rate, and there's also a tech spec associated with it.

DR. WALLIS: That's fine, that's fine.

MR. WHEELER: Discussions and questions on FAPCS?

MR. GALVIN: We can proceed, and you can ask them all at the end. Okay.

CHAIRMAN CORRADINI: Keep on going.

MR. WHEELER: Next presentation is related to the service water system, component cooling system and the nuclear island chilled water system. Regulatory guidance is found in SRP 9.21, 9.22, which includes the relative requirements of GDC 245, 44, 45 and 46.

Next slide. Once again, we already t alked about RTNSS on the FAPCS presentation.

Next slide. RTNSS sea water system focus was part of the March 19th and 20th, 2009 audit. That was to resolve RAI 9-224. The staff found the following acceptable: adequate design margins between the cool ing tower capacity and bounding heat loads for service water between the component cooling heat exchanger capacity, maximum heat loads, and between the nuclear island chilled water system and the maximum heat loads.

Single failure criteria has been properly addressed due to the redundancy of the design. Components have a diesel-backed availability. Components failure positions on a loss of preferred power.

Next slide. Service water pumps have sufficient available net positive suction head in the pum p sections, located for the lowest possible water levels of the heat sink. The component cooling and the chilled water pumps have sufficient available net positive suction head at the pump suction's lowest possible water level in those surge tanks.

Next slide. Service water component cooling, chilled water system, RTNSS components are in fact in maintenance rule, which require performance monitoring of the ISSEs. These three system RTNSS components have adequate main control on this rotation for system monitoring, and during loss of preferred power, these three systems, if their associated pumps fail, can be powered by the two non -safety related on -site standby diesel generators.

Next slide. Procedures to ensure avoidance of water hammer and gas binding. We talked about that earlier. That's a COL item. There is redundancy in the service water component cooling and the nuclear island chilled water trains. Once again, RTNSS components are within the scope of D-RAP.

Staff's conclusion for the servi ce water component cooling system, nuclear island chilled water system: For the RTNSS functions, highly reliable, meets single failure criteria, are subject to enhanced design quality and reliability, and they meet applicable SRP 9.21 and 9.22. Any questions?

(No response.)

MR. GALVIN: We will proceed. David Shum is going to speak about the staff's review of the instrument air system, and cover it. It's described in Section 9.36 of the SER.

MR. SHUM: Okay. The instrument -- the system function is to provide air, compressor air, try to compress the air to all the safety -- I mean the air -operated equipments, and the instrumental control outside the containment, and to provide air to the high pressure nitrogen supply system inside of containment during the refueling outage operations.

The system is non -safety related, and has no -- and not needed for safety shutdown. It is RTNSS -- not RTNSS. The system was designed to meet the ANSI Standard 7.0.01, the quality standard for ISA, instrumentation air.

DR. WALLIS: The air is drawing after it's compressed, is it?

MR. SHUM: Yes.

DR. WALLIS: Okay.

MR. SHUM: And the system has two identical 100 percent filtration and dryer systems, and has a cross -tie between the distribution headers of th e service system and instrumentation systems. Use it to bypass the instrumentation air system, in the event that both of them, instrumentation air and dryer trains fail.

MEMBER STETKAR: I don't have the drawing in front of me here, and I'm having problems finding it quickly. My recollection is that that bypass line not only bypasses the dryers, but it also bypasses the filters. Is that correct?

MR. SHUM: Right. It comes from two headers. It come out from the service air system discharge header, d irectly to the discharge headers of the instrumentation heads.

MEMBER STETKAR: That's what my recollection was, and so that means if for some reason I have problems with both the air dryers, or one is out for maintenance and I have a problem with the op erating air dryer, and I need to cross-tie the system, in a sense, I'm putting direct service air into my instrument air header.

I'm effectively bypassing the dryer and that really small three millimeter, micron, or three whatever it was, -- that they talked about.

MR. SHUM: You are right. You are right. If you assume both of them are not in operations.

MEMBER STETKAR: Yes. Do you have any idea of the reliability of air dryer?

MR. SHUM: There are no moving parts.

MEMBER STETKAR: Oh yeah, there are.

MR. SHUM: In the air dryers.

MEMBER STETKAR: Typically, you have two towers that blow down. You have a lot of moving parts there. Most plants they're out of service a reasonable fraction of the time. When I say "reasonable," I don't mean --

MR. SHUM: That's why you have two trains, 100 percent trains for.

MEMBER STETKAR: Some plants have three, and they have to occasionally bypass them.

MR. SHUM: I understand.

MEMBER STETKAR: So the question then, and I think the reason for o ur original concern was given the design of the system, with the bypass capability, where you bypass not only the air dryers, which is a good thing, because they are not necessarily highly reliable pieces of equipment, but also bypass the filters, what's the chance of introducing now contaminants from the service air system into the instrument air lines, which could then migrate --

MR. SHUM: To answer your question, you have two trains, 100 percent, okay? If both fail, they only fail during the refuelin g outage times.

MEMBER STETKAR: I'm not necessarily --

MR. SHUM: You only use it for that.

MEMBER STETKAR: Inside the containment valves.

MR. SHUM: Outside the containment, this system, the instrumentation air system, is not going to operate an y air operated equipment in the safety system.

MEMBER STETKAR: Okay. Let me make sure I understand that. Maybe I might need some help from GE. Does instrument air supply outside the containment? Does instrument air supply air-operated containment is olation valves that are located outside the containment?

MR. ARCARO: This is Mike Arcaro, GEH. I think Chapter 6 has a list of containment isolations. I believe there is instrument air.

MEMBER STETKAR: Yes. I think that's the case.

MR. BEARD: A nd Alan Beard of GEH again. I'd also say that the CRD pilot valves.

MEMBER STETKAR: Oh, okay. I didn't even think of that.

MR. BEARD: So the pilot valves will get instrument air --

MEMBER STETKAR: I was just thinking. The problem, of course, h as been historically that contaminants in instrument air piping, in particular oil and other contaminants, can migrate through the air piping and essentially collect at the ends of the distribution headers, which are typically solenoids for air operated valves.

And the problem is that the air, the valves are designed to fail closed on loss of air pressure, provided that the spool piece in the solenoid actually can physically move when the solenoid is de-energized.

If the spool piece is varnished in place, because you now have a normally energized solenoid that actually has heat associated with it, and a long-term accumulation of small amounts of oil perhaps. Now are all of your air compressors oil free?

MR. ARCARO: This is Mike Arcaro, GEH. That's correct. They are oil-free.

MEMBER STETKAR: That's good news. So then it would be any entrained moist, you know, any contaminants that might be entrained in moisture, for example, from the intake that got through the compressors. But that's less of a concern.

MR. ARCARO: Now one of the things we committed to Reg Guide 168, 168 has you take air samples at the full loads --

MEMBER STETKAR: You're going to do that down at the loads?

MR. ARCARO: That's correct.

MEMBER STETKAR: Okay, good. Thank you.

DR. WALLIS: The compressors presumably have a facility for removing moisture. As you compress air, you tend to condense. So they presumably remove moisture --

MEMBER STETKAR: They usually do have moisture separators, but they're not --

DR. WALLIS: --all together.

MEMBER STETKAR: But they're not as good as these air dryers. That's why they have them.

DR. WALLIS: Because there's a notorious problem with compressed air getting moisture.

MR. SHUM: But the compressed air, later on we will address that. The air coming out of the compressor of the service air is supposed to be less than 10 microns. It's a lot less than the ANSI standard will allow. ANSI standard define, you know, specify 40 microns, I mean 40 microns.

MEMBER STETKAR: Just for particulate contamination?

MR. SHUM: Uh-huh, so and the system continues monitors for moisture contents.

MEMBER STETKAR: Depends where that monitor is. If the monitor is right after the air dryer, it's not going to help you when you bypass the dryers.

MR. SHUM: Yes, sure. So and instrumentation air is not supposed to go to any safety-related systems.

MEMBER STETKAR: Well, the point is that it does go to safety-related systems. It does not provide a design basis, safety-related function in the sense of the fact that pressure must be supplied to operate that equipment. It does connect the safety-related pieces of equipment. Those are containment isolation valves.

MR. SHUM: The containment isolation

valves, that's a fail safe.

MEMBER STETKAR: You know, I'll tell the story from a plant that I used to operate at, that had a notoriously bad instrument air system, that supplied air -operated containment isolation valves.

They failed safe on loss of air pressure. When we did our quarterly containment isolation test, we always had valves that did not work because the solenoid spool pieces that were de-energized, that had to move to vent the air pressure from the valve, did not move. They were varnished in place.

So altho ugh air pressure, air pressure is not removed from this thing until a spool piece moves to vent the pressure off the top of the valve operator. If that spool piece doesn't move because the spool piece was varnished in place, because it was cooked, you kno w, you took some oil and cooked it there, you could de-energize that valve all you wanted to, and the valve would stay open. The isolation valve would stay open. That's the basic concern.

MS. CUBBAGE: May I interject please? Is there a recommendation the Committee would like to make on this?

MEMBER STETKAR: No, there isn't. Actually, he's defending things too quickly.

MS. CUBBAGE: Okay.

MEMBER STETKAR: But the fact that you don't have oil in your air compressors is the key.

MS. CUBBAGE: Okay.

MEMBER STETKAR: And the fact they've committed to monitoring the quality of the air at the, you know, the loads, the end of the distribution lines. Those two in parallel satisfy me that this is okay.

MS. CUBBAGE: All right. Let's roll.

MR. GALVIN: Do you want to hear the rest of our presentation on that or not?

MEMBER STETKAR: No.

MR. GALVIN: Okay. So I guess we're done with it.

MEMBER STETKAR: Amy, my only point was you shouldn't say that the air system does not interface with safety-related equipment, because it absolutely does.

MS. CUBBAGE: Okay. Point taken. Thank you.

MEMBER STETKAR: And that is not as a -- that is not an appropriate defense for the concern.

MR. GALVIN: Okay. So we were going to skip the rest of thi s. So Amy, I guess now you can ask questions. That's the end of our presentation.

CHAIRMAN CORRADINI: There were questions being asked.

MR. SHUM: Am I done?

(Laughter.)

MR. GALVIN: I don't know if they're done. I don't know if the rest of th e members want to ask you questions.

CHAIRMAN CORRADINI: Other questions for the staff?

(No response.)

CHAIRMAN CORRADINI: Thank you.

MR. SHUM: Thank you.

MEMBER ARMIJO: Going to do Chapter 6.

MR. GALVIN: We're going to do Chapter 6 --

CHAIRMAN CORRADINI: That is our plan. We want to do Chapter 6.

MS. CUBBAGE: Okay, GE.

CHAIRMAN CORRADINI: GE is up.

(Off mic discussions.)

Chapter 6/GEH

MR. MARQUINO: Okay, so is John ion the line? John Gels, are you on the phone?

MR. GELS: Yes, I'm here.

MR. MARQUINO: Okay. So we have more information on our FAPCS questions from earlier today, and ability to drain via one single failure from one pool to another pool. There was a comment made by the folks in Wilmington that there wa s a check valve. Do the folks in Wilmington want to go further than that and tell us more?

MR. GELS: Right. The check valve I was referring to is not in fact a check valve, if I understand your question, and you're referring, I believe, to the point i mmediately exiting the surge tank?

MEMBER STETKAR: Yes. On the one -line drawing, the only one that I have is the one-line drawing, this single -- there's a normal, you know, a manual isolation valve shown on that line, but I didn't see any check valves.

MR. GELS: That's right. There is not

a check valve on that line, and if I understand your concern, it was drainage from the suppression pool through the suppression pool suction line, and then back up the surge tank suction line.

MEMBER STETKAR: Y eah, that's correct, and the concern, now that there aren't any check valves, just to make sure you have it clear, the concern is kind of twofold. Number one is how quickly and how far can I drain either the suppression pool or the GDCS pool, because I could be aligned to -- in principle, I could be aligned to either one of them.

MR. GELS: Uh-huh.

MEMBER STETKAR: And that's just basically line size and hydraulics, and I don't know where the suction lines connect to those particular pools, whether they're at the bottom or whether they have, you know, some other configuration.

So that's one question, is how quickly can I drain and how far can I drain either of those pools.

The second question is if I do have this alignment, where I'm now in a water transfer mode from one of those pools into essentially the pull pools, you know, it will go through the skimmer surge tank and back through the skimmer lines and overflow the fuel pools, where does that water go, and how much of it is there?

Can I flood all of the equipment in the basement of the turbine building? Not turbine building, fuel building, and in particular because the FAPCS pumps and valves and everything is down in the basement.

So it's kind of a twofold. It's drainage of tanks that I'd like to have water in, and a potential incapacitation of equipment that it's not safety -related, but it's at least identified as RTNSS functions.

MR. GELS: Okay. I can't immediately answer the question about how fast they do drain. The GDCS po ol is equipped with anti-siphon holes that would prevent drainage below the minimum level. The suppression pool has monitoring on it that would signal when low level has been reached.

But I think the more overriding feature is that there are interlocks built into the FAPCS system, such that valve alignments that could result in water flowing from the suppression pool to either the surge tank or the fuel pools would be prohibited by the logic.

MEMBER STETKAR: And that's in the suction valves?

MR. GE LS: That's right. There is a valve bridge on the suction side of the pumps, and right.

MEMBER STETKAR: Yes.

MR. GELS: And so those valves can be configured in certain ways that allow both trains to operate. But there are also certain specific configurations that are prohibited, and one of those configurations would be one that would allow drainage from the suppression pool through the surge pipe.

MEMBER STETKAR: Okay. So you're basically saying that we're protected against this by the valve interlocks?

MR. GELS: That's correct.

MEMBER STETKAR: Okay. Thank you. I'd still be interested in the original questions, only because we have operating experience where people indeed have drained large pools into places that they ought not to be in similar configurations that have valve interlocks that are overridden for one reason or another.

But thanks for the information about the interlocks. That certainly helps.

MR. BEARD: This is Alan Beard, and John, jump in if I get this wrong. But I t hink the key points he made was on the suppression pool, we are monitoring level and if it drops below a certain point, the isolation valves will close and terminate that drain down. Correct John?

MR. GELS: I would have to look that up.

MR. BEARD: W ell, we'll check on that, and then the point on the GDCS pools is we are sucking off the top of the water. So it's a weir type of situation.

MEMBER STETKAR: Yeah, I see that. I see that on the --

MR. BEARD: It's not a suction from way low down in the pool. There's only so much water off the top for the drain down.

MEMBER STETKAR: Yes. So the bigger concern would indeed be the suppression, how far can you drain it down before you get below level.

MR. BEARD: And I will take the action tonight to go and check on that. But I believe it's down to seven meters is where we would have the isolation point.

MEMBER STETKAR: I have no idea what that volume of water --

MR. BEARD: From 7 to 7.1 meters.

CHAIRMAN CORRADINI: You'd have the isolation point because of the valve logic, or you have the isolation point because of what? I'm sorry.

MR. BEARD: To terminate a potential drain down of the suppression pool.

MEMBER STETKAR: I mean on the suppression pool, you want to keep water --

MR. BEARD: And as far as your --

CHAIRMAN CORRADINI: I understand that, but I don't understand --

MR. BEARD: Your other thought. The pumps for the FAPCS system are located in water-tight rooms. So although the water would accumulate in the -- area of the basement of the spent fuel pool or the spent fuel building, it would not get into the room where those pumps are.

MEMBER STETKAR: Okay, good, good. Thank you.

CHAIRMAN CORRADINI: Thank you very much. Okay. On to Chapter 6.

MR. MARQUINO: With control room habitability and EO.

MR. ARCARO: All right. Next slide. Okay. What we wanted to talk about today was control room habitability area tech specs, talk about the heat sink temperatures.

Also, the passive heat sink validation, how we validate the functioning of the heat sink, and go through the bounding ESBWR standard plant site parameters, specifically the temperatures associated with Table 2.01 for site parameters on ambient temperatures. I'll also talk about the reactor building temperature monitoring requirements.

MR. MARQUINO: And these are mostly follow-up items from previous ACRS comments. We've got about three slides on each of the four topics that tell our story. So to get to the bottom line, you have to wait for the third slide. But we'll go quick.

MR. ARCARO: Okay. Passive heat sink

issues. The control room habitability area heat sink is maintained below the analysis values by maintaining the air temperature below the requirements in the tech specs, and there's a table in the basis that tells you the different air temperatures for the different groups or zones in the control room habitability area.

Permanently installed sensors will monitor temperature in various locations and elevations inside the control buil ding, and these temperatures are what are used for the -- to contain the passive analysis used for the heat sink.

Tech specs say when the average temperature of one or more of the rooms is greater than the limits, we go into an action statement. Action Statement A-1 requires that we restore the air temperature within eight hours. So if air temperature in any of these rooms, zones, goes above the limit, we're in a tech spec.

MEMBER ARMIJO: What's the limit?

MR. ARCARO: There's a slide that's coming up, but it depends on the different area. The control room habitability area is 74 degrees. The HVAC rooms are a higher temperature.

DR. WALLIS: Now it says here "air temperature of each heat sink." The heat sink is the wall, isn't it?

MR. ARCARO: That's correct.

DR. WALLIS: So there's no air temperature of a wall?

MR. ARCARO: The air temperature --

DR. WALLIS: The air temperature adjacent to a wall, isn't it?

MR. ARCARO: Yes. The average temperature of that area.

DR. WALLIS: Near the wall. It's the average temperature of the region beside which the wall is.

MR. ARCARO: Right.

DR. WALLIS: But you're not actually measuring anything in the wall itself?

MR. ARCARO: That's correct, that's correct.

DR. WALLIS: Right.

MR. MARQUINO: So we're controlling the concrete at the bottom of the heat sink temperature by monitoring the air temperature.

DR. WALLIS: That's right. It's just the wording is odd. The air temperature of each heat sink is very peculiar wording. Okay. I understand what you're doing.

MR. ARCARO: Right. So prior to reaching 85 degrees, and there's a basis on that number, we'll restore forced ventilation, we'll reduce loads, we'll make sure we get the temperature within spec. So we got up to that point before we end up tripping non -essential DCIS loads in the control room.

So at 85 degrees, we tripped the heat loads to maintain us below the parameters that were used in the analysis.

MEMBER STETKAR: Mike, that 85 degree set point is the same set point? That's the safety-related trip set point that you used to trip during any heat up?

MR. ARCARO: That's correct, right, right. Yes. It's a --

MEMBER STETKAR: Because that was one of my questions, is what was that temperature.

MR. ARCARO: Yes. The safety -related instruments trip the non -safety loads in the control room at 85 degrees, and that mimics the analysis that we did. Okay.

Next slide. Okay. The other part of the tech spec action statement is A-2, which requires that the averag e temperature of each heat sink be restored within 24 hours. So here's -- before we were looking at air temperatures. Now we're looking at the heat sink. The average heat sinks exceed the specified limit.

We can verify the restoration of the heat si nks, either by administrative evaluation, considering the length of time and extend that the heat sink average air temperature went above the limits, or by direct measurement.

So two different cases to verify and validate that the heat sink is within the requirements of the analysis. Okay. The way you can do that, the evaluation can provide temperature profiles based on the initial conditions, and you use the air temperature to estimate, validate the concrete temperatures, the heat sink temperatures.

In lieu of that, you can actually go measure the heat sink temperatures. You can measure the concrete temperature at the surface, and determine what the temperature would be.

DR. WALLIS: That's probably all right. But usually the radiation heat transfer coefficient is about the same as the convector in a room like this.

So if you had a hot light bulb here, it would heat the wall, and then the wall could conceivably be hotter than the air. You don't have that situation, I think, in the control room. You're just relying on the air, air convection to keep the wall cool?

MR. ARCARO: That's correct.

DR. WALLIS: And that's probably right. But if you did have a big radiation source in there, that wouldn't be true. If the sun was shining on the wa ll, the wall could well be hotter than the air?

MR. ARCARO: That's correct, and I think that's one of the assumptions.

DR. WALLIS: For sun in the control room, so we're all right.

MR. ARCARO: Okay. Next slide.

DR. WALLIS: I'm just going to be sure there isn't something else coming into this.

MR. ARCARO: Okay. So those are the two conditions for the tech spec. If you don't meet either the air temperature or the heat sink temperature, requirements are to be in Mode 3 in 12 hours, Mode 5 at 36 hours.

The way we control that, the implementation of that will be through a COL item. We have a COL item that relates to control room habitability area procedures and training, and that would be where the applicant would provide this operability ev aluation for the heat sink and the relationship to the air temperature. Okay, next slide.

CHAIRMAN CORRADINI: So now we're onto the second topic.

MR. ARCARO: Okay. Second topic, why was an analysis chosen for the ITAAC method for the control room heat sink, rather than an operational test? So in Tier 1 for the control building, we validate the passive heat sink by comparing as-builts with the conditions used in the analysis.

So the critical parameters are the as-built heat sink dimensions, therm al properties, exposed surface area, thermal properties and materials covering parts of the heat sink. If you put posters up on the wall or painting, and the as-built heat loads.

So that's how we do. The way the ITAAC is written is it's a validation of the analysis. An operational test that would simulate the limiting design conditions would be extremely difficult to perform. Like I said, the analysis itself is a Tier 2 star item. So in the LTR, there's a table with a list of parameters that need to be met.

Tier 2 star means the NRC needs to provide prior approval if we change the methodology of the test. Okay. Next slide.

MR. MARQUINO: Of the calculation.

MR. ARCARO: Of the calculation, I'm sorry.

MR. MARQUINO: There's a specified calculation that will be done to validate the as-built control room.

MR. ARCARO: Okay. So here's some bullets why analysis rather than a test. The heat capacity of the control room concrete mass will be validated in ITAAC. This is similar to other passiv e functions such as building structural response and, you know, by validating the components, the key parameters, that would be all you need to do to make sure that the function is met.

Limiting parameters associated with the passive heat sink could not be readily reproduced during the performance test. So to get the 117 degree ambient temperature with an 86 -degree ground temperature during start -up testing in the middle of the winter would be very difficult to obtain.

You'd end up extrapolating outsid e of your normal heat loads and parameters to a condition that is beyond what you're testing to. Performance tests would have to last for a period of 72 hours, to simulate the entire event.

MEMBER ARMIJO: Before --

MR. MARQUINO: I think he's got one more.

MEMBER ARMIJO: I'm sorry. I think you're making it awfully hard. I've just seen -- I agree. Your analysis is probably --

(Simultaneous discussion.)

MEMBER ARMIJO: Let me finish asking my question. Why wouldn't you just run a limited test? You've got a prediction of time versus -- temperature versus time. You don't have to take it up to the extremely, the extreme conditions, and say hey, we're in the ballpark. A sanity test, if nothing else.

MR. MARQUINO: So any test we did would not be a design basis test. It wouldn't have the exact weather conditions. In terms of the heat loads, we have enough trouble figuring out how to build the control room and get it to the pre-op test state, without scheduling in a period where the non-DCIS loads are going to be powered off, but all the safety-related loads are going to be available and powered on.

So in terms of the schedule for performing the start-up test and pre-op test, having this as a test would have some effect on when you had completed all of the tests.

CHAIRMAN CORRADINI: But I guess, I think what I hear Sam saying, I know John's going to ask you more questions. But I think what Sam is saying is as a pre-operational test, it doesn't have to be design basis in boundary condition, but it can be a way of checking your calculation that you use for your design basis calculation.

MEMBER STETKAR: You're relying on an

analysis and just --

MEMBER ARMIJO: See if the analysis is good.

MEMBER STETKAR: You have faith that the analysis indeed models reality, and you could in principle change the input parameters to that analysis, to be consistent with the known input parameters when you run the pre-operational test, run the test and see how well your analysis indeed models reality.

And if it models reality quite well, then you could have reasonable confidence that it would model reality under design basis conditions. If it doesn't model reality under the non -design basis conditions, then there's some questions.

MEMBER ARMIJO: Ye s, and I'm not talking about cranking it up to 117 degrees or anything like that.

MEMBER STETKAR: Well, you can't. I mean that's outside. You can't do much with the sun.

MEMBER ARMIJO: You just go with what's reasonable for that, but you know, give you some experimental verification that your model has got everything covered.

MEMBER STETKAR: I think of this as the analogy. We do a lot of design basis accident analyses that assume that we can deliver X amount of flow from injection systems, and yet we don't rely on those analyses, period. We actually run pre-op tests to make sure the pumps can put that flow out.

MR. ARCARO: Well, I guess a similar example would be containment air cooling testing for Generic Letter 8913. You know, there was a point where utilities were trying to simulate the design conditions for these heat exchangers, you know, and they were extrapolating on the heat loads that they had to try to get to limiting conditions.

And you know, a lot of utilities, you know, gave u p on the testing and went to inspection, because it didn't simulate real life. You couldn't get those heat loads in the containment, and it wasn't a valid test to represent what it would do under accident conditions.

CHAIRMAN CORRADINI: John, it's your turn.

MEMBER STETKAR: I don't have much more to say. I don't have much more to say.

MEMBER ARMIJO: I think we're in engineering space, not regulatory space, I think, and just take actuals and run a simple test.

CHAIRMAN CORRADINI: The only thing I guess I can appreciate where I think they're coming from is if they were to accede to a pre -op -- I call it a pre -operational test is what they're suggesting, not a --

(Simultaneous discussion.)

CHAIRMAN CORRADINI: Right. But if you were to acce de to a pre -operational test, then you'd have to develop acceptance criteria for if you fall within or without. It would be the equivalent, I know you don't want to hear this, but the equivalent of a containment leak brake test. You're building the plant . I was at the same plant he was at. You shut down everything, you close everything up and you do the CLRT test.

It doesn't work and you come back down. You pump it back up and you do it until you match your .1 percent. But my only point is it's a pr e-operational test under some acceptance criteria and operating conditions for the test.

That's what I think --

MEMBER STETKAR: And the acceptance criteria would be how well the heat-up analysis --

CHAIRMAN CORRADINI: Matched the model.

MEMBER STETKAR: Matched the model, and you would - max is the real world.

MR. MARQUINO: But in this case, in the leak rate test, you pump the containment up to the design pressure, so you're testing at the --

CHAIRMAN CORRADINI: Well, you actually pump it up to 150 percent of design pressure.

MR. MARQUINO: So in this case, we would have a different analysis that we would be comparing the test to.

CHAIRMAN CORRADINI: What I think they're suggesting, I mean and we understand where we're coming from, but I think what these two gentlemen are suggesting is what you're doing is you're showing that your modeling assumptions are being used in a controlled manner, and you can match, within acceptance criteria, for response.

DR. WALLIS: It's the same model. It's the same analysis.

(Simultaneous discussion.)

MEMBER STETKAR: It's the same model, you just put different inputs.

DR. WALLIS: Whatever nature gives you, you put in there.

MEMBER STETKAR: And by the way, I'd expand this discussion to not -- we tend to be control room -centric on this, but there are really three areas of the plant. It's the control room envelope, and then the -- I've forgotten the ventilation system, but the Q -DCIS rooms in the control building. It's a different ventilation system.

MR. MARQUINO: Right, control building, general area.

MEMBER STETKAR: Right, and the reactor building, whatever, clean air ventilation system, I think, that cools the safety-related areas, you know, where you have the inverters and the power supplies and stuff out in the reactor building. Those are the three areas, I think, you would take the safety -related equipment. You take credit for 72 hour passive heat removal.

MR. MARQUINO: Well, we'd like to continue and then maybe cycle back on this after the staff has their presentation.

CHAIRMAN CORRADINI: That's fine. Keep on going, keep on going.

MR. ARCARO: Okay. So I think we talked through all the bullets on this. Next slide. Okay. This is the issue about site characteristic values. In the Table 2.01 for site-specific acceptance criteria, there's criteria that talks about the daily temperatures associated with both dry bulb temperature and then the high humidity case.

Next slide. So I think the last ACRS, we went through how does an applicant actually do this? How is he going to take the numbers and relate it to the conditions at the site? So in 3H of the DCD, we explained the notes on the table, how the applicant would use his temperatures to determine if the passive heat sink analysis is bounding for that site.

So the terms that we use there, the daily temperature range for summer conditions associated with the dry bulb temperature, and the daily temperature range for winter conditions, and then there's also high humidity. S o for dry bulb temperature conditions, we're looking at sinusoidal ambient temperature response, as given by ASHRAE 2005.

The applicant will look at his zero percent max exceedance value, and then he'll look at -- they'll look at 24 hours either before or after, and come up with a range based on those numbers.

So the historical zero percent exceedance for that site, and then we'll look at a range of 24 hours before and after that, and come up with an average value based on that.

DR. WALLIS: Wasn't i t last time we were looking at some typical curves, and it seemed to be difficult to unequivocally define what you meant by "minimum"?

MR. MARQUINO: Right, and we -- you probably aren't recognizing what the changes are on here, but they're very small changes, where we replaced terms like the daily value with the minimum occurring in the previous and successive 24 hours.

The staff has -- the staff is going to bring back those actual temperature graphs, and we believe that we have a unique definition that can be used from available met data, to come up with the three numbers to characterize the site.

DR. WALLIS: What you mean by "minimum" is the lowest value over 24 hours, even though it's not necessarily the bottom of a curve? It's quite clear what you mean by "minimum"?

MR. MARQUINO: Yes. You define a temperature for the dry summer conditions. You define a maximum temperature, and then you look at the highest low temperature plus/minus 24 hours, because we're not allowed to credit the lower of the two temperatures. It's got to be the higher of those lower temperatures.

MEMBER STETKAR: And I think these two are relatively easy to kind of understand what they're doing. It's the third, the high humidity calculation on the next slide that gets more convoluted.

MR. ARCARO: Okay. So here's the new definition for the diurnal swing with the high humidity. We took the maximum wet bulb temperature, and we looked at the coincident dry bulb temperature for that.

Then we looked at the minimum, the highest low for the wet bulb over -- this would be over three periods, three before and three after. So that would be three 24 -hour segments. So we looked at that, and we based -- and we looked at the dry bulb associated with that high/low wet bulb temperature.

MEMBER STETKAR: I think for this one, we really need to see those same curves that the staff had, because this was where the confusion is, and quite honestly, even reading this and trying to think about it without those curves --

MS. CUBBAGE: The staff's presentation has the curves in them, so --

MR. MARQUINO: Okay. So keep, put a post-it note on this page. When the staff comes up, we'll read it relative to actual weather data.

MR. ARCARO: Okay. The next issue is talking about the as sumptions for the passive heat calculation for the reactor building. The concern is how do we -- how are the assumptions of the heat -up calculation assured? Specifically, how do we maintain the control temperatures of the areas in the reactor building associated with the passive analysis?

And we'll point to different sections in the DCD that show that we're maintaining, monitoring, alarming for those areas that have input into the passive heat -up analysis, this time for the reactor building.

Okay. I guess one of the issues was why don't we include an LCO for rackable and temperature monitoring, and this slide here talks about this being consistent with the standard tech specs, where other plants, previous vintages of boiling water reactors, have gotte n rid of that out of tech specs.

MR. MARQUINO: And the justification for not having it in tech specs is that it is continuously monitored and alarmed in the plant, and ESBWR is consistent with that. We've committed in the DCD to monitor area temperature and have control room alarms on high temperatures.

MR. ARCARO: And I think the next slide will show a few of those examples.

MEMBER STETKAR: But if that temperature instrumentation was not operable, you would never get a high temperature alarm.

MR. MARQUINO: And you would repair the inoperable temperature indicators.

MEMBER STETKAR: How would you know

it's inoperable, unless you have a continuous read-out or something?

MR. MARQUINO: Well, I believe the same indication is used in the A track system to control the A track system. So if the indication was wrong --

MEMBER STETKAR: If it's failed low, it won't turn the fans on, and you won't get a high temperature alarm.

MR. MARQUINO: Right, and when you went in the room, you would find it's really hot. But we're talking about one -- I think what we're talking about here is you're talking about a failure that would be detected by an operator making -- I'm talking about a failure that would be detected by an operator making his rounds, if the normal way of detecting a failure in the HVAC system didn't work.

MEMBER STETKAR: From what I heard you saying, you're relying -- you know, you're essentially relying on the fact that it's a normally operating system. You have alarms in the control room if temperature in the area is too high, and as a surrogate for having a tech spec requirement for operability of that temperature instrumentation.

I'm saying if the temperature instrumentation fails low, such that it does not start the normal HVAC equipment, it's failed low. It won't give you any indication of high temperature in the control room. So the failure actually is a contributor to the fact that the room is heating up, and you don't know the room is heating up because you don't get the hi gh temperature alarm.

MR. MARQUINO: In one room and at the same time you have the loss of offsite power, in other words, that would have to be coincident with a loss of --

MEMBER STETKAR: I'm not talking about necessarily accident analyses here. I'm just talking about normal plant operation. This is temperature instrumentation for those rooms. How do you verify that it indeed it is available. I'm not talking about safety-related instrumentation here necessarily.

MR. MARQUINO: Right.

MEMBER STETKAR: We're talking about safety-related rooms in the reactor building, right?

MR. MARQUINO: Also, I think we may -- do you expect you'll have redundancy in the temperature indications in the HVAC system, Mike?

MR. ARCARO: Yes. You would have, you know, you would have multiple channels for monitoring temperature, and in the final analysis, you know, if you had a failed instrument, it would fail in a condition that would provide you --

MEMBER STETKAR: It depends on what kind of displays you have in the control room to tell you that. I mean if you're only relying on the high temperature without --

MR. ARCARO: In the control room, the reactor building area temperature high is a minimum inventory parameter. In the HVAC system, you know, we'r e going to be doing air flows; we're going to be doing damper positions. We're going to be doing fan speed and, you know, flow rates. We'll be doing temperatures.

So there's multiple parameters that will give you the validation that you're providing room cooling, you know, in addition to, you know, operators doing rounds and actually seeing what the temperatures are.

The only difference is that it's, you know, it's not tech spec control, like in the control building.

MEMBER ABDEL -KHALIK: So they're monitoring. They get high temperature. What are they going to do about it?

MR. MARQUINO: It would fall under the maintenance rule, to -- depending on the area. If it was a RTNSS area, it would be maintenance rule.

MEMBER ABDEL -KHALIK: Yeah, the way they do non -safety systems now is if you had an indication that's out of spec, you know, it would fall under the maintenance rule. That would be a parameter that you would, you know, you would have an indicator for that.

So you would, you know, write a corrective action item to repair that.

MR. MARQUINO: Now if it's safety, if it's Q -DCIS room, and it's above the EQ temperature, I think that would indicate that it's inoperable and they would be forced to -- they'd be forced to declare the equi pment inoperable.

MEMBER ABDEL-KHALIK: And then what do

they do?

MR. MARQUINO: And take the actions --

MEMBER ABDEL-KHALIK: They have to shut down within a certain time?

MR. MARQUINO: Right.

MEMBER ABDEL-KHALIK: So why -- what difference would it make, putting this in tech specs and indicating certain time lines associated with LCOs?

MR. MARQUINO: Well, the difference is you're monitoring -- we've incorporated this as the basic monitoring of the HVAC functions in the plant. It doesn't rise to the level of a tech spec. The difference is if it's tech spec, if there's any change made, there's an additional burden on the utility. It has to be reviewed by the NRC.

For example, if you change the -- if you replace the equipment, you have a different EQ qualification for the equipment. So you want to change the number in this -- in the table. There's a lot of administrative overhead in changing it, versus if it's not a tech spec, you can process the paper work internal to the utility, make the change in the alarm set point, and satisfy it that way.

MEMBER STETKAR: This sounds -- this is more a question for the staff, I think, because I kind of think they're relying on legal interpretations of things. I mean I understand the reason for not wanting it in a tech spec. It's a question of without it in the tech specs, are we sacrificing any protection of high temperature in those rooms?

Because especially in the reactor building, you're talking about not only the fact that it's in the reactor building, but some of those rooms tend to have fairly high heat supplies. You know, you're talking about switch gear; you're talking about inverters and things out in there that could be reasonable heat sources.

I don't know how big your rooms are. I don't know how fast they heat up, you know. I guess your heat -up calculations say passively they don't heat up very quickly, but --

MR. MARQUINO: Yes, and we have to limit the heat load in the rooms in order to make that true. That's exposed in our analysis.

MEMBER STETKAR: But there might --

well, I'm not going to presuppose things. There might be justification for, you know, periodic rounds detecting high temperature, but people tend not to rely on that for safety-related, especially for safety-related areas.

MR. MARQUINO: But I think the concern is -- if the concern is one temperature sensor failure is not going to be detected for a long period, I think we get more back with you on more information.

MEMBER STETKAR: Yes, I mean that's sort of the technical concern. The second bullet on there -- that was curious. You said "During development of the current standard tech specs." Current standard tech specs apply to BWR-6s?

MS. CUBBAGE: Yes.

MEMBER STETKAR: You know, because before BWR-6, you basically didn't have this same kind of stuff, equipment, out in the reactor buildings. So some of the concerns about high temperatures for safety -related power supplies and you know, inverters and things were sort of a moot point up until BWR-6s.

MR. MARQUINO: Yes. This is the case for BWR -6 tech specs. Joe Friday and our Reg

Affairs staff looked at, I think it was River Bend and Grand Gulf, or at least two BWR -6 plants, in terms of their -- he confirmed that they didn't have this in their tech specs.

MEMBER STETKAR: Okay.

MR. ARCARO: Okay. I think we talked through these. Here's the sections of the DCD that provide flows, temperatures, indications, alarms, both for normal and design deficients. Table 3H -3 and 9 have the environmental conditions, the actual limits and the temperatures that are expected during accident conditions.

And then Table 18 -1 is the minimum inventory that shows that the reactor building area temperature is a parameter that's monitored in the control room.

In summary, we think the design meets GDC 19 habitability requirements for the control room habitability area, related to the heat removal conditions. The design validation surveillance procedures assure that the functions will be met, and the site paramete rs can be interpreted and implemented by COL applicants. I think when we see the staff's presentation, we can walk through the specifics there.

And then the controls we have in place for the reactor building, temperature monitoring, are in line with existing BWR practices for tech specs, and provide the same assurance for EQ life for equipment.

MEMBER STETKAR: Mike, before we switch to -- I know you've got a couple of other slides here.

CHAIRMAN CORRADINI: Those are backups. I think he's giving something to us.

(Simultaneous discussion.)

MR. MARQUINO: We have one more slide on here.

MR. ARCARO: I've got to talk just about Chapter 16 update.

CHAIRMAN CORRADINI: Okay.

MEMBER STETKAR: I was going to ask him sort of a 16 and sort of a control room heat-up.

CHAIRMAN CORRADINI: Do you want to do the update on 16 first?

MR. ARCARO: I think that might be best.

MEMBER STETKAR: Actually no. I'd rather ask my question now, while people are thinking about control room. The question is, and it's the -- boy, I wish I could speak clearly. The control room envelope has temperature sensors that automatically de - energize non-safety related heat loads, you said, when the temperature reaches 85 degrees Fahrenheit.

MR. ARCARO: Right.

MEMBER STETKAR: And they're safety-related, four divisions, two out of four redundancy, all of that kind of stuff. Are those -- is the availability and operability of those temperature sensors controlled by the tech specs anywhere?

MR. ARCARO: Yes.

MEMBER STETKAR: Where?

MR. ARCARO: It could be in the instrumentation section there --

MEMBER STETKAR: Okay. I looked in control room HVAC, and I couldn't --

MR. ARCARO: It's not in 3; it's 3-7.

MEMBER STETKAR: It's not in 3-7.

MR. ARCARO: Or 3-3, I believe it is.

MEMBER STETKAR: Okay. If you can find a reference or somebody can, I'd appreciate it.

I didn't do a thorough search, but there's a lot of stuff in the tech specs. I looked at the most likely place that I thought, but it's not there.

MR. ARCARO: It is.

MEMBER STETKAR: It is, good. It is, that's good. If you'd just give me the reference, I'd appreciate that.

MR. MARQUINO: Okay. We do have follow-up to one of your comments on Chapter 16. You were concerned about our staggered, well the lack of a staggered test interval for surveillances on the passive safety systems. So we had some which were simply once every ten years, and you asked why don't you test one at the first outage and another one at the second outage and so on.

So we've made, we discussed this with the staff, and we're in the process of making changes to the tech spec, to add more staggered test intervals, and they include the GDCS injection lines, the GDCS equalizing line, the ICPCCS pool, moisture separator flow paths, and the GDCS deluge lines.

So they will be set on a staggered interval, based on the old surveillance interval and the number of systems or divisions that can be tested.

MEMBER STETKAR: So essentially, you'll test each division every ten years, if that's what's the interval?

MR. ARCARO: Yes.

MEMBER STETKAR: But on a staggered basis?

MR. MARQUINO: Right.

MEMBER STETKAR: Good.

MR. ARCARO: So your earlier question about testing the N-DCIS, that's described in the Surveillance Requirement 3725, and the functional test is in 3372. So that's where we do the instruments.

MEMBER STETKAR: No, I was -- I'm sorry.

MR. ARCARO: This is the testing to show that the instruments will trip the N-DCIS off.

MEMBER STETKAR: Wh ere is it? I'm sorry.

MR. ARCARO: 3372.

MEMBER STETKAR: 3372.

MR. ARCARO: That's correct.

MEMBER STETKAR: That's a surveillance requirement. Okay. But there's no operability requirement? There's no LCO for those instruments, is there?

MR. ARCARO: No, there is.

MEMBER STETKAR: Oh, is there?

MR. ARCARO: Right. The logic system functional tests. So we're on a --

MEMBER STETKAR: It's a surveillance requirement?

MR. ARCARO: Right.

MEMBER STETKAR: It's not an LCO.

MR. ARCAR O: The LCO 3372 is the instrument test for the switches that will trip off N-DCIS.

MEMBER STETKAR: I don't have that.

MR. MARQUINO: You're looking for surveillance on the temperature sensors?

MR. ARCARO: Right.

MEMBER STETKAR: I was looking f or an operability requirement on the temperature sensors, such that if you had -- you know, you could have one train inoperable indefinitely. If you had two trains inoperable, they could be inoperable for 72 hours, or something like that, not just a surveillance requirement.

MR. MARQUINO: All right. Let's, we'll look while the staff is up.

MR. HARBUCK: This is Craig Harbuck from the Technical Specifications Branch. I could just clear that up right quick. Surveillance requirements must be met in order to meet the LCO. The LCO requires that the instrumentation functions in 3.3.7.2 be met during modes of applicability.

So if you don't meet that surveillance on one system functional test, you're not meeting the LCO, and you would enter the actions for the instrumentation divisions affected.

MEMBER STETKAR: Well, what I was curious about, and again, I'm trying to do this real-time, which is not fair, as are you, which is not fair. I see things in 3.3.7.2 that talk about actuation divisions, but I don't know --

In particular, I can't find anywhere in the bases document for the tech specs, I find four sets of instrumentation in the bases documents listed under control room/HVAC, none of which are these particular temperature sensors.

They're actuation signals for

transferring to the EFUs. They're actuation signals for isolation. I don't find any actuation signals for turning off the non -safety heat loads. So that's -- it might be in there somewhere, but I'm having problems finding it.

MR. HA RBUCK: Well, I'm pretty sure there's a test to verify actuation on a simulated or real signal in the CRHAVs specification in Section 372, I believe it is.

MR. MARQUINO: Yes. Mike found that.

MR. HARBUCK: So I think that's the test that covers this.

MR. ARCARO: The Surveillance Requirement 3.7.2.5 verifies selected main control N-DCIS electrical loads automatically de - energized on an actual or simulated initiation signal.

MEMBER STETKAR: I'm sorry. 3.3.7.2.5?

MR. ARCARO: 3.7.2.5.

MEMBER STETKAR: 3-7. 3.7.2.5.

MR. ARCARO: Right.

MR. HARBUCK: Plant Systems section.

MEMBER STETKAR: Okay.

MR. ARCARO: Right, and then in addition to that, you do a logic system functional test for LCO 3.3.7.2. I thought that was your question.

MEMBER STETKAR: Well, I was looking up in 3.3.7. Let me keep the meeting going here and get the staff up, and I'll search through things here.

MR. ARCARO: I think that's it for our presentation, if there's no questions.

CHAIRMAN CORRADINI: Other questions?

(No response.)

CHAIRMAN CORRADINI: Okay, thank you. Amy, is the staff ready to talk this afternoon?

MS. CUBBAGE: Yes, we are.

CHAIRMAN CORRADINI: That would be wonderful.

MS. CUBBAGE: Our meteorologist is out of the office, but we'r e going to pinch -hit for him.

CHAIRMAN CORRADINI: Well, I trust you to get a good designated hitter.

MS. CUBBAGE: Yes. Jim O'Driscoll is going to do his very best.

CHAIRMAN CORRADINI: He'll do his best.

(Off mic discussions.)

CHAIRMAN CORRADI NI: You guys are

ready?

MR. GALVIN: We're ready.

CHAIRMAN CORRADINI: Okay. Have at it.

MR. GALVIN: All right. The staff is here today to present on the habitability area, issues related to Section 6.4 and Section 9.4, and actually, as GEH ment ioned, we're following up on several issues previously identified by ACRS. So Jim?

Chapter 6/Staff

MR. O'DRISCOLL: Good afternoon. My name is James O'Driscoll, and I, along with Craig Harbuck, are here to provide the Subcommittee discussion on the rem aining issues related to Section 9.4, HVAC, and Section 6.4, Control Room Habitability.

Next slide. In particular, this briefing will address the follow -up items from the previous briefings to the ACRS Subcommittee held on 19 May 2010 for Chapter 6.4 an d 9.4, and the Subcommittee meeting held on August 17th, 2010 for Chapters 2 and 16. We will also answer your questions.

Here's the staff team, Dennis Galvin, project manager for 9.4; Bruce Bavol is project manager for 6.4; Jim O'Driscoll is a lead reviewer for Chapter 6.4 and 9.4, with Ed Forrest, Syed Haider and Shie-Jeng Peng supporting. Also Brad Harvey for Chapter 2.3 and Craig Harbuck for Chapter 16.

Next slide. The four issues we'll discuss today are the following. One, we will provide and discuss heat-up profiles for the three models, CONTAIN 2.0, GOTHIC and the NRC's First Principles Analysis, used to model the control room hazard heat sinks and their performance post-accident.

Two, we will discuss details of the tech spec surveillance on the control room habitability area heat sink's temperatures. Three, we will discuss details on verification of related site characteristics, and four, we will discuss how assumptions used in the reactor building heat-up calculation are assured.

Next slide. The staff's review focused on the applicant's submitted CONTAIN 2.0 analysis in two areas. One was a staff review of the suitability of the use of CONTAIN 2.0 as a method to model the ESBWR control room heat-up, as opposed to alternate analysis demonstrations, methods such as GOTHIC or a First Principles approach.

The staff did this by comparing the submitted analysis with a GOTHIC analysis that was submitted by the applicant to support RAI 9.4-29, which was related to the control room habitability area mixing, that's air mixing.

The GOTHIC analysis was updated by the staff with the current control room habitability area load, heat loads, and EFU, emergency fan unit fan loads. In addition to this, the staff requested the applicant to provide a Fir st Principles calculation, which was provided to the staff in September 2009.

Based on review of this calculation and the staff's need to perform sensitivity studies, the staff decided it would be worthwhile to perform -- the study the problem from a Fi rst Principles on its own, and it developed its own First Principles calculation of the GE/ESBWR control room habitability area.

Two, the second area the staff focused on was the need to understand the sensitivities in the calculations input assumptions, in order to gain insight on what parameters are significant to the outcome, what input parameters are significant.

The staff's focus was on the heat sink properties, heat sink initial temperatures and outside environmental conditions, since these things produce the most significant changes in the control room habitability area temperature and humidity. The results of these studies were discussed in earlier ACRS meetings.

In summary, the staff reviewed the submitted CONTAIN 2.0 analysis. The staff reviewed a GE First Principles Analysis. The staff developed its own First Principles model to study the problem. The staff also performed one run using a GOTHIC model updated by the staff, to the current heat load and EFU fan flow values.

Upon review o f the closest in behavior of the overall heat -up, and the closeness of the final temperature results, in the base cases for the three models, and with an understanding of the remaining differences between the three models, including initial conditions that were not reconciled, the staff was satisfied that the submitted CONTAIN model could be used to model the heat of the ESBWR control room habitability area.

Subsequently, the staff focused on the submitted CONTAIN 2.0 analysis and the staff's First Princi ples Analysis to perform further sensitivity studies. 24 sensitivity runs were performed using the applicant's CONTAIN 2.0 analysis and the staff's First Principles Analysis.

Next slide. After reviewing the results of the varied sensitivity studies, us ing CONTAIN and the NRC First Principles Model, and the results of the updated GOTHIC analysis, the staff concluded the following:

One, after the effects of the remaining differences, including initial conditions are considered, the staff concluded that the heat-up rates for all models agree. This can be seen in a comparative run of the three models on the following slide. We'll get to that slide in a minute.

Two, CONTAIN and the staff's First Principles model behaves similarly when various parameters were changed during the 24 sensitivity runs. The staff's First Principles model was slightly higher than CONTAIN 2.0. The greatest difference between the staff's First Principles model and contain on these runs was less than four degrees, most runs aver aging about 2.5 degrees.

The staff attributes the higher control room habitability area temperatures obtained by the First Principles model to difference between the model and CONTAIN, described in the white paper submitted by the staff to the ACRS in July. Briefly, these differences are the following:

First, more heat is assumed to enter the control room habitability area from adjacent spaces from those interior wall structures that face rooms with heat generation. The staff's First Principles model conservatively assumed that 50 percent of the heat generated in adjacent rooms enters the heat structures common room habitability area.

Second is the staff ignored steel structures, which are five of the 21 heat structures modeled in the applicant's CONTAIN model, in order to reduce the complexity of the model.

Third is that CONTAIN uses the temperature distribution in each heat structure, resulting from an earlier soaking phase in the initial condition. It's a three -step -- structured in three steps . The initial temperature distribution used in CONTAIN ranged from 74 degrees to 79.9 degrees for all solid structures, with the exception of the wall facing the soil, with a mean initial temperature of 82.8 degrees Fahrenheit.

The staff's First Princip les model assumed an initial 80 degree uniform temperature for all heat structures. Since the soil -facing wall is only 16.6 percent of the total mass of the heat sink, overall, this is a conservative simplification with respect to CONTAIN.

Finally, another difference is that the staff's First Principles model did not credit one-half of the mass oif that one heat structure facing the soil, in order to account for the heat absorption from the 86 degree Fahrenheit soil.

As previously stated, primarily d ue to the similarity and response to the sensitivity studies comparing the staff's model and the design basis CONTAIN model, the staff gained confidence in the applicant's treatment of the control room habitability area, and concludes that CONTAIN 2.0 is an acceptable means to demonstrate the passive heat sink's performance for the ESBWR control room habitability area.

The remaining differences in temperature results between the two models is judged to be small, and could likely be reduced further if the staff's conservative simplifications were eliminated from its First Principles model. Next slide.

MEMBER ABDEL-KHALIK: Now your argument is that these graphs are within two to four degrees, and that is true. But my concern is not the error in the vert ical direction, but the variation in the horizontal direction. In one case, you cross the boundary after 72 hours, and in another case you cross the boundary after 48 hours.

MR. O'DRISCOLL: That's correct. I'm going to go through why that is. The top -- I want to explain each graph.

The staff was asked to provide a graphical comparison of some selected runs from different models. The slide displays is their 72 hour heat-up profile from CONTAIN and GOTHIC, and the staff's First Principles base cas e runs, along with one First Principles run showing the sensitivity of the changing concrete density. That's that dark blue one.

The bottom green line is the applicant's CONTAIN 2.0 analysis, submitted and referenced in the DCD, and that reaches a final temperature of 92.048 degrees in the control room at 72 hours. The light blue line is the staff's First Principles model, using the same values for concrete as those used in the CONTAIN 2.0 one. It's 120 pound per cubic foot concrete, and that temperature is 95.71 degrees.

Please note that this also includes the effects of the conservatively higher heat sink uniform temperature discussed earlier. There are higher heat sink temperatures assumed at the beginning of the analysis, which causes the heat rate to go, to rise.

As discussed earlier, generally these -- there was about a two to four degree difference between the staff's First Principles model and CONTAIN. Both models behaved similarly when parameters were changed, thus providing confidence to t he staff that CONTAIN is a valid way of estimating the control room habitability area heat -up in the ESBWR control room habitability area. For example --

DR. WALLIS: This dashed line, this black line is the criteria?

MR. O'DRISCOLL: That's the accep tance criteria, correct.

DR. WALLIS: And two of your models don't meet the acceptance criteria?

MR. O'DRISCOLL: Two of the models don't because -- but that can be explained.

DR. WALLIS: So why is this a confirmatory analysis, but they don't lead t o -- usually, you should satisfy yourself that even though you're conservative, you still meet the criteria?

MR. O'DRISCOLL: Right. What we had to do -- that's a good point. ? What we had to do, what I'm trying to say for this review, we had to first d etermine if CONTAIN is a valid tool for this application, and so we used other models to get assurance, confidence that the control room was behaving in the way we would expect.

So we used a multi -node code as updated by the staff, and we used a single node that we generated ourselves and created ourselves.

CHAIRMAN CORRADINI: The single node is the red?

MR. O'DRISCOLL: No. I'll continue on. I'll go through that.

DR. WALLIS: Blues are the single node.

CHAIRMAN CORRADINI: Excuse me.

MR. O'DRISCOLL: Okay. I'll just continue this, and we can -- I'm almost half through here.

DR. WALLIS: What puzzles me is that the biggest, the difference between say the green and light blue starts off right at the beginning.

MR. O'DRISCOLL: That's right. I can go through --

DR. WALLIS: It seems to be an initial condition that's somehow different, rather than the model itself?

MR. O'DRISCOLL: That's correct, that's correct, and --

MEMBER ARMIJO: And you made that point with your initial assumption.

MR. O'DRISCOLL: That's right. I mean one model, and the thing is is that to change and to get all the clocks to align would take an inordinate, in my opinion as a reviewer, amount of resources. What we're trying to do here is not to get all t he clocks to read the same time, but to make sure that they're ticking at the same rate. Those differences can be explained, and we understand what they are. I believe we're at that point.

DR. WALLIS: But isn't the initial condition -- why is the initial condition so different? Why don't you just have them all start at the same point?

MR. O'DRISCOLL: Because we would have to update every single heat sink temperature in the model to do that.

DR. WALLIS: Nothing's happened yet at the beginning. I mean heat sinks are irrelevant at the beginning?

MR. O'DRISCOLL: I guess, Syed, maybe you might want to explain how much -- what mechanically would it take to align the initial conditions for, let's say, our First Principles model, and CONTAIN 2.0?

DR. WALLIS: Yes.

MR. HAIDER: Hi, Syed Haider. CONTAIN uses an initial temperature distribution that is -- that comes out of Phase 2. You know, CONTAIN models the entire phenomenon in a three step process. In the first phase, it's a soaking phase. In the second phase, it's an eight hour NCO digit model while keeping the room temperature at 85 degree Fahrenheit.

So what happens at the end of the second phase in CONTAIN, all structures have a temperature distribution, and those temperatures are somewhere between 74 to 79 degree Fahrenheit. To do that within the First Principles model would take a lot more effort. So we had to assume a uniform temperature.

So we assumed a uniform 80 degree Fahrenheit temperature. While to do that in First Principl es model, we would have to replicate exactly what the initial conditions were coming out of this Step 2 of the CONTAIN model, and that would take a lot of time. That's why it was not done.

But what we assumed was conservative. That's the main point, an d these individual differences are not the only -- are not the only difference. There are three more differences that --

DR. WALLIS: But the biggest difference

is in the first hour. Once you've got that, then they're sort of parallel.

MR. O'DRISCOLL: Yes. Let me explain that. I had this question written down actually. The GOTHIC model assumes, was submitted to address the RAI on thermal gradience in the control room. That's what that was for. The input deck was reviewed by the staff and we updated.

The model analyzed the control room in a single step. That was a one -stage model. At the beginning of that model, all heat sinks -- excuse me, the air temperature of the control room was set at 87 degrees.

The CONTAIN 2.0 analysis consists of three steps: The output of which feeds the input of the subsequent steps. CONTAIN Step 1 consists of a soak period, where the heat sinks and sources are allowed to function, assuming the control room habitability area air temperature is stable at 74 degrees.

The output of this run is used as input data for an eight hour run, where the control room habitability area air temp is set up, is set to 85 degrees, simulating a control room habitability area ventilation system degradation. The output of this run is fed into Step 3, which is the 72 hour run, with the control room habitability area ventilation system shut off, and heat removal performed solely by the action of the heat sinks.

The staff's First Principles analysis is a single step model. The sta ff chose to use an 80 degree Fahrenheit uniform temperature for all heat sinks, conservative with respect to CONTAIN temperature distribution condition. The staff's First Principles model also set the air temperature in the room to 85 degrees at time zero, to match the CONTAIN analysis.

For CONTAIN, since there are -- there's already a substantial delta T between the heat sinks and the air, the heat sinks bring down the temperature of the control room until the heat input and the output rates are equal.

GOTHIC, on the other hand, has a similar delta T between the heat sinks and the air that started the analysis. The main control air it at 78 degrees at the start of the analysis. Thus, the room air temperature must rise to a value to where there will b e enough difference and potential to drive the heat sink at a rate, excuse me, drive heat into the heat sinks at a rate that matches the heat input rate.

For the staff's First Principles model, the difference between the heat sinks and the control room h abitability area air temperature, 80 and 85 degrees, respectively, causes the control room habitability air temperature to rise about a degree and a half, until the heat input and output rates are equal.

DR. WALLIS: So it's all in that first hour. I me an there's an adjustment that occurs, depending on the models, in the first hour. The CONTAIN goes down; the NRC models go up.

MR. O'DRISCOLL: That's right.

DR. WALLIS: And that's what the main differences between them is.

MR. O'DRISCOLL: Well, i t's not exactly -- that is a main difference. But another main difference is we also assumed much more heat coming in from surrounding heat sources. So that will drive the rate slightly, as you go through the 72 hours, which will drive a delta as well. So that's also causing a change.

MEMBER ARMIJO: Why did you run 140

pound concrete case, since that's not what the CONTAIN analysis used?

MR. O'DRISCOLL: The CONTAIN analysis used 140, 120 pound concrete as their conservative submitted analysis. The DCD specifies 150 pound concrete to build this control room.

So what we did is we said let's do a sensitivity study of more denser concrete, but one that is still conservative with respect to what is specified in Tier 2, and that's put there to show the benefit of the higher dense, of more dense concrete.

MEMBER ARMIJO: Sure. In one case it's converging; in the other case, that initial delta stays the same.

CHAIRMAN CORRADINI: I guess I understand what you're trying to do, but I'm not sure if you' re helping your case or hurting your case by the calculation. I think what Professor Wallace is asking is a fair point, which is your green and your light and your dark blue curves are going two different directions.

You're saying, if I understand your argument, that that's because in one case CONTAIN soaks it at one temperature, and then turns on the transient and for eight hours to get it to another temperature, but that's not enough time to get all the concrete to the different temperatures.

So you create an internal temperature difference, because when you turn on the long-term calculation, the concrete continues to cool down the room. So that's the --

MS. CUBBAGE: I just want to interject for a moment on the reason we did these analyses. We we re trying to inform our review, do sensitivities, find out what was important, find out and explore margins, and then at the request of the Committee, we plotted these, because you wanted to see them together.

CHAIRMAN CORRADINI: Right, correct.

MS. CUBBAGE: So I think you need to be careful about what message we're trying to give you here.

MR. O'DRISCOLL: We had a choice of giving you something new, but we want to give you what you saw already in the white paper, and talk to that.

CHAIRMAN CORRADINI: That's fine.

MR. O'DRISCOLL: That dark blue line is a sensitivity run.

CHAIRMAN CORRADINI: Right, but let me just finish my question. I think what I observed is correct, which is the green line goes down because I have a gradient in temperatu re in the solid, which is cooling the room.

The light blue and the dark blue lin got up, and that's what I think you said, but I didn't catch.

MR. O'DRISCOLL: Okay, okay, sure. We're talking initial conditions again. The reason why the green line goes down is because at the start of Phase 3 in the applicant's submitted analyses, the room is at this 85 degree temperature, but you have very cool heat sinks.

So what that acts -- it's not an official condition, and it's pulling down -- it doesn't need that much of a delta T.

DR. WALLIS: I thought the heat sinks were supposed to come into equilibrium with the room? They don't do that.

(Simultaneous discussion.)

MR. O'DRISCOLL: What the applicant did is they did their analysis in three steps. Phase zero is when the put the heat sinks in equilibrium with the room. Then what they wanted to do is they wanted to simulate a control room air conditioning system malfunction, but something that it would -- something at the worse case, but would still allow you to operate for eight hours, which is the limit of the allowed time, before they started their accident period. So conservatism.

CHAIRMAN CORRADINI: And just to, because that's a good point. But just to make sure, did we know that before? Th at's a piece, I guess, that maybe I missed.

MR. O'DRISCOLL: Well, we did discuss that before.

CHAIRMAN CORRADINI: Okay.

MR. O'DRISCOLL: And the other thing to point is that you see, if you did this -- what we found out is the room rapidly rises to 85 degrees or so. But it's really -- you really want to say that there's about a ten degree delta T between the heat sinks and the heat sources before the heat input is matched to the heat output.

MR. MARQUINO: This is Wayne Marquino for GE. Yes, I want to confirm that for a long time, we've had this Step 2 in the analysis, and the reason is to provide some -- to provide in the 72 hour coping period a temperature that's above normal, so that if we lose HVAC in the control room, we don't have to immed iately scram or take compensatory actions.

So we have a low temperature that's in the tech spec, and then we have an eight hour LCO that's in the tech spec, and we've included that eight hours in our heat-up analysis.

CHAIRMAN CORRADINI: From a conservative standpoint?

MR. MARQUINO: Yes.

CHAIRMAN CORRADINI: Okay, thank you.

DR. WALLIS: But still, I mean everything depends on what happens in the first few minutes or something, to the green and blue curves. Therefore, they're kind of power leve ls. So what you're telling me is everything is sensitive to what you do in your second condition.

MEMBER STETKAR: Let me ask just a simple question, because I don't understand all of this stuff. How do these analyses account for the non safety related heat sources in the control room?

MR. O'DRISCOLL: The analysis assumes that those non-safety heat sources are not in operation. There's 9630 watts of sensible heat assumed. That number is in Tier 2, and that number is also in the design basis heat-up calc. That's the Tier 2 star information.

So the applicant must verify. That's one of the things they must verify that the end, when they -- in their as-built plant, that they're not going to have safety and un --

MEMBER STETKAR: In the real world, they will be operating until they're shut off. The time at which they're shut off depends on the time at which -- I originally thought it was two hours, because in the design basis vent, the non-safety stuff maintains power for two hours. This obviously is shutting them off earlier, I think.

MR. MARQUINO: This is Wayne Marquino.

MEMBER STETKAR: This is like shutting them off at time zero, which is curious.

MR. MARQUINO: This is Wayne Marquino, GE. We have provided for eight hours of all of, basically all of the non-safety DCIS loads are in our analysis for eight hours, provided that the control room temperature is below 85. If it gets to 85, then those loads have to be tripped, and they are tripped.

MEMBER STETKAR: It's automatic.

MR. MARQUINO: Beyond that, I have to check on this, but there's a limited amount of non-safety loads that will be powered by a battery for a short period of time, and they're in the analysis.

MEMBER ABDEL-KHALIK: What's time zero on this graph?

MR. MARQUINO: Time zero is --

MEMBER ABDEL-KHALIK: On this graph.

MR. MARQUINO: Okay. Time zero is the complete loss of cooling in the control room, following eight hours at 85 degrees.

MEMBER ABDEL-KHALIK: So time zero is plus eight?

MR. MARQUINO: Yes.

MEMBER STETKAR: No, no, no. Minus eight on this is the control room staffed, the control room air temperature stepped from its normal temperature, which is around 74 to 85 degrees. So there was some degradation of the HVAC system.

DR. WALLIS: Look at the green curve when -- why is it when you turn off the cooling, it gets colder?

MR. BARRETT: This is Antonio Barrett from GEH, and the reason why it gets colder is because the concrete temperature is very cold, but the air temperature is very high. The air temperature at that exact moment is 85 degrees Fahrenheit, and the concrete temperature is something a lot lower.

DR. WALLIS: But this has been going on --

MR. BARRETT: And the heat capacity of the air is very low.

DR. WALLIS: But this has been going on before though.

MR. MARQUINO: For eight hours, and then at eight hours you trip these loads, so you reduce -- you actually reduce the heat load at time zero by tripping the non-safety loads.

MEMBER STETKAR: By tripping those loads. I' m not a code guy, and I don't understand how the codes work. I'm sort of a simple-minded engineer. Is it possible to run one of these codes with an initial condition that says I'm starting at a temperature that is within the normal tech spec operating te mperature, and the air temperature is equalized with the concrete temperature, which is a fundamental assumption in the heat sinks?

And from that T zero condition, then turn off normal ventilation and allow the control room to heat up, at the point at wh ich the normal non-safety loads would trip off as a function of temperature, remove that heat input.

If there's some residual non -safety loads that, you know, some small input that remain for some additional time, keep that input and do the simulation for 72 hours.

DR. WALLIS: That's more realistic.

MEMBER ARMIJO: That's what they did.

DR. WALLIS: No, it isn't.

MEMBER STETKAR: No, it isn't.

(Simultaneous discussion.)

MEMBER STETKAR: There are some artificial conditions on temperatures and DTs.

CHAIRMAN CORRADINI: So now Antonio, go ahead.

MR. BARRETT: So that's initially what we did, and so back before we put in the eight hour LCO, that's exactly how we had our analysis, except where we started, and if you look at that red curve they had, which is their GOTHIC analysis, that's basically what they're doing.

But what they did instead there is they have a higher heat sink temperature. They're starting at 78 instead of 74. So the very original analysis that we had did exactly what was stated. Now the later analysis that we have is more conservative, in that we exposed the concrete to 85 degrees for eight hours, and then started the transient.

So we did exactly what you said, and then later, we exposed the concrete. So we started at a higher concrete temperature and a higher air temperature. But one difference I have note that we did make from the old analysis to the new analysis is we decreased the starting temperature from 78 degrees to 74 degrees, which is reducing the starting concrete temperature from 78 degrees to 74 degrees.

MS. CUBBAGE: That's because you lowered the tech spec limit.

MR. BARRETT: Right. We lowered the tech spec from 78 to 74, which in effect is, you know, lowering the heat sink temperature from 78 to 7 4, and then so like I said, we did the analysis exactly as was suggested by -- I don't know who it was. But then we added some additional conservatism by artificially increasing the air temperature to 85 degrees for eight hours, and then starting the transient --

DR. WALLIS: It would help if you showed the prediction for that eight hours, so we could see what's going on in that eight hours on the ground.

MR. MARQUINO: If you look in the backup, GEH backup slide, I think it's 22, is that right? It's labeled the "Asset Heat Sink Issues." It's got steps on it.

DR. WALLIS: I didn't understand that. Maybe you can explain that.

MEMBER STETKAR: What chart number?

DR. WALLIS: The one at the very back.

MR. MARQUINO: Slide 22, I think.

MEMBER STETKAR: 22?

DR. WALLIS: At the very back, 22.

MEMBER STETKAR: Yes.

MR. MARQUINO: So you see Step 1 is the soak period that the staff referred to, and --

DR. WALLIS: That's the eight hours there.

MR. MARQUINO: And Step 2 is a step increase in the control room air temperature to 85 F.

DR. WALLIS: How does that happen?

MEMBER ARMIJO: It's assumed.

DR. WALLIS: It can certainly happen.

MR. MARQUINO: It's assumed. So for this change, this change was made about 18 months ago, and th e reason for the change is without this, the operators would have to take compensatory measures immediately on the loss of HVAC. So we looked at that situation.

We said we don't want the plant to have to immediately begin shutting down if we lose HVAC in the control room. We want to at least be able to accommodate a small temperature heat -up. So we added the minus eight hours in the analysis.

CHAIRMAN CORRADINI: So one clarification, Wayne. I think this is an excellent graph personally. Maybe no body else likes it, but I like it.

DR. WALLIS: What's Step 1?

CHAIRMAN CORRADINI: So when are you stopping the internal heat loads, would be John's question.

MEMBER STETKAR: Non-safety.

CHAIRMAN CORRADINI: Non-safety heat loads would be John's question, at zero?

MEMBER STETKAR: The beginning of Step 3.

MR. MARQUINO: At time zero.

MR. BARRETT: This is Antonio Barrett of GEH, and so in the control room at time zero, all the non-safety loads get shut off. Not all of them, but most of the non-safety loads get shut off, with some small non-safety loads still operating.

But in the rest of the control building, the non-safety loads continue to operate for two hours.

CHAIRMAN CORRADINI: Thank you.

DR. WALLIS: Is that why you get the step drop in the temperature?

MR. MARQUINO: Yes.

DR. WALLIS: Where do you get the step rise in the temperature at minus eight hours? I didn't get --

MR. MARQUINO: Because that's an assumed? That's assumed for them to bound the fact that if they lost air conditioning, they would have to not shut down. They'd have to be able to sustain it.

DR. WALLIS: It could be as hot as that.

MR. MARQUINO: It could be as hot as that.

DR. WALLIS: And the eight hours is an arbitrary number, because you d on't show the concrete temperature here.

MR. MARQUINO: It's not completely arbitrary. It's written in the tech specs.

DR. WALLIS: So because you were doing this, you've got a different starting kick to everything than the staff does?

MR. MARQUINO: No.

DR. WALLIS: The staff does something that when they switch off the load, the thing heats up, which is rather odd at the beginning.

CHAIRMAN CORRADINI: Well, I think Graham, I think just to answer, from a clarification standpoint. I think the staff understands what they did. Then the staff went off and did a series of sensitivities to see the effect of some of these assumptions, which created the light blue, the dark blue, and the red.

DR. WALLIS: And they got confidence, because they're almost parallel. If they bring them down to the GEH assumptions, they'll probably get the same answer.

MR. O'DRISCOLL: That's right, and we have to decide when do we get the -- you know, what's the benefit, and you find that it's -- we're convinced, and we want to focus on the sensitivities of changing the concrete and see how the model behaves.

But let me just talk about that one sensitivity, and we'll get back on track. Let me get the slide. The staff did a sensitivity run in CONTAIN, using 140 pound concrete. This is not shown here, okay. This is -- what we did is we took their model, okay, and put 140 pound concrete in it.

This is not shown here. The final control room habitability air temperature in this run was 89.9 degree Fahrenheit, or almost three degrees lower than CONTAIN 2.0. When we did it on ours, we got about three degrees. So they're doing the same thing. Does that make sense?

MEMBER ARMIJO: Yes. To me it does.

MR. O'DRISCOLL: The top red line is the GOTHIC analysis t hat was performed by the applicant in response to the RAI, and we talked about that already. It was updated per the latest values of the EFU, fan flows and the control room habitability area sensible heat load.

As can be seen on the graph, the heat-up r ate of these models are similar to CONTAIN and the staff's First Principles model. This run, the GOTHIC run also was about three degrees higher than CONTAIN's run.

I discussed in the earlier ACRS presentation, that although some heat load assumptions were updated, the heat sink initial temperatures and the initial control room habitability area temperatures in that model were not updated by the staff.

In addition, the GOTHIC model assumed a 78 degree control room habitability area air temperature, and the initial temperature of the walls are not the same as those used in either

CONTAIN or First Principles model. Is there any other questions on this slide?

DR. WALLIS: Well, I think GEH said they did this strange Step 1 in order to be conservative, and yet their values are less than yours. So your lack of conservative. You're overly-conservative compared with them.

MR. O'DRISCOLL: I attribute the rise of ours to the initial conditions that we talked about.

DR. WALLIS: The initial conditions, right. That's right.

MR. O'DRISCOLL: Plus the fact that we have made different assumptions for heat rate or heat input over time into the room. There's also, I mean we can go through those assumptions again, but there's about four differences in those models.

DR. WALLIS: The reason that there is acceptable whereas yours would not be is that you think their assumptions are more realistic?

MR. O'DRISCOLL: We think that their input assumptions are adequate. Those inputs -- we had no problems wit h either CONTAIN, the way it was performed, or the input assumptions used.

We think they're reasonable, and therefore we find basically that CONTAIN, or for that matter GOTHIC, or our First Principles model, it could be either could be used. Any one of those models could be used to demonstrate this room.

Therefore, CONTAIN 2.0 is adequate as any. Therefore, and their input conditions are adequate, and they seem to have performed it the right way. We checked their input deck. Therefore, their result of 92 degrees in 72 hours is valid.

DR. WALLIS: But this jump, this sudden jump to 85 degrees is really a very unphysical thing.

MR. O'DRISCOLL: That's correct, because they -- what they're doing is they're artificially holding the room at a high temperature, which wouldn't -- if you shut off all the AC, you wouldn't get -- it wouldn't go that high that fast.

DR. WALLIS: That's right. So it's very strange --

MEMBER ARMIJO: If it had been a calculation from the very beginning, the time they shut off the air, then it would have been a rise in the air temperature, and you wouldn't have these strange --

DR. WALLIS: Everything would be continuous. You wouldn't get these jumps and things.

MEMBER ARMIJO: Except when you turn off the heat.

DR. WALLIS: Except when you turn off the heat.

MR. O'DRISCOLL: That's not what was provided by, to the staff to review.

DR. WALLIS: Well, I guess your judgment is that everything is okay.

MEMBER STETKAR: I mean Antonio said that GEH originally ran essentially that analysis.

CHAIRMAN CORRADINI: But I think -- I don't think the staff would have accepted that original analysis, because that essentially takes credit for the fact that you were at your starting condition. They essentially assumed the worse case starting condition by essentially going to their limiting, their LCO for eight hours. Unless I misunderstood what Wayne said.

MR. MARQUINO: This is Wayne Marquino.

I believe the history is we didn't have a tech spec on the control room air temperature, and the staff asked us to put a tech spec in that was our analysis initial temperature. We said wait a minute. If we lock in this temperature, they're going to be shutting the plant down as soon as they lose HVAC.

At that time, we said we have to change the analysis to accommodate some duration of loss of HVAC.

MS. CUBBAGE: And to make up some of that. That's when they changed the tech spec temperature.

MEMBER ARMIJO: Sorry.

MS. CUBBAGE: Go ahead.

MEMBER ARMIJO: Why did you use the 120 pound concrete when your design is 150 pounds, and NRC picked 140? If there's any, you know. I just wondered why you'd make this problem tougher. You ought to be able to tell how much your concrete weighs.

MR. MARQUINO: Right, but it's just a little bit of conservatism that we added in the analysis, that lighter concrete has less heat capacity.

MEMBER ARMIJO: So you're saying maybe over time it may not be as good of a conductor?

MR. MARQUINO: No.

MS. CUBBAGE: It provides them some cushion.

MR. MARQUINO: We're sure that because there's a structural spec on the concrete, I think we would be justified in using 150 pound concrete in this analysis. But the person who did it initially chose to put that as a conservatism, and we haven 't -- we haven't found a reason to remove that conservatism.

DR. WALLIS: Well, I think if you had found your exceeded your criteria, you would have gone back and put in a realistic value.

CHAIRMAN CORRADINI: Now, now, now.

DR. WALLIS: So the reason the staff is happy is that the trends are about the same, and if you put in this realistic concrete, it comes, everything comes down by about the margin by which the staff is over the criteria.

MR. O'DRISCOLL: Yes. That's correct.

DR. WALLIS: So this concrete thing is important in reassuring us that everything is okay, right?

MR. MARQUINO: Yes.

DR. WALLIS: Otherwise, I think I might still have doubts, because it seems to me you can wiggle these things by how you sort of shake the whip at the beginning, and then it goes off and does its wiggle.

CHAIRMAN CORRADINI: Yes. I think it's called an initial value problem.

DR. WALLIS: Well.

MEMBER STETKAR: Well, I don't understand the undulation.

(Simultaneous discussion.)

MEMBER STETKAR: There are two different kinds of the two different models.

MEMBER ABDEL-KHALIK: Could you please put Slide 22, GE Slide 22 up? Let's look at that eight hour period initially. The air temperature is pretty much constant. It varies very slightly, right.

MEMBER STETKAR: Pretty much.

MEMBER ABDEL-KHALIK: What does that tell you?

MR. MARQUINO: Can you say the question again?

MEMBER ABDEL-KHALIK: Air temperature

is pretty much constant during that eight hour period.

MR. MARQUINO: Yes.

MEMBER ABDEL-KHALIK: What does that tell you?

MR. MARQUINO: That the control room is above normal.

MEMBER ABDEL-KHALIK: In terms of energy balance on the air within the control room. That means that whatever heat input you're putting in is --

MR. MARQUINO: Oh. Now let me clarify. So in that eight hour period, there's some -- there would be some HVAC function, we expect. But we've just put a boundary condition, air temperature, in of 85 degrees. And you were asking why did we assume it steps u p versus come up over time?

MEMBER ABDEL-KHALIK: No, no, no. I was just looking at what happens during that time period of eight hours.

MR. MARQUINO: Something happened to the HVAC system, and we assumed that it stepped the temperature up to 85 and then held it there. Because we don't know what's going to happen.

All we're trying to do is provide for 85 degrees as an upper limit. As long as it doesn't go above 85, you can keep going for eight hours.

MEMBER STETKAR: They're not modeling reality or anything during that T zero to T minus --

DR. WALLIS: You are modeling something. You're modeling the concrete temperature, aren't you?

CHAIRMAN CORRADINI: Right. That's all they're doing. That's all they're doing.

DR. WALLIS: So if you're i mposing 85 degrees on the concrete temperature, you know, you're not worry about the heat balance for the room itself.

MEMBER STETKAR: Correct.

MR. MARQUINO: Yeah. We're imposing 85 on the air, and then the concrete is heating up in this eight hours , and then at time zero, we stop all heat removal and trip most of the non-safety loads.

MEMBER ABDEL-KHALIK: And let the air and concrete float.

MR. MARQUINO: Yes.

MR. GALVIN: You also have, of course,

the boundary condition of, at least the peak, 117 degree air coming into the room.

MEMBER ABDEL-KHALIK: Right, which is the blue line.

MR. GALVIN: Which is the blue line.

DR. WALLIS: And this is only on the worse day of the year?

MR. MARQUINO: Yes. 117 would be the worst time of the year.

(Simultaneous discussion.)

DR. WALLIS: So we are looking at some extreme condition?

MR. MARQUINO: Yes. This is their --

(Simultaneous discussion.)

MR. O'DRISCOLL: Dennis, why don't we go back to the staff's presentation?

(Simultaneous discussion.)

MR. ARCARO: This is Mike Arcaro. To clarify what I did on that chart, all I did is put a forcing function on the chart that already exists, that showed the response. So you know, before the zero point on there, it's all made up. It's just a forcing function that shows what the model does for air at 85 degrees.

MR. HARBUCK: Okay. This slide may

look familiar because we presented it at the Chapter 16 briefing in August, and it simply reiterates what was already presented by GEH, explaining that the temperature specification is not just for the main control room, but for heat sinks in adjacent areas in the control building.

And just as a thought, I understand that all the other spaces stay within their EQ limits for the 72 hours also. So we've been focused on the control room, but I think the other spaces are also adequately maintained at temperature rises above these that are acceptable, and I don't know what those are.

And so the conclusion is that the analysis shows that the passive heat sinks will keep the control room at or below 93 degrees over the course of the 72 hour period post-DBA.

DR. WALLIS: This is according to the GEH analysis?

MR. O'DRISCOLL: Say again?

DR. WALLIS: According to the GEH analysis.

MR. O'DRISCOLL: According to the design basis analysis submitted.

DR. WALLIS: Submitted by GEH?

MR. O'DRISCOLL: That's correct.

MR. HARBUCK: All right, and then the CRHAV spec itself, the LCO is really focused, you know, it says heat sink temperatures have to b e this, but as has already been explained, we're assuming there's this equilibrium established between the air that's enclosed by the heat sinks. So we focused on what the air temperatures are and based the actions and conditions on that.

So there is this Action A, which as was previously explained, you get eight hours to get the air temperature back. The thought is that the temperatures of the heat sinks, having previously been equilibrium and a lower temperature, would not be significantly affected by that.

I think it's also -- well, if you just were to assume that the cooling units turned off, and the internal recirculation turned off. Then the rise in the temperature of the air over eight hours is also not that significant. If it got up to 85, of course it would trip off the N - DCIS load. So okay.

And of course the question is then is

how do we do the surveillance requirement? How do we determine if we have our heat sink temperatures are satisfied at 24 hours and that also was discussed in the two bullets there. You do some evaluation or you do a direct temperature measurement, make some inferences from that.

However, those are things for the licensee to work out in procedures, and I think, as they mentioned, they were going to have procedures for this.

DR. WALLIS: So this bulk average has to be calculated?

MR. O'DRISCOLL: It has to be justified. The spec is based on the average temperature of the heat sink. So either by direct measurement or by calculation, they have to say what' s the temperature inside that heat structure.

DR. WALLIS: So they may have to cool the control room below normal temperatures in order to recover from a high temperature transient, in order to get this back to --

MR. O'DRISCOLL: I don't think that's necessary.

DR. WALLIS: Calculate the transient in

the wall?

MR. O'DRISCOLL: If they restored their normal cooling, the room would soak at that temperature and become -- the bulk temperature would be satisfactory.

DR. WALLIS: Concrete relaxes to th e room temperature in 24 hours?

MR. O'DRISCOLL: Well, if you assume an eight hour excursion and only an eight hour excursion, you know, your LCO, Action Statement 1 requires you to restore the air temperature fast, eight years.

DR. WALLIS: Right. That's right.

MR. O'DRISCOLL: And then it allows you a longer period of time to restore the bulk average temperature of the heat sink to wherever it was.

DR. WALLIS: You've got some kind of wave that goes through the concrete?

MR. O'DRISCOLL: That could be developed through procedures.

DR. WALLIS: Is that you expect them to do, calculate that?

MR. O'DRISCOLL: That's one way of handling this surveillance.

MR. HARBUCK: Or rather this action requirement.

MR. O'DRISCOLL: This action requirement.

MEMBER ABDEL -KHALIK: So in the calculations that we were shown, this graph here --

MR. O'DRISCOLL: Yes.

MEMBER ABDEL-KHALIK: During this eight hour soaking period, whatever you called it, what was the assumption as far as the temperature distribution within the concrete?

MR. MARQUINO: It was not an assumption. It was calculated, so that the eight hour period --

MEMBER ABDEL -KHALIK: No. At time minus eight on this graph, what was the temperature distribution in the concrete?

MR. MARQU INO: It's actually given on the next slide. So Slide 23 shows the temperature after Step 1, which is the normal operating soak period, and the temperature at the end of Step 2, which is the eight hour abnormal high control room temperature, and the temperature at the end of 72 hours, without cooling and without safety-related loads.

MEMBER ARMIJO: So okay. So the outside temperature was 76 degrees?

DR. WALLIS: That leaps up?

MR. O'DRISCOLL: No. You're looking at one heat structure. I believe it's the worse case heat structure. It's the ceiling of the control room.

You have a very hot room above it, a Q, excuse, me, an N -DCIS room, I believe, are above the control room, and that's the heat structure that was chosen by GE -Hitachi to show h ere. That's not the outside of the --

MEMBER ABDEL -KHALIK: That's not the outside level?

MR. O'DRISCOLL: That's not the outside in the air. That's an adjoining room.

DR. WALLIS: Which is hotter somehow.

MEMBER ABDEL -KHALIK: But within the concrete, the temperature at the beginning on the concrete control room air interface, the temperature was what, 74 degrees?

MR. MARQUINO: Yes. The air temperature was 74 degrees, right.

MEMBER ABDEL-KHALIK: Okay, and at the

other side of the concrete, the temperature was what, of the concrete?

MR. O'DRISCOLL: 76.

MR. MARQUINO: Yes.

MEMBER ABDEL-KHALIK: It looks like 76 something. Is that what you would expect, even in the concrete that's in contact with the soil?

MR. O'DRISCOLL: No, no, no . That's only one heat sink. There's one structure. If you think about it, it's just one wall. So this particular wall has got a heat source.

It's got some equipment that's pumping some heat into that piece of concrete. So for that particular wall , that's the expected soaked profile, unless I'm mistaken, what you'd see through that wall.

MR. MARQUINO: That's right, and to get back to the original question, you said what's the temperature after eight hours?

MEMBER ABDEL-KHALIK: No, no, no. I' m just trying to understand --

MEMBER STETKAR: The graph.

MEMBER ABDEL-KHALIK: The assumptions that you're making in doing this calculation.

MR. MARQUINO: Right. It was a

calculation of the concrete temperature. The concrete temperature was not an input.

MEMBER ABDEL-KHALIK: But the results of all this analysis depends on what you assume as far as the initial temperature distribution within the concrete, because that will determine the initial average temperature for the concrete, and that's what I'm trying to get to.

MR. O'DRISCOLL: Yes.

MEMBER ABDEL-KHALIK: And let's look at a concrete wall that's in contact with the soil.

MR. O'DRISCOLL: Okay.

MEMBER ABDEL-KHALIK: Okay. At time minus eight in this analysis, which is the beginning of your soaking period, on the inside surface of the concrete, the temperature is 74 degrees. What is the temperature on the outside surface that is in contact with the hot source?

MR. MARQUINO: Well, you're asking about the soil? It would be the soil temperature. Is it 86 degrees?

MR. O'DRISCOLL: 86 degrees is what was assumed as soil temperature. The uniform soil temperature of 86 degrees. So for that one wall, you have one side of it touching 86 degree soil;

the other side, 74 degrees air, correct.

MR. HARBUCK: Not necessarily what group heat sink is that?

MR. O'DRISCOLL: That's a different group. The heat sinks --

MR. HARBUCK: So it's going to be the temperature for the limit on that group?

MR. O'DRISCOLL: That's correct.

MR. HARBUCK: Which could be 78, 104, whichever it is.

MR. O'DRISCOLL: Right.

CHAIRMAN CORRADINI: I think what Syed's asking, I know where he's going with it, he's trying to understand the situation going in, and I guess I'm guessing that the situation going in is what you said for the soil temperature. But everywhere on the building, because you have active HVAC, it's cold.

But somewhere out there, you've got damn hot air in the atmosphere that's then eventually, once you get through your eight hours of some artificial heat-up, it has to penetrate through all of this to essentially heat up the room.

MR. MARQUINO: That's right. So the

situation going in is all the rooms are at their maximum tech spec temperature, even though it's 117 degrees out side. But all the HVAC is working, at least within its specified value.

And then something happens to the control room HVAC, and the control room temperature goes up to 85 degrees, and now we calculate for it at the end of eight hours, what are the co ncrete temperatures, what's the concrete temperature distribution, and now we lose off site power and we start a 72 hour heat - up from that point.

MEMBER ARMIJO: What fraction of the total surface area that you're dumping heat to is the outside wall? Is it a fourth of it or an eighth or you know I know you've got a lot of walls.

MR. MARQUINO: The control room habitability area itself is, doesn't touch the ground on the outside.

MEMBER ARMIJO: It's totally surrounded by internal walls?

MR. MARQUINO: Right.

CHAIRMAN CORRADINI: But I think the key thing is that I think John said it privately.

Because of emergency air so nobody's asphyxiated, the infiltration is high. That's the biggest heat source in the surrounding, that's causing this whole thing to go up. Then they have the swing of that stuff as it goes through the time period.

MEMBER ARMIJO: Right.

MR. MARQUINO: Antonio, did you want to add something?

MR. BARRETT: I was just going to, a small clarification. This is Antonio at G EH, that there is a small portion that's -- of the control room habitability area that is in contact with the soil. But it's not --

MEMBER ARMIJO: It's not much.

MR. BARRETT: It's a smaller portion. Most of it is contained by other rooms. They're surrounded by other rooms and a hallway.

MEMBER ARMIJO: Okay, thank you.

MEMBER STETKAR: Craig, I've got a question of the tech specs. I've been searching, you know, thanks to GEH, I found the surveillance requirement for verifying that indeed the temperature sensors turn off the non -safety related loads. That's performed once every two years.

I still cannot understand whether or not there is an LCO on operability of those temperature sensors, because you know, LCOs are different from surveillanc e requirements. Why can't I take out --

MR. HARBUCK: The LCO is on the automatic function, to turn off the NDCIS loads.

MEMBER STETKAR: But I don't --

MR. HARBUCK: And that surveillance requirement verifies that function.

MEMBER STETKAR: Where is the LCO on that function?

MR. HARBUCK: Up in the beginning section of Chapter 3, the tech specs, there is an LCO, I mean a surveillance requirement called SR-302. It says if you don't meet a surveillance requirement, you don't meet the LCO.

MEMBER STETKAR: But that presumes that since I'm only performing that surveillance once every two years, it presumes that those things are always operable.

MR. HARBUCK: There is a presumption of operability.

MEMBER STETKAR: Well, but it says that

I can't take them out of service for maintenance. Suppose one fails during normal operation? What do I do?

MR. HARBUCK: Okay, there's three divisions required. So you take one of the divisions out. You would go to the actions of the LCO, to see -- now I think the control room habitability area is, it's got two trains. So but I'm not sure about exactly how the instrumentation is.

MEMBER STETKAR: That's the thing I'm struggling with because again, I'm trying to do this real-time and in fairness to every one, I've not been able to -- I'm trying to flip back and forth between the actual LCO statements and the basis documents, to see --

The basis documents discuss the function of de-energizing the non-safety loads. But everything that I read in the LCO statements is with respect to other functions, you follow me? It's for things like isolation. It's for things like starting. It's, you know, the two trains of ventilation and things like that.

It's, you know, the items you have identified here on Slide 9, the temperatures and things like that. I don't -- if I'm an operator, I don't see how my operation is limited, if for example I remove two of these particular temperature sensors from service, for whatever reason.

MR. HARBUCK: I'm sure you're familiar with RIS 2005 -20, that was updated in 2008, dealing with degraded non-conforming conditions and talks about operability, and you know, operability is something that you -- it's determined not, say outside the tech specs.

And then if you determine that you're not operable, then you do what the tech specs tell you to do.

So in this case, if you don't meet this surveillance requirement for one or more of the divisions, or one or more channels, one or more of the detectors, then you take the actions that are specified in the associated LCO. In this case, you would be looking at the operability of the CRHAVs.

MEMBER STETKAR: That's the point that I'm struggling with, because --

MR. HARBUCK: Right. So if you determine that the way the tech spec is written, if you determine that this automatic securing of non-safety loads at 85 degrees was not functioning, either through the sensors being inoperable or the logic being inoperable, then you would have to declare both trains of CRHAVs inoperable, be cause you could not meet the surveillance requirement, and you'd be shutting down.

That's, in this case the tech specs are rather severe, I think.

MEMBER STETKAR: As long as that's a uniform interpretation. You see, I look at other parts of the SBW R tech specs, where they do have explicit LCO statements for instrumentation, and also surveillance requirements for the instrumentation.

So I have both of those established. If I have an instrument channel out of service for 12, you know, I can have it out of service for 12 hours. I only require three, but I basically can have two out of service for 12 hours, and then I must shut down.

In this particular case, I don't have that type of statement. That's why I was curious about that.

MR. HARBUCK: Right.

MEMBER STETKAR: Because it's -- I wouldn't be so concerned, but it's a pretty important function in these room heat-up analyses.

If I don't actually shut off those non - essential loads at 85 degrees Fahrenheit, I'll get a different response. I have no -- like I said, I don't know how these things work, but I have no idea what that response will look like, but certainly the end point temperature will be higher.

So it's a pretty important function. I just want to make sure that people opera ting the plant recognize the importance of that function, and that if I happen to take two of those particular temperature sensors out of service, that I have -- I may have a problem. I don't read that in the tech specs.

MR. HARBUCK: I would have to defer to the instrumentation experts regarding the specific design, the number of sensors and how those are computed in the average temperatures and how --

MEMBER STETKAR: Best as I can tell,

it's four, in the two out of four.

MR. HARBUCK: But how the -- you know, is it -- I mean I'm just not sure exactly how it's done, but --

MEMBER STETKAR: Well maybe -- you know, we're running long here.

MR. HARBUCK: But I stand by my statement. I think it's clear from the way the tech specs are structured and written, that you'd have to declare both trains inoperable.

MEMBER STETKAR: I understand if they don't, if they run the surveillance and it fails.

MS. CUBBAGE: That wasn't what he said.

MEMBER STETKAR: I understand what I have to do as an operator under those conditions. That's really clear. What I'm talking about is I perform the surveillance, everything works.

A month later, for whatever reason, Joe comes into the control room and says hey, we want to do some painting and those temperature sensors are in the way. Can you de-energize them for the next three hours or six hours or two days?

If I'm an operator, what do I understand about that?

MR. HARBUCK: There's SR-301 up in the

front says that surveillance requirements have to be met w henever the LCO is within its applicability, all right. So whether -- so meeting a surveillance is not just when you perform it, but it's all the time.

So whatever criteria you have to satisfy to meet the surveillance, if you have reason to believe th at criteria is no longer met, which you wouldn't be if you took it out of service and de-energized it.

Then you would say hey, you know, I'm inoperable. Now you have to figure out what is the impact on the systems that are supported.

MEMBER STETKAR: Okay.

MR. HARBUCK: I'll just make this comment. I think there are probably other ways to write the tech specs for this particular function, and the actions. You could be perhaps more specific to this function and that sort of thing. But that's not what GEH has proposed.

MEMBER STETKAR: Well, you know, I'm just questioning. I understand what they proposed, and I understand the desire to keep as much equipment as possible out of the technical specifications. I also understand the desire to make sure that the operators don't inadvertently place the plant in a vulnerable condition, because they aren't -- because the tech specs might be somewhat convoluted, and it's not clear, you know, how they would interpret that configuration.

MS. CUBBAGE: All right. Could I interject here please? Craig Harbuck is our technical specification expert. He is an expert in how tech specs are interpreted, etcetera, etcetera. He's well -known with the staff for an expert in this area.

He has told you how this would be interpreted. If you have disagreement with us on that, we'll have to take that up. But this is our position.

MEMBER STETKAR: Okay.

MR. HARBUCK: We'll go to the next one.

MR. O'DRISCOLL: I'll do this. I'm presenting the following slide on behalf of Brad Harvey. Brad is our meteorologist in the Siting and Accident Consequence Branch or SAC. My name is Jim O'Driscoll.

Within the division of -- well, Brad is a meteorologist in the Siting and Accident

Consequence Branch within the Divisi on of Site and Environmental Reviews, the SER. I'll be discussing the addition of the three new site temperature site parameters to support the control room habitability area heat -up analysis that was presented during the August ACRS meeting.

In particu lar, I would like to address the concern expressed during the August ACRS meeting that unequivocal methodology should be specified regarding how COL applicants are to determine their site characteristic values, that correspondence to the control room habit ability area heat-up analysis site parameter values.

The applicant has made a change to its definition of the control room habitability area heat-up analysis site parameter values, which they presented to you earlier this afternoon. The staff believes t hese changes will help alleviate the ACRS' concern.

My goal this afternoon is to (1), describe the basis for the three control room habitability area heat -up analysis site parameters, (2) describe the revised methodology to be used by the COL applicant in deriving the corresponding site characteristic values.

I will also used the revised control room habitability area heat-up analysis site parameter definitions to review the three example site-specific cases presented during the August ACRS meeting. I mean we can do one, if that's satisfactory.

The table -- next slide please. That's right. The table in the slide before you lists the ambient site temperature site parameters that are to be included in the ESBWR DCD. The three site parameters listed in bold at the bottom of this table are the new set of ambient design temperature site parameters related to the control room habitability area heat-up analysis.

Also note that a zero percent exceedance maximum dry bulb of 117 degrees Fahrenheit, the ze ro percent exceedance non - coincident maximum wet bulb of 88 degrees Fahrenheit, and the zero percent exceedance minimum dry bulb of minus 40 degrees Fahrenheit remain as site parameters, as these values are an important input to the control room habitabili ty area heat-up analysis.

If I can just -- as the person who has

reviewed this, I can talk a little bit about sensitivities, in case you have questions about what happens if, let's say, things are different than what they proposed. Next slide.

DR. WAL LIS: Is this different from what we saw last time?

MR. O'DRISCOLL: The slides themselves are slightly different. But the key thing, I think, I believe it was you that requested or brought up the point that the three day period, the terminology they used, three days, was kind of ambiguous.

DR. WALLIS: That was the problem, yes. But this chart is the same, this table that we just saw.

MR. O'DRISCOLL: Yes, yes, exactly the same.

DR. WALLIS: So nothing has changed?

MR. O'DRISCOLL: That's correct.

MR. GALVIN: So do we want to just skip the three-day thing?

CHAIRMAN CORRADINI: No, no. Let's just continue.

MR. GALVIN: Okay. Just keep going through it.

MR. O'DRISCOLL: Okay. The 103.5 degree Fahrenheit value for the site parameter was derived by averaging the zero percent exceedance maximum dry bulb site parameter value of 117 degrees Fahrenheit, and the dry bulb temperature resulting from a daily temperature range of 27 degrees Fahrenheit.

The correspondence site characteristic value is determined by averaging the site specific zero percent exceedance maximum dry bulb temperature and the dry bulb temperature that corresponds to the higher of the two low dry bulb temperatures occurring within 24 hours before and after the zero percent exceedance maximum dry bulb temperature.

DR. WALLIS: Now this first thing, 103.5, I think, is 117 minus a half of 27. Isn't that what it is?

MR. O'DRISCOLL: Yes. It's 103.5 minus half of 27.

DR. WALLIS: But it's not the average of 117 and 27. The words are strange in the slide. It's actually the mean. It's 117 minus a half of 27. So it's assuming that it's a symmetrical curve. But the words are strange.

It's not the average of 117 and 27. But I understand what you did. It's just the words don't make sense. They don't seem to be consistent with what was done.

CHAIRMAN CORRADINI: Can you just go back to the definition again, and just let us maybe stare at it for a minute, so we get clear on it?

DR. WALLIS: I understand. The 103.5 is 117 minus a half of 27. So it's simply the average when you take a curve, which oscillates between 117 and 90, whatever it is.

MR. O'DRISCOLL: Right. I mean what we had to do here, I mean we know what we're doing. What we're trying to do here is give an applicant, who is somebody -- a COL applicant who is looking at sites, a box.

DR. WALLIS: I understand that. It's just the words don't seem to correspond to what you did. That's all.

MR. GALVIN: It could have been written in a better way.

MEMBER ARMIJO: Yes. It's not --

MR. O'DRISCOLL: So that's the site parameter value, and determining the corresponding site characteristic value below, looking at that definition.

CHAIRMAN CORRADINI: So is the corresponding site characteristic value i s what the COL applicant would have to do at their site to compare to the 103?

MR. O'DRISCOLL: That's correct.

CHAIRMAN CORRADINI: Thank you.

MR. O'DRISCOLL: Yes, that's correct.

CHAIRMAN CORRADINI: Okay, thank you. That's all I wanted to know.

MR. O'DRISCOLL: Okay. Next slide. Here's an example. As an example, the blue line in this slide before you shows a plot of hourly dry bulb temperatures that occurred from 36 hours before to 36 hours after occurrence of a zero percent exceedance max imum dry bulb temperature of 110.

So here we have a site. Here's some met data. We found our hottest zero percent exceedance point, and we have the time between, before and after. The higher of the two low temperatures occurring within 24 hours before and after the zero percent exceedance maximum dry value, dry bulb temperature is 77 degrees.

That's the dark black one.

The maximum average dry bulb temperature for the zero percent exceedance maximum temperature day is therefore an average of 110 and 77, which is 93.5, which is below 103.

Next slide. This is basically the same thing, but for the winter case. The minus 26.5 degree Fahrenheit value of the site parameter was derived by averaging the zero percent exceedance minimum dry bulb site parame ter value of minus 40, and the dry bulb temperature resulting from a daily temperature range of 27 degrees.

The corresponding site characteristic value is determined by averaging the site - specific zero percent exceedance dry bulb temperature and the dry bulb temperature that corresponds to the lower of the high dry bulb temperatures occurring within 24 hours before and after the zero percent exceedance minimum dry bulb temperature.

As an example, the blue line in this slide before you shows a plot of ho urly dry bulb temperature that occurred from 36 hours before to 36 hours after the occurrence of a zero percent exceedance minimum dry bulb temperature of minus

17 degrees Fahrenheit.

The lower of the two high temperatures occurring within 24 hours befor e and after the zero percent exceedance minimum dry bulb temperature is zero degrees Fahrenheit.

The minimum average dry bulb temperature for the zero percent exceedance minimum temperature day is therefore an average of minus 17 degrees Fahrenheit and z ero degrees Fahrenheit, which is minus 8.5 degrees Fahrenheit.

MEMBER ABDEL -KHALIK: Well, isn't it the average of minus 17 and minus 7, if I look at this graph?

MR. O'DRISCOLL: Minus 17 and minus what?

MEMBER ABDEL-KHALIK: Minus 7, which is the mi nimum immediately prior to the minus 17 minimum, rather than the zero.

MR. O'DRISCOLL: We assume a -- we're trying to figure out a diurnal swing. So we're saying -- we're assuming generally that the day gets -- during the day it's warmer; during the night it's cooler. So when we look at the peaks and we try to find the peak, and then determine -

- that will determine a diurnal swing.

DR. WALLIS: But doesn't it depend on where you draw the black lines, the vertical lines? I mean how do you define this diurnal?

MR. O'DRISCOLL: We look for the -- it's based on the zero exceedance low.

DR. WALLIS: So from 12 o'clock to 12 o'clock or what?

MR. O'DRISCOLL: No. It's based on the time of the low occurring.

DR. WALLIS: Time of the minus 17?

MR. O'DRISCOLL: That's correct.

CHAIRMAN CORRADINI: So they looked, if I -- just to say it back to you so I get it right. You looked where you got over a plus or minus, a 48 hour period the lowest, and then you went 24 hours behind and ahead and took the lowest of the two highs?

MR. O'DRISCOLL: That's correct.

DR. WALLIS: This is an effort to make it unequivocal. You center yourself on that minus 17?

MR. O'DRISCOLL: That's right.

DR. WALLIS: Okay.

CHAIRMAN CORRADINI: Oh, I see. All

right.

MR. O'DRISCOLL: Okay, next slide.

CHAIRMAN CORRADINI: Now the one.

MR. O'DRISCOLL: Yes. First --

DR. WALLIS: Now that number is not necessarily the peak of the curve. It's the maximum throughout the day, which could be at the end of it?

MEMBER STETKAR: Which is what that curve said.

DR. WALLIS: Okay. That was the problem we had before too. Thank you.

MR. O'DRISCOLL: Okay. First recall that the wet bulb globe temperature, WBGT index is defined, for this case, for the ESBWR control room in this analysis, as 0.7 times the wet bulb temperature, plus 0.3 times the coincident dry bulb temperature.

This 86.5 degree Fahrenheit value is a site parameter. Site parameter was derived by averaging the wet bulb glow temperature index for the zero percent exceedance maximum wet bulb site parameter value of 88 degrees Fahrenheit, and assuming a coincident dry bulb temperature of 92 degrees.

The wet bulb globe temperature index resulting from the high humidity diurnal dry bulb temperature sw ing is eight degrees. That is a dry bulb temperature of 84 degrees, assuming a coincident wet bulb temperature of 84 degrees. That's what was assumed in the analysis.

DR. WALLIS: It's 100 percent humidity?

MR. O'DRISCOLL: Yes, 100 percent. That's what the applicant assumed as a worse case wet day, wet conditions. So we have to now compare our site, our picked site to this number, this site parameter.

The corresponding site characteristic value is determined by averaging the wet bulb globe temperature index coincident with the site-specific zero percent exceedance maximum wet bulb temperature, and the wet bulb globe temperature index coincident with the wet bulb temperature that corresponds to the highest of the six low wet bulb temperatures occu rring in each of the three 24 hour periods before and after that zero percent exceedance maximum wet bulb temperature.

So in this case, we're trying to, you know, a lower diurnal swing is worse. If you have -- if you stay, for this particular analysis, if you stay close to very high unit conditions, you'll end up with a more stressful effective temperature in the control room.

Okay. This is the Slide 16. As an example, the green line in this slide before you shows a plot of hourly wet bulb temperatures that occurred from 84 hours before to 84 hours after the occurrence of a zero percent exceedance maximum wet bulb temperature of 75 degrees.

DR. WALLIS: All pinned on the 75?

MR. O'DRISCOLL: That's correct.

DR. WALLIS: Right.

MR. O'DRISCOLL: Similarly, the blue line shows a plot of coincident hourly dry bulb temperatures for the same time period. Notice that the dry bulb temperatures coincident with the zero percent exceedance maximum wet bulb temperature is 95 degrees.

This results in a w et bulb globe temperature index of 81 degrees Fahrenheit for the hour when the zero percent exceedance maximum wet bulb temperature occurred. The highest of the six low wet bulb temperatures occurring in each of the three 24 -hour periods before and after the zero percent exceedance maximum wet bulb temperature is 59 degrees.

DR. WALLIS: No, because these six minimums you've shown here are all actually minimums of curves. But they could be minimums of the extreme of the day.

MR. O'DRISCOLL: Right.

DR. WALLIS: Because that was a point we had, trouble we had before. If say the curve where you show a 56, if that curve had actually gone down, so that it was a 53 at the end of the day, you've picked the 53?

MR. O'DRISCOLL: That's correct, that's correct.

DR. WALLIS: Right. So it's the absolute lowest one throughout that period?

MR. O'DRISCOLL: That's correct.

DR. WALLIS: It's not the bottom of a --.

MR. O'DRISCOLL: Right. Okay.

MEMBER ARMIJO: Sort of like the 59, right?

MR. O'DRISCOLL: Okay.

DR. WALLIS: It's clear to me that you've got a clearer definition. Why you have this as a definition, I have no idea.

MR. O'DRISCOLL: I'll get to that. The coincident dry bulb temperature is 68 degrees for that wet bulb temperature, res ulting in a wet bulb globe temperature index of 61.7 degrees for that point. The maximum high humidity average wet bulb globe temperature index with a zero percent exceedance maximum wet bulb temperature days.

Therefore, the average of 81 degrees and 61.7 degrees Fahrenheit, which is 71.4 degree Fahrenheit. That's one example of how to do this. Now is there --

CHAIRMAN CORRADINI: Go ahead.

MEMBER STETKAR: Another example of how to do this is if I look at your plot there, and I look at the right -hand vertical dash line, which is actually the maximum dry bulb temperature, which looks to be about 103 degrees Fahrenheit, and the coincident wet bulb temperature obviously must be a little lower than 75, or else you would have identified it. So let's call it 74.

I back up 48 hours from that, and I look at the other peak over there, which looks like a dry bulb temperature of 80 degree Fahrenheit, with a wet bulb of let's call it 60.

You know, I get an average of 74.4 degrees or three degree higher than yours.

So the point is there are other ways of calculating this, and your method doesn't necessarily, and I'm not trying to necessarily maximize the temperature. I might be able to maximize it, you know, by doing some other manipulations of this particular set of data.

MR. O'DRISCOLL: Right.

MEMBER STETKAR: The question is if I'm looking to an applicant now, a COL applicant, to confirm that their meteorological conditions are bounded by the DCD calculation of whatever it is, 86.6, and if they're close to that margin, the way that you tell them to calculate that, you know, if I'm a plant in the southeastern United States.

If I'm close to that margin, the way that I calculate this, those rules that you're establishing there, might not lead to an appropriate result.

MR. O'DRISCOLL: Right, and I think I have an answer for that. I can give you an answer to that, and this might, may or may not help. But we did a sensitivity run. As an example, the staff performed a CONTAIN run where the extreme combination of dry bulb and wet bulb temperatures were used, with no swing.

Okay, this was 100. We used 116 degrees Fahrenheit dry bulb, and 33 percent relative humidity, resulting in 88 degree Fahrenheit coincident wet bulb. Now these parameters are well outside the applicant's design envelope, and are not realistic for any sites, in my opinion.

The temperature was not allowed to vary, so there's no swing.

MEMBER STETKAR: So just to make sure I understand, 72 hours, 88 degrees wet bulb.

MR. O'DRISCOLL: Wet bulb. 116 degree dry bulb, okay? The resulting CONTAIN results was 93.1, okay. This is the applicant's CONTAIN analysis. It was .1 degrees above their acceptance criteria, okay, in the main control room, with an 86.4 degree wet bulb global temperature index.

So for that case, they're actually below their acceptance criteria, which is 89 degrees.

DR. WALLIS: Even though there are no

swings at all?

MR. O'DRISCOLL: No swings at all.

MEMBER STETKAR: This is flat.

MR. O'DRISCOLL: Right. They calculated --

(Simultaneous discussion.)

MR. O'DRISCOLL: I won't ask that one.

MEMBER STETKAR: That's a pretty good calculation.

MR. O'DRISCOLL: Okay. We also did a run --

DR. WALLIS: Bounding calculation.

CHAIRMAN CORRADINI: I guess I -- can you just say it again slower?

MR. O'DRISCOLL: Okay. I'm going to talk about two sensitivity analyses on this.

CHAIRMAN CORRADINI: That's fine. But just do the one you just did again.

MR. O'DRISCOLL: Okay. As an example, the staf f performed a CONTAIN run where the extreme combination of dry bulb and wet bulb temperatures were used, with no swing.

This was 116 degrees Fahrenheit dry bulb, and 33 percent relative humidity, which results in an 88 degree Fahrenheit coincident wet bulb. This input parameters are well outside the applicant's design envelope, and are not realistic for any site, in my opinion.

The temperature was not allowed to vary. The resulting CONTAIN results was 93.1 degrees dry bulb in the main control room, wi th an 86.4 degree wet bulb globe temperature index. The calculated wet bulb globe temperature index is still within the ITAAC acceptance criteria.

We also did a run with the worse case non-coincident wet bulb allowed with no swing. In order to maximize the humidity in the control room, we made the coincident dry bulb 88.

The resulting CONTAIN results was 90 degrees Fahrenheit in the control room, with a wet bulb globe temperature index of 88.32 degrees. The calculated wet bulb globe temperature index is more than one degree lower than the applicant's proposed ITAAC acceptance criteria for the wet bulb globe temperature index.

Based on these examples, it can be reasoned that a failure to select the correct high site -specific wet bulb globe temperatur e index temperature result results in low risk that a site would be selected that has environmental parameters that would result in failure to meet the ITAAC acceptance criteria.

That is, an error in the calculation in the site-specific magnitude of the daily average dry bulb swing for use in the high humidity case, would result in very low risk of failure to meet the ITAAC acceptance criteria for the as -built plant.

MEMBER STETKAR: Essentially what you're saying is it doesn't make too much difference precisely how you specify those --

DR. WALLIS: You did a bounding calculation, bounding the worst you could possibly be. So I don't understand why you deal with all these wiggles on that.

CHAIRMAN CORRADINI: Because the wiggles are real, so they've got to --

MEMBER STETKAR: Well, the wiggles are real. You still, you know, Jim was careful to say in his opinion, those conditions would never be exceeded at a site, if you have some place in the swamps of Lord knows where.

CHAIRMAN CORRADINI: Brazil.

MEMBER STETKAR: That might be

exceeded.

DR. WALLIS: Oh, I see.

MEMBER STETKAR: So you still have -- the COL applicant still has to do some sort of confirmation, that indeed --

DR. WALLIS: So it's more 116 degrees on the average or something?

MR. MARQUINO: This is Wayne Marquino. Maybe I can wrap this up. GE has done similar calculations, and we agree with the staff that -- we found that it's the high temperature that's most important, and the low temperature and the swing is not very important.

In terms of why didn't we do the analysis that way? Number one, we didn't know that when we started. Number two, if we had done it that way, people would say everyone knows the temperature drops at night. Why didn't you include that in your analysis?

DR. WALLIS: Because you were being conservative.

MR. MARQUINO: So we have an analysis with something similar to the sinusoid variation in temperature. You see weather data which isn't very sinusoidal, but the staff has worked out a parameter that characterizes the real weather, and it seems to be adequate to me.

MEMBER ARMIJO: And that's the index?

MR. MARQUINO: Yes, that's that index.

CHAIRMAN CORRADINI: I might be speaking too much for the rest of the Committee, but I don't think we want any more examples.

DR. WALLIS: Well, I'm just happy that 5046 is simpler.

(Laughter.)

MEMBER ARMIJO: This is a lot like IRS inspections.

(Laughter.)

MR. HARBUCK: Okay. Why don't we go to the language of the --.

(Simultaneous discussion.)

MR. HARBUCK: This sort of revisiting the issue of the temperature monitoring in spaces outside the control room, and why don't we have an LCO on that. So first, let me address why we have an LCO on the heat sink temperature for CRHAVs. I'll be not as explicit as could be. We do it through a surveillance requirement.

But the CRHAVs meet CLCL (ph) Criterion 3, and its passive cooling function depends on the heat sink initial temperatures, and it's also part of the primary success path for a mitigated condition that you would have.

And then you deviated where you lost power, so you didn't have the normal cooling function, and because it supports control room habitability to meet GDC -19. So that's why we have CRHAVs.

Now going back to this o ther, in the past, we did have technical specifications on area temperature monitor and also on systems that were in place to maintain temperatures, that latter being Hatch Unit 1, which had custom tech specs, and the Hatch Unit 2, which had the old standard tech specs, and these are BWR -4, with a Mark I containment.

In the BWR standard tech specs, it's Grand Gulf Unit 1. It had an area temperature monitoring tech spec. Now when we -- when the interim policy statement in 1987 established the criteria fo r what you have to have an LCO for, the industry was asked to go and take a look at the standards at the time, and specifically base it on existing plant's tech specs, and for BWRs, Hatch Unit 2 and Grand Gulf Unit 1 were chosen.

Hatch Unit 1 was chosen also, but it didn't appear in the initial report from GE, the topical report, which you may have heard mentioned.

And the conclusion of that analysis was that the area temperature monitors did not meet the criterion, and also, when we did the conversion of the Hatch Unit 1 tech specs to the standard, we came to the conclusion that the room air coolers also did not meet the criteria.

Because the purpose of both of these flavors of tech specs was simply to maintain equipment qualification, and indeed the action requirements simply stated well, as long as temperature's not too high, just write a report. If it is higher than say 30 degrees, write a report, but also shut down the plant.

So in the Hatch tech spec, the custom tech specs say to say hey, if the room coolers aren't working, shut down the plant, you know. that was the action requirement, was to shut down. So with the criteria for what needs to be, we need to have an LCO for, we -- what am I trying to say is that the issue here is equipment qualification.

If the temperature of the room is not what it's normally supposed to be, then you evaluate what's the impact on operability of any equipment in the room. And you do that using the guidance that's been provided by the staff in RIS 2005-20.

There's still lots of things that go into the operability of a piece of equipment, and equipment qualification is one. So there's -- I have summarized the criteria there's that -- because to address this temperature monitoring, because we don't usually inc lude monitoring instrumentation or indication -only instrumentation in tech specs, with the exception of those that are used to detect degradation of the reactor pump pressure boundary.

These temperature monitors are not in the primary success path for an y accident, and the monitors are also not in initial conditions for any DBA, or the temperature is not initial conditions for any design basis action.

However, if in your operability assessment, upon having a high temperature in the room, you determine t hat that equipment can no longer be considered operable, then you would take the appropriate LCO actions. So the conclusion is is that 5036 does not require an LCO for the temperature monitors on the heat sinks or the temperatures themselves.

DR. WALLIS: Do I go back to Jim? I don't understand what you said. We saw these curves with these diurnal variations, and we saw the response of the control room. At night, the rate of increase decreased, by the way.

I thought you said that you did a run where you kept the temperature 116 all the time, without cooling down at night? Is that what you said?

CHAIRMAN CORRADINI: That's what he said.

DR. WALLIS: And you still met the criteria, which is sort of hard to believe, when you look at this curve, and the night has a big effect.

MR. O'DRISCOLL: Well, we were above -- I mean we were 93.1. So the applicant's analysis was 93.1

MEMBER STETKAR: That was a GE CONTAIN analysis, not the staff's analysis.

MR. O'DRISCOLL: Right. We did it on -

- once we were satisfied with CONTAIN 2.0, we did these on CONTAIN 2.0.

DR. WALLIS: Well, what is the -- but the CONTAIN analysis, G analysis for this one is pretty close to 93, isn't it?

MR. O'DRISCOLL: Okay. I can compare the two runs. I've got them here.

DR. WALLIS: It's 92, right, and you've got one degree more?

MR. O'DRISCOLL: Yes.

DR. WALLIS: You got one degree more.

MR. O'DRISCOLL: You have, let's see, 92.04. You have about 1.0, something, not even -- a little bit of a smidgen over a degree.

DR. WALLIS: Well it's hard to believe, when you look at how much this heats up during the day, and how much it doesn't heat up during the night.

MR. O'DRISCOLL: Well because, you know, your EFU has got 460 -- there's only a small amount of air c oming in. All that air is coming in from that emergency fan unit. The control room is buried inside the control building, but it';s getting this hot air coming in, and that heat that's used in the model is the sensor wall heat and the humidity that's contained in the air that's being pumped into the room.

DR. WALLIS: I think the humidity may do it, because the humidity -- the water content stays constant, whether you cool down or not.

MR. O'DRISCOLL: The biggest concern when we look at it generally was humidity issues, and the human performance impact. We were much closer to acceptance criteria on humidity for this room. If the room gets very humid, it gets --

DR. WALLIS: That could be what's doing it, because I think when you cool down at night, you don't change the water content of the air. The water doesn't disappear. The water just gets a high humidity level.

MR. O'DRISCOLL: That's right, that's correct.

DR. WALLIS: Wet bulb doesn't change that much.

MR. O'DRISCOLL: That's right. The water content stays in. The relative humidity goes up when the --

DR. WALLIS: Well, it's still a little

hard to believe.

CHAIRMAN CORRADINI: I think John has a question.

MEMBER STETKAR: No, I don't.

CHAIRMAN CORRADINI: Oh, I thought you did.

DR. WALLIS: It's hard to believe.

MR. GALVIN: Okay. So this one wasn't actually -- this goes down to 20 percent at --

(Simultaneous discussion.)

MR. GALVIN: 93 humidity. It's a different case.

MR. O'DRISCOLL: Yes.

CHAIRMAN CORRADINI: This is a 20 percent relative humidity case. This is nice dry air.

MR. O'DRISCOLL: This is a separate analysis entirely from what I've shown here.

MEMBER STETKAR: Okay. So this is -- I should take this.

MR. O'DRISCOLL: Yes, please.

CHAIRMAN CORRADINI: Other questions? Okay. You guys did an absolutely excellent job. I figure we'd never come to a good understanding of this. But excellent job.

MR. O'DRISCOLL: Thank you.

DR. WALLIS: Excellent job. Still, they still have to use some en gineering judgment to decide whether it's okay or not.

CHAIRMAN CORRADINI: Thank God we need engineers.

DR. WALLIS: It certainly will be nicer if it would -- well, for me, it would be nicer if it's more clear-cut and didn't depend upon these odd init ial conditions and things like that. Maybe I should just say I rely on your judgment and I don't have to assert my own.

MR. GALVIN: I mean I think like what Mike Arcaro said. It's somewhat of an artifact of the way this analysis was performed and developed over time.

DR. WALLIS: It's also the worse condition. I mean it's the worse day of the year and everything else.

MR. GALVIN: I have to do an operability analysis if it gets -- if you don't choose the worse day of the year.

MS. CUBBAGE: All right, so we're done.

CHAIRMAN CORRADINI: So I think -- should I go through and ask people's opinions, or wait until we get through the glories of Chapter 7? I have a series of comments. Maybe we should take about five minutes and go past everybody without Chapter 7, and see if there's key things.

I have things written down, but maybe I should add to my list. Dr. Cress.

MEMBER KRESS: Well, let's talk about squib valves first.

CHAIRMAN CORRADINI: Oh good. I have that on my list. Go ahead.

MEMBER KRESS: Okay. I still think that you don't do an in situ test. I think the process of inspection and testing the igniters is what you need. I think they need some sort of innovative way to inspect, and they need to be thinking about how to do that.

I also think you need a significant qualification program outside, that is statistically relevant. You know, that sounds very hard and expensive to me, so I don't know what the trade-off is there. That's number one.

Number two, seismic effects on Category 1 components from Category 2 and 3. Seismic effects.

CHAIRMAN CORRADINI: Okay.

MEMBER KRESS: I know they showed that the Category 2 components and 3 wouldn't collapse under this earthquake, and I still worry about what earthquake would make them collapse, which is a PRA issue and they did a seismic margins PRA, which doesn't really capture that. So I worry just a little bit about me missing something there.

CHAIRMAN CORRADINI: Just to push back a little bit though, but my understanding is the seismic margin is an acceptable approach.

MEMBER KRESS: Oh yes, yes. I mean there's lots of acceptable approaches that leave me worried.

CHAIRMAN CORRADINI: Okay.

MEMBER KRESS: Added mass I'd like to talk a little more about, for spent fuel pools. My view of the shaking of spent fuel pools is that you don't shake the racks; you're shaking the wall, and it's approaching the racks, and how close the wall approaches the racks depends on an added mass that's brought about by moving the water at the wall, up, down and down the other wall.

That's a different kind of added mass

than you normally think of with an array of bundles. I don't know what they used. We didn't see the details of the calculation.

So I think we need to look a little more about whether those walls are going to impact those racks or not, and how did they do the added mass part of it. So I'd like to see a little more about that.

I was all right with the blow down effects on the internal structures. I thought at first i t was going to be a flow-induced vibration, because you've got higher flows. But that wasn't what they did, and I don't really think that's important to those internal structures. So I was all right with that.

I was intrigued with the comment that they did the calculations for the spent fuel pool using an equivalent porous medium.

CHAIRMAN CORRADINI: This is staff now we're talking?

MEMBER KRESS: Yes, staff and GE. They both did the same thing. But, you know, if I look at a spent fuel pool and think about how the flow travels through the bundles, I've got flow resistances that are not isotropic. They differ in all different directions, and I don't know how they account for that.

I would like to see more about how they did the equivalent flow resistance to put into a porous medium.

CHAIRMAN CORRADINI: That's an open item I think they'll provide.

MEMBER KRESS: Okay. It's an open item.

MR. GALVIN: No, we were going to do the open item on the temperatures.

MEMBER ABDEL-KHALIK: No. G E was going to come back to us with that information.

MR. GALVIN: Oh, okay.

MEMBER KRESS: Yes, and there was somebody suggested that go to -- when you get into the operational stage, to actually use thermal models for the control room, and then just any old day and see if you can calculate what's going on there as they check on the models.

I think I'd support that. That doesn't sound like too tough a thing to do, and I don't know where you'd require this or how you'd put in with a rule. But that' s all the things I have on my list.

CHAIRMAN CORRADINI: Okay, thank you. Graham.

DR. WALLIS: Yes. I think they'll have to look back on PCCS. We still have this added mass thing for the PCCS in my mind, where it may be more important than for the f uel pools. Certainly, you can't just add some mass. You've got a coupling, an inertial coupling as you jiggle the water such that it can't respond, and you can't just add mass to the structure.

You've go to look at the way in which there's a term in -- or is in the motion of both the fluid and the structure, which represents the reaction between them as a result of relative acceleration. I haven't seen that expressed properly. Otherwise, I thought the questions of fuel pool heating and cooling and boiling off and so on were satisfactory.

Tom, I think the porous medium thing is probably okay. It's been used before.

MEMBER KRESS: Well, I think it's okay. I'd just like to see a little more --

DR. WALLIS: And then the flow is mostly in one di rection. There isn't much cross-flow in there.

CHAIRMAN CORRADINI: I mean just to make sure we're clear. The maximum temperatures are still very low.

DR. WALLIS: Very low.

CHAIRMAN CORRADINI: I think from a quantitative standpoint they could be --

MEMBER KRESS: I don't think there's a problem. I just --

(Simultaneous discussion.)

DR. WALLIS: I think this boy has enough experience for this and CFX is a normal thing to use. So I'm satisfied with that. This control room heat -up is extra ordinarily complicated, and you have to use some judgment when you look at all the evidence supplied.

I'm inclined to say that it's okay, but I am puzzled by how if you keep the temperature up all the time, looking at the amount of wiggle you get when yo u don't keep it up all the time, that it can not have a bigger effect. So I think that's puzzling to me.

What also we talked about, I guess where the water goes when you boil off the spent fuel pool. Even if it all lands in the building, it doesn't mat ter, because there's nothing left there that you're concerned about from a safety point of view, and if it goes outside, then presumably it's no worse than having a bad snowstorm, and that's protected against by roofs and so on. So probably that is all right.

Again, I'd be interested to have the staff make the decision rather than me, to give a case about why it's all right. What else was there?

CHAIRMAN CORRADINI: Well, the one thing --

DR. WALLIS: Oh seismic. I was a little puzzled by some of t he answers about seismic, but I didn't push them too much, because it's not really my subject. But I didn't really understand some of those things about coefficients of friction.

Okay, squib valve testing. Well enough's been said about that, I think, already. This is a tough thing to do. New device, you can't test a great number of them to get assurance. You can't test them in situ; it doesn't tell you anything. It's hard for me to see how you really get that really high percent probability that they won't fail. I'm not quite sure how you do that.

I'll write some other stuff on the other issues.

CHAIRMAN CORRADINI: Okay.

DR. WALLIS: I think we do need to know what equations were used in these added mass models, for both the PCCS -2 and the spent fuel pool.

CHAIRMAN CORRADINI: Sam.

MEMBER ARMIJO: Okay. On the squib valves, I think it's a tough development program, and it all depends on the requirements that are put into the development program. In addition to having them work one time, they have to work over a period, you know, with aging.

I think a number of severe tests in the development program, as opposed to hundreds of tests, would probably be more practical. I think they'll work, and I don't think it's practical to test them in a plant at all.

As far as the boil-off stuff, pretty straightforward. I didn't have any problem. I don't think there's a big problem with -- I don't see a problem with the seismic and impact of the racks with the pool wall. I think they're awfully tight in some dimensions. But just from an engineering standpoint, I'd put a little more room, where you've got like eight millimeters or something.

DR. WALLIS: They're not tied down, are they?

MEMBER ARMIJO: Oh yeah. They're bolted down to the floor of the --

DR. WALLIS: That's what I didn't get. I got the impression that they just moved around.

MEMBER ARMIJO: I was shown a sketch during off time. So I don't think there's a real problem there. I think the --

DR. WALLIS: They were said to be free-standing. Doesn't that mean they're not tied down?

MEMBER ARMIJO: They're bolted to the floor, to the floor of fuel pool.

(Simultaneous discussion.)

MR. GALVIN: The spent fuel pool, they're free-standing. The buffer pool, they're bolted down.

DR. WALLIS: They're not bolted down?

MEMBER ARMIJO: The racks are bolted.

MR. GALVIN: No. In the spent fuel pool, they're not. They're free-standing.

DR. WALLIS: It could be a piece of furniture.

MEMBER ARMIJO: And they're just sitting there in place?

MR. GALVIN: Yes, like a piece of furniture.

MEMBER ARMIJO: Yes. Okay, what -- where are the bolted ones?

MR. GALVIN: The buffer pool.

MEMBER ARMIJO: In the buffer pool?

MR. GALVIN: Yes.

MEMBER ARMIJO: Okay.

MR. GALVIN: In the reactor building.

MEMBER ARMIJO: Okay. Well then I'd better back off on my conclusion that nothing much is going to happen.

DR. WALLIS: Why aren't they bolted down? It seems to be a simple thing to do. I mean if you're worried about --

MR. GALVIN: It's an installation problem, I think. That's what Wayne would tell you.

MEMBER ARMIJO: It seems strange that in the buffer pool they'd be bolted; in the spent fuel pool, they wouldn't.

MR. GALVIN: There's not many racks in a buffer pool.

MS. CUBBAGE: This is not a novel design, right?

MEMBER ARMIJO: I think it's different.

MR. GALVIN: Well no, not terribly.

MEMBER ARMIJO: I think this is a typical design. Okay. As far as the control room habitability, thermal analysis , I think it's pretty -- the two independent models and the sensitivity studies convinced me there's, you meet the requirements. So I don't see any problem there.

I'll just, as far as the index calculation, I was totally confused. That is very similar to filling out your tax forms when you have a complicated thing to do. I'm glad it only has to be done by somebody else. That's all I have.

CHAIRMAN CORRADINI: Okay.

MEMBER STETKAR: I think other folks -- by the way, I'd like to thank both the staff and

GEH. I thought the presentations today were really good, and the discussions were really good. They closed out a lot of kind of open concerns. I'll come down on the side, would advocate functional testing of the squib valves, meaning to verify that they operate under design, you know, pressure differential and things like that.

It's difficult to do, but it's a new piece of equipment. You can't develop statistics to predict that they're going to fail ten to the minus five for demand, but you m ight discover something that you didn't expect. That's the concern. It's a confidence builder, not a reliability quantifier.

I'd also advocate a pre -op test to verify that the passive cooling system, namely the concrete in the control room works, or th at more accurately, that indeed the observed behavior of that system is adequately represented by these models, you know, whatever best model you can decide on.

And in all deference to the tech spec experts, I'd really like to see a tech spec on an LCO, specifically for the temperature sensors that turn off the non -safety heat loads in the control room, because --

MS. CUBBAGE: That would be difficult to justify under 5036.

MEMBER STETKAR: Well, you know, I don't know what 5036 is. I'll admit ignorance there.

(Simultaneous discussion.)

MEMBER STETKAR: Hear me out for a second. I'm staring at tech specs for the ESBWR, that specifically applied to the neutron monitoring system, and I have an LCO that says one or more functions with one require d division inoperable. I have a 12 hour completion time to do something, and I have a separate surveillance requirement to verify functional operability once every 24 months on a staggered test basis.

I'm assuming that these technical specifications satisfy 50 whatever it was.

MS. CUBBAGE: 5036, Criterion 2, I believe.

MEMBER STETKAR: And I don't understand why the analogous conditions don't apply for these temperature monitor that do something to verify a safety function, mainly control room cooling, that I meet those room heat up things. To me, I don't understand why they're different.

MR. HARBUCK: I believe that the requirements we currently have in the tech specs were, they evolved from questions from the staff, from changing from the EBASS (ph) system to go to CRHAVs. But as I described in my presentation, the way the rules of the tech specs were, that function that you're talking about actually is the subject of an LCO.

It's not as straightforward or as clear as it could be, and that might be something we should look into.

MEMBER STETKAR: My concern is, you know, I come from an operational background. My concern is if I go look at the tech specs for the neutron monitoring instrumentation, it's really clear to me --

MS. CUBBAGE: Those directly pertain to one of the criteria in 5036 for a fission product barrier.

(Off mic comment.)

MEMBER STETKAR: Well, but don't the -- doesn't shutting off the non-safety heat loads in the control room directly apply to control room habitability for a design basis accident scenario?

MR. HARBUCK: In the tech specs, that's addressed by the functioning of the CHRAVs, and it's also addressed by the instrumentation functions that cause automatic -- cause different configurations or starting the syst em automatically on certain parameters.

MEMBER STETKAR: The only thing is, Craig, that these particular temperature sensors don't do any of that things that you just said.

MR. HARBUCK: It's a fairly straightforward, simple function that --

MEMBER S TETKAR: That's a message. Think about it from an operational sense, in terms of consistency in the way that instrumentation LCOs and surveillance requirements are specified in these technical specifications, and try --

If you're confident that indeed the protection of not exceeding a required, you know, plant configuration, if indeed you're convinced that the current technical specifications provide that protection and the way that they might be interpreted.

Also think whether or not the owner operator of the plant, reading the technical specifications, could easily understand how that function is met, you know, in particular for those temperature sensors. Because of the protection is there and there's no down side of putting an LCO on them. In othe r words, your assertion is there's already an LCO.

MR. HARBUCK: I think perhaps, you know, if I hear what you're saying, is that there needs to be perhaps more explicit appropriate action requirements.

CHAIRMAN CORRADINI: I think he's bringing some clarity.

MEMBER STETKAR: I'm looking for clarity in the same way as I look at, for example, the neutron monitoring system. If I'm an operator, if I have two trains of neutron monitoring, two channels down, it's very clear that I need to do something, an d I have a specific time window.

MS. CUBBAGE: I think we need to take a timeout on this. We need to caucus. I'm not proposing that we're going to ask GE to make any changes in this area.

MEMBER STETKAR: Okay.

CHAIRMAN CORRADINI: Others, John?

MEMBER STETKAR: No. I have no additional comments.

CHAIRMAN CORRADINI: So I can put your initials anywhere on the list?

MEMBER STETKAR: Right.

CHAIRMAN CORRADINI: Okay, all right. I do have three or four action items. No, I take it back. Three action items that we have. Heavy load lifting, to be answered relative --

MS. CUBBAGE: GE plans to get back tomorrow on that topic.

CHAIRMAN CORRADINI: Right. The open item on -- I thought it was more to the staff than it was to GE, on the iso tropic versus non-isotropic, I call them friction factors or form factors relative to flow in the spent fuel pool cooling.

MEMBER ARMIJO: Either one of them.

CHAIRMAN CORRADINI: Well, I think Chris was answering your question, but I thought we left i t with staff. But I'm sure you would love to explain it to us.

MR. GALVIN: You're going to have to

get an answer from GE.

CHAIRMAN CORRADINI: Okay, that's fine. That's right. You're not on the docket. You're just checking the docket.

MR. MARQUINO: An answer on what?

CHAIRMAN CORRADINI: On your modeling of --

(Simultaneous discussion.)

CHAIRMAN CORRADINI: When you're modeling the porous medium, when you're flowing, let's say, perpendicular to the bundle or parallel to the bundle, what is your form losses? How are you modeling the form losses.

And then the third one was that at first we thought there was no check valve, then we thought there was a check valve. Now it's a matter of valve wind-up relative to the FAPCS.

MEMBER STETKAR : I think I'm okay on that, except I'd still -- just to kind of, it's a curiosity issue, to follow up on the size of the pipe and the rate at which it would drain, if for some reason you could get into that lineup.

CHAIRMAN CORRADINI: Good. So with that, the decks are clear tomorrow for Digital Inc. and we are siked (ph).

MR. GALVIN: All right. Is Charlie going to be here tomorrow?

CHAIRMAN CORRADINI: God, I hope so.

MR. GALVIN: That's an excellent question.

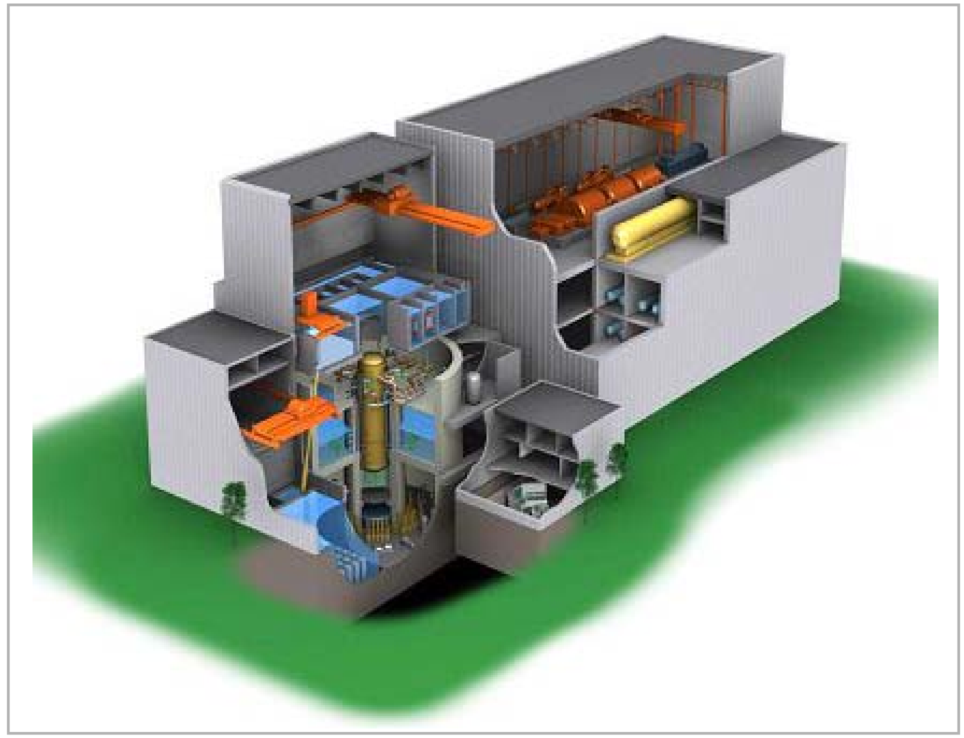
(Simultaneous discussion.)

CHAIRMAN CORRADINI: We're adjourned. Thank you.

(Whereupon, at 6:17 p.m., the meeting was recessed, to reconvene on Friday, September 24, 2010 at 8:30 a.m.)

GE Hitachi Nuclear Energy

ESBWR Chapter 3: Design of Structures, Components, Equipment, and Systems



Advisory Committee on Reactor Safeguards

Sujit Niogi

September 23, 2010

HITACHI

Introduction

The following NRC RAIs will be discussed in this presentation:

- 3.8-79 (Seismic II/I Issue & Seismic Gaps Between Structure)
- 3.8-94 (Soil Bearing Capacity & Enveloping FRS with Valleys Filled)
- 3.8-96 (Stability Analysis of the Structure due to Sliding)
- 3.8-107 (SSDP Computer Program Validation)
- 3.8-120 (Reactor Shield Wall)
- 3.8-125 (Impact of Spent Fuel Rack on Spent Fuel Pool Structure)

NRC RAI 3.8-79

Summary from RAI question:
Confirm that the Seismic Category II and Seismic Category NS structures, which are in close proximity to Seismic Category I structures, are designed to Seismic Category I requirements.

Response:
The following structures are in close proximity to Category I structures:
- Seismic Category II: TB, SB & Ancillary Diesel Building
- Seismic Category NS: RW

Seismic Category II & Seismic Category NS structures listed above are designed to withstand SSE loads. The method of analysis of these structures are the same as the Seismic Category I structures including the load combinations and acceptance criteria. During SSE event, these structures will not collapse and impact a Seismic Category I structure. Also, the gaps between the structures are large enough to preclude impact due to out-of phase displacements during SSE event.

(cont'd)

HITACHI

NRC RAI 3.8-79

Conclusion:

- It was demonstrated that the Seismic Category II and Seismic Category NS structures, which are in close proximity to Seismic Category I structures, are designed to SSE requirements.
- The gaps between the structures are large enough to preclude impact during SSE event.

HITACHI

NRC RAI 3.8-94

<u>Summary from RAI question:</u>

- Confirm that the soil bearing demand is less than the soil bearing capacity due to static and dynamic loading conditions.
- Provide the technical basis for not considering the effect of uplift during SSE event in the bearing and sliding calculation which uses SASSI analysis results.
- The staff noted that “valleys” exist between successive peaks in the low frequency region. The staff requested that the these valleys should be filled-in to accommodate the expected variability in site shear wave profiles.

(cont’d)

HITACHI

NRC RAI 3.8-94

Response:

- GEH used the energy balance method to calculate the soil bearing pressure and considered both uniform and layered sites. GEH demonstrated that the soil bearing demand is less than the allowable soil bearing pressure. Results are documented in DCD Tier 1 Table 5.1-1 & DCD Tier 2 Table 2.0-1.
- GEH used the energy balance method which takes into account the effects of uplift in the linear response calculated by SASSI. It was concluded that this simplified method provides a reasonable estimate using the linear analysis results when the amount of uplift is less than 50% of the basemat dimension. As shown in Figure 1, the extent of uplift is not extensive and a large portion of the basemat remains in contact with the soil.
- GEH complied with the NRC request and filled the spectral valleys between the peaks as shown in Figure 2.

(cont'd)

NRC RAI 3.8-94

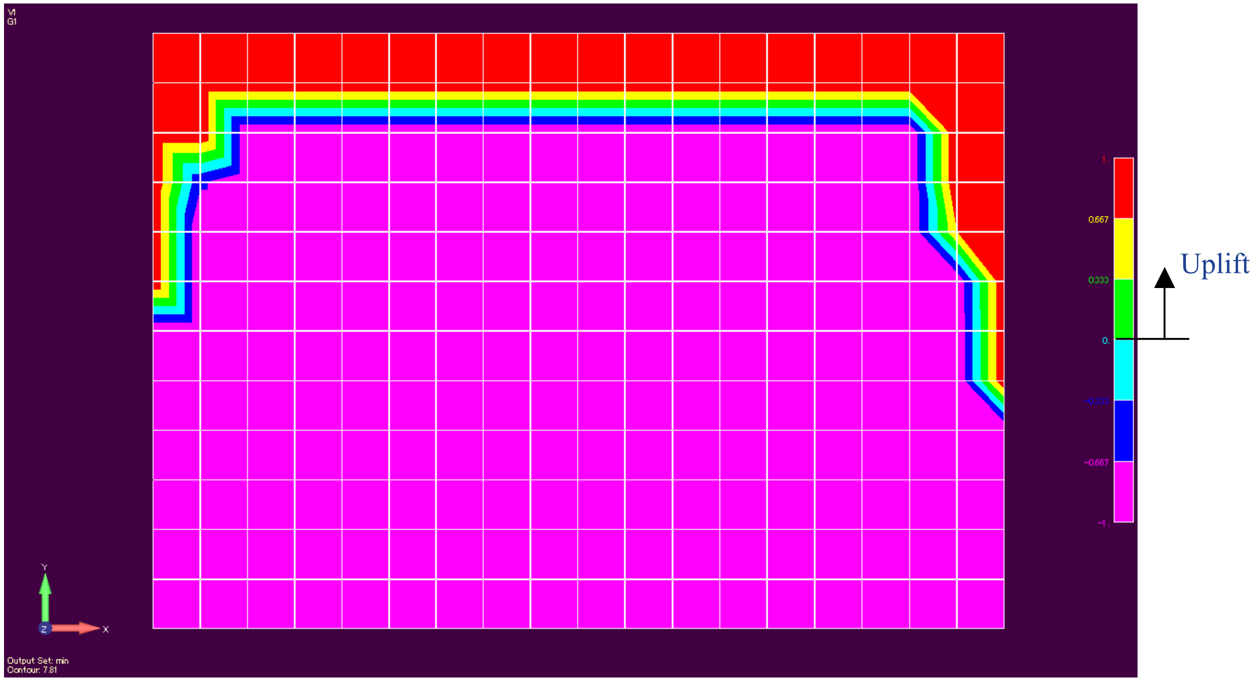


Figure 1
Plan View of RB/FB Complex Basemat
Extent of Uplift for Maximum Bearing Capacity (DL + Buoyancy)
(cont'd)

NRC RAI 3.8-94

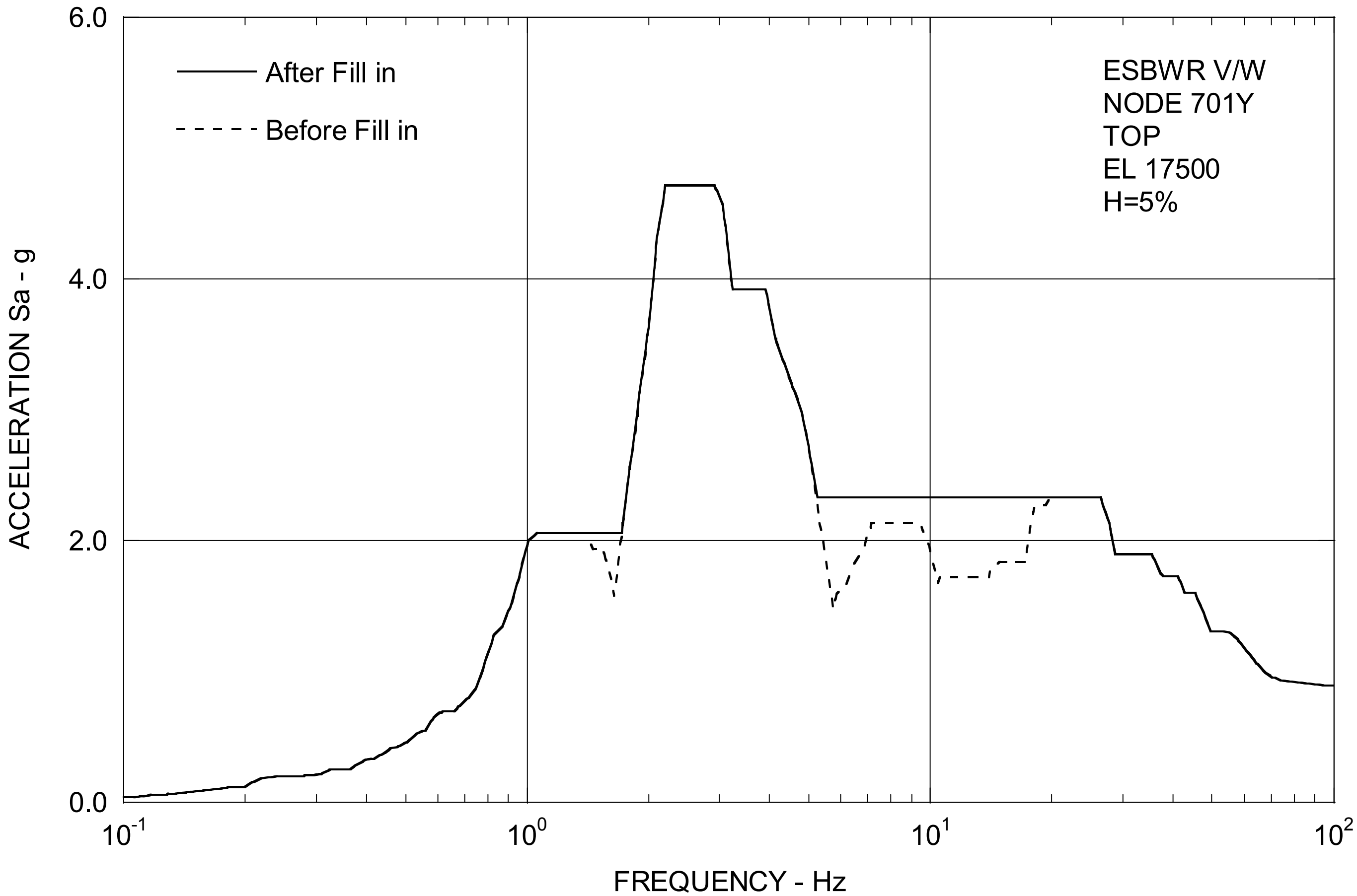


Figure 2
Floor Response Spectra with Valleys Filled-In

(cont'd)

NRC RAI 3.8-94

Conclusion:

- It was demonstrated the soil bearing demand is less than the soil bearing capacity due to static and dynamic loading conditions.
- The technical basis for not considering the effect of uplift in the seismic demand loading in the bearing and sliding calculation which uses SASSI analysis results has been demonstrated.
- Spectral valleys between the peaks have been filled-in.

HITACHI

NRC RAI 3.8-96

Summary from RAI question:

- Confirm that the Seismic Category I structures meet the sliding stability requirements of the SRP 3.8.5.
- Justify use of static coefficient of friction beneath the basemat and along the vertical surfaces of the walls.
- Justify use of full passive pressure at the side of the vertical surfaces of the walls in the sliding resistance.
- How did GEH consider other potential sliding interfaces in addition to soil shear failure (i.e., basemat to concrete mudmat, concrete to soil)?

(cont'd)

NRC RAI 3.8-96

Response:

- It was confirmed that the Seismic Category I structures meet the sliding stability requirements of the SRP 3.8.5 by considering passive pressure resistance, resistance due to friction at the bottom of the basemat and along the vertical surfaces of the walls.
- GEH used reduced coefficient of friction in the vertical walls to calculate friction resistance due to passive pressure. In this evaluation passive pressure was needed to comply with the SRP 3.8.5 requirement.
- GEH added shear keys to the RB/FB complex and FWSC to increase the sliding resistance. See Figure 3.
- By roughening the top surface of the mudmat concrete, friction resistance is increased between the mudmat and basemat. Added troughs in the soil under the mudmat to increase shear resistance.

HITACHI

NRC RAI 3.8-96
(continued)

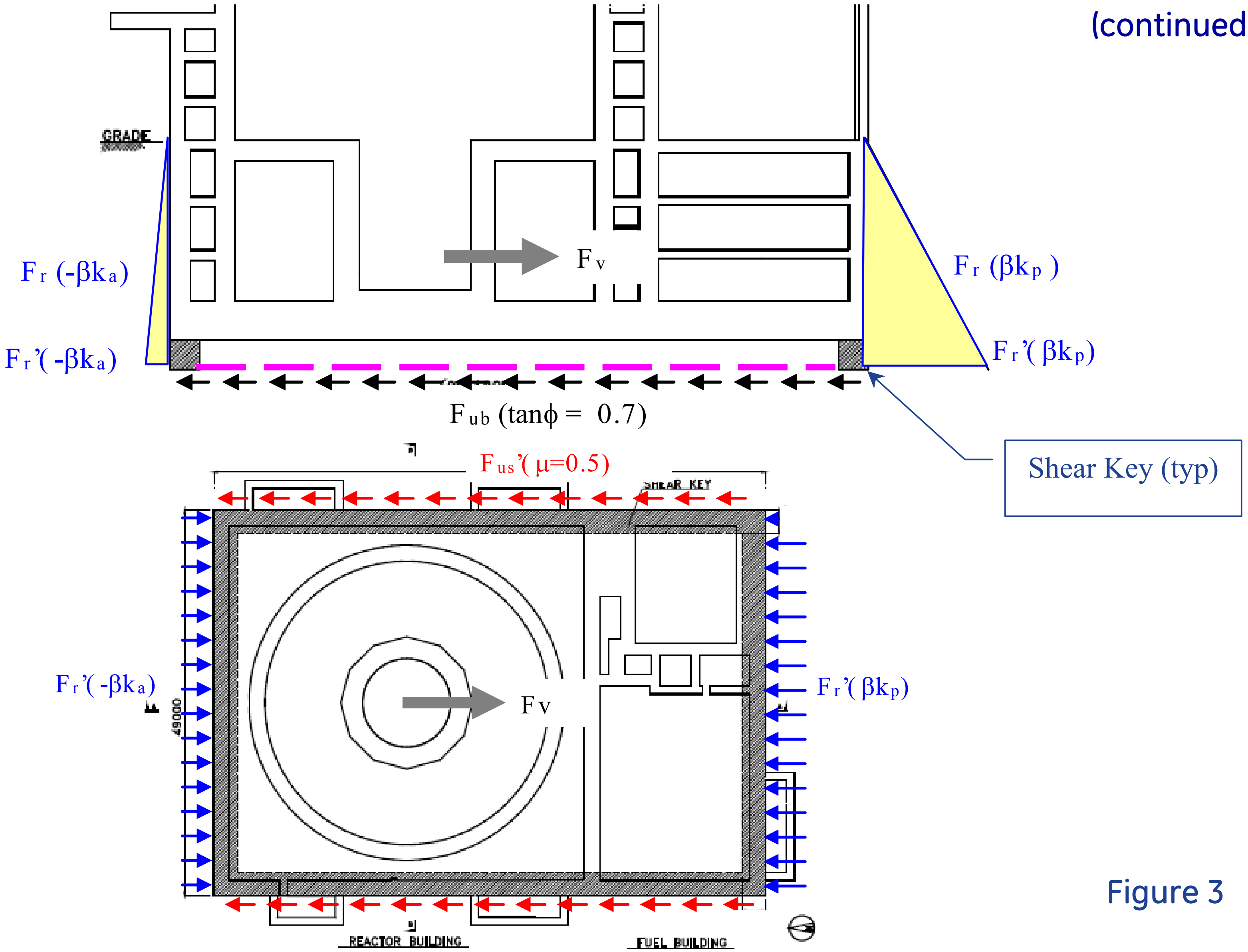


Figure 3

HITACHI

NRC RAI 3.8-96 (cont'd)

Conclusion:

- Seismic Category I structures meet the sliding stability requirements of the SRP 3.8.5.
- Static coefficient of friction of 0.7 beneath the basemat and a reduced coefficient of friction of 0.5 for the vertical surface of the wall is adequate to provide sliding stability.
- Additional reinforcement was added to the vertical walls to resist the passive pressure.
- Added requirements to increase the friction resistance between the basemat, mudmat and soil.

NRC RAI 3.8-107

Summary from RAI question:

NRC staff reviewed the SSDP computer program validation package but found that the validation did not satisfy items of interest, such as:

- How does SSDP apply the concrete codes used in the US and how are the code editions that are accepted by the NRC incorporated in SSDP to keep it current?
- How does SSDP identify critical sections of a structure?
- In the RCCV structure, how does SSDP evaluate the tangential shear stress to demonstrate compliance with the ASME code?
- GEH was requested to verify the equations used in the SSDP by comparing the quantitative results with the use of the equations presented in a concrete textbook.

(cont'd)

NRC RAI 3.8-107

Response:

- SSDP calculates stresses of concrete and reinforcements for forces and moments. Calculated stresses are compared with the allowable stresses specified in the applicable codes. SSDP has supplemental subroutines for the tangential shear and transverse shear, and it is confirmed that the provided sections satisfy the code requirements. The validation of SSDP provides confirmation that calculation results meet the requirements of code editions which are specified for the project.
- The equations used in the SSDP computer code were verified by comparing the results with the results from the equations presented in the concrete design text book.

(cont'd)

NRC RAI 3.8-107

Conclusion:

- The validation of SSDP confirmed that calculation results satisfy the requirements of the codes.
- The equations used in the SSDP computer code were verified with hand calculation.

HITACHI

NRC RAI 3.8-120

Summary from RAI question:

- NRC indicated in their review that the material thickness for the Reactor Shield Wall (RSW) in some locations is greater than 10 inches.
    - ASTM A-516 is only available up to 8¼ inches thick.
    - ASTM A-709 is only available up to 4 inches thick.
- NRC requested GEH to explain how RSW will be fabricated.
- The staff also raised a concern related to welding A-709 material to the containment steel liner and the acceptability of a code case for this type of welding.

(cont'd)

HITACHI

NRC RAI 3.8-120

Response:

- GEH plans to fabricate using 4 inch maximum thickness steel using multiple-layer vessel construction technique. Multiple layer construction has been very effective for cylindrical pressure vessels more than 16 inches thick. The construction techniques allow the multiple layer shells to act as a solid wall. There are four common types of layered construction used in the pressure vessel industry. These are identified in Section VIII of the ASME code.
- GEH provided a justification for dissimilar material welding with A-709 material as part of GEH's response to NRC RAI 6.1-12.

(cont'd)

NRC RAI 3.8-120

Conclusion:

- Fabrication technique in compliance with ASME code will be utilized.
- Welding of dissimilar materials with A-709 material has been satisfactorily addressed.

NRC RAI 3.8-125

Summary from RAI question:

Confirm that impact of the spent fuel storage racks will not adversely impact the spent fuel pool walls during SSE event which may cause overstressing of the concrete walls.

Response:

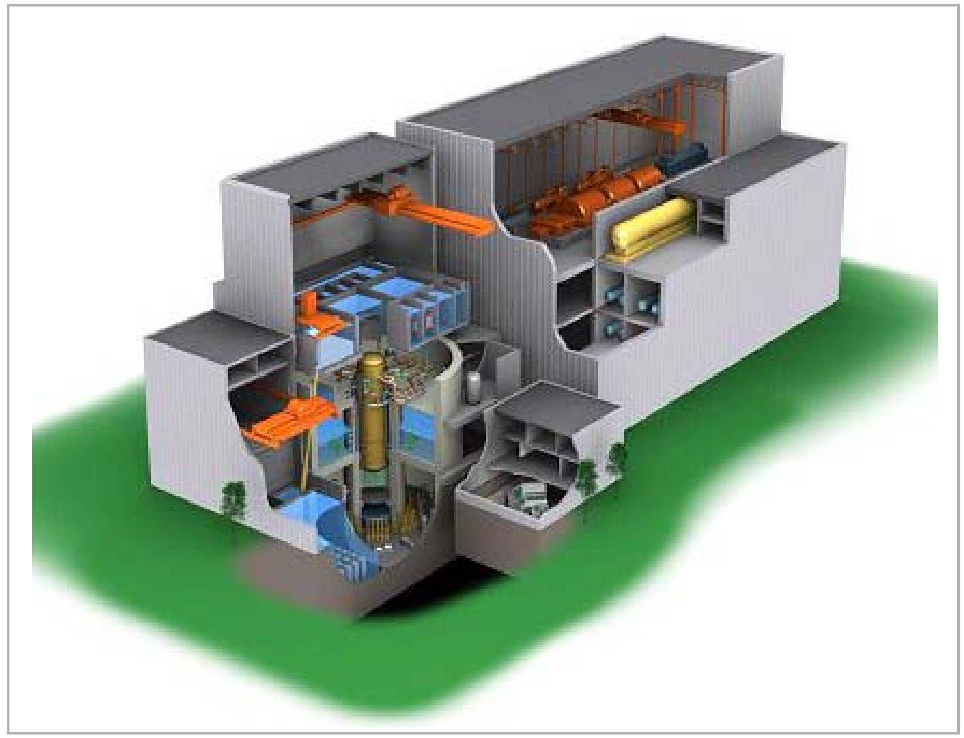
The free-standing spent fuel storage racks are supported on embedded plates on the spent fuel pool basemat. To preclude the racks contacting the walls during an SSE event the free-standing racks were designed to provide sufficient gap between the racks and the walls.

Conclusion:

Analysis has demonstrated that the racks will not contact the spent fuel pool walls.

GE Hitachi Nuclear Energy

ESBWR Chapter 3: Section 3.9 Design of Structures, Components, Equipment, and Systems



Advisory Committee on Reactor Safeguards

Jerry Deaver

September 23, 2010

HITACHI

Introduction

Review of Selected Chapter 3 SER Open Issues:

- 3.9-75
- 3.9-96
- 3.9-81
- 3.9-177
- 3.9-254/255

Open Issue 3.9-75

Summary from SER Open Item:
The use of the terms “prototype” and “non-prototype” in DCD, Tier 2, Section 3.9.9.1, and NEDE-33259P are contradictory. The staff asked the applicant to revise Section 3.9.9.1 using RG 1.20, including the information on startup testing that will be provided to the NRC.

Response:
GEH agreed to reclassify the ESBWR as a prototype, in accordance with Revision 3 of RG 1.20, for the reactor internals vibration program

Conclusion:
GEH revised applicable sections of the DCD and NEDE-33259P to reflect this change in classification

Open Issue 3.9-96

Summary from SER Open Item:

The staff asked the applicant to explain why the testing for the first ESBWR plant is restricted to only those aspects that are perceived to demonstrate that the FIVs expected during operation do not cause damage. It was requested that GEH identify the differences in the tests that were conducted on the plant that are considered to be prototypical of the ESBWR reactor internals design, and those tests that are proposes to conduct on the reactor internals of the first ESBWR plant.

Response:

- GEH provided a description of the reactor internals that were in the startup testing program and the number and location of sensors that would used.
- The methodology of of how the data would be evaluated was also provided
- Justification for components that do not need instrumentation was provided

Conclusion:

A comprehensive vibration testing program has been established for the first ESBWR that is classified as a prototype plant

HITACHI

Open Issue 3.9-81

Summary from SER Open Item:

The staff requested that the applicant provide the analytical results to demonstrate that there is no significant dynamic amplification of the loads on the reactor internals CS structures as a result of the postulated break in the main steam line (MSL) or feedwater (FW) line

Response:

- The only reactor internals vertical core support structure, are the control rod guide tubes/control rod drive housings (CRGTs/CRDHs).
- An assemblage of axial beam elements represents the CRGTs/CRDHs fuel vertical inertia load path in the vertical primary structure model.
- There is no vertical natural frequency, below 105.4 Hz.
- Blowdown loads associated with the MSL and FW line breaks do not excite the CRGTs/CRDHs.

Conclusion:

- There can be no dynamic amplification of the blowdown loads through the CRGTs/CRDHs load path
- GEH revised DCD Tier 2, Section 3.9.2.5, Revision 5, to address this issue.

HITACHI

Open Issue 3.9-177

<u>Summary from SER with Open Items:</u>
GEH was requested to reinstate a COL item requiring that the ASME code design specifications and reports for equipment be made available to the NRC staff for audit

<u>Response:</u>
- GEH responded by adding component ITAAC requirements to Section 2 of Tier 1 requiring that ASME code reports be made available for review.
- GEH prepared design specifications for ASME and Risk Significant mechanical components that were audited by the NRC staff.

<u>Conclusion:</u>
Since GEH demonstrated their capability to prepare component design specifications and has implemented ITAAC commitments for ASME component design documentation

HITACHI

Open Issue 3.9-254/255

Summary from SER Open Item:
These open issues dealt with the qualification and use of the PISYS and ANSI7 computer codes that are used for the ESBWR piping analysis, and compliance with RG 1.92

Response:

- GEH resolved open technical issues
  - Environmental effects on fatigue per RG 1.207 were incorporated into ANSI7 and implementation was audited
  - RG 1.92 rev 1 is used and computer codes were benchmarked using NUREG/CR-6049, which is permitted by RG 1.92 rev 2
- Level 2 qualification for each of these computer codes was completed and audited by NRC staff.

Conclusion:
PISYS08 and ANSI7 version 14 are now fully qualified to perform piping analysis for ESBWR

HITACHI

Summary

- The reactor Internals vibration program has been fully defined for the prototype plant
- GEH sufficiently demonstrated that it is capable of defining requirements and documentation that are required for the ASME code

HITACHI

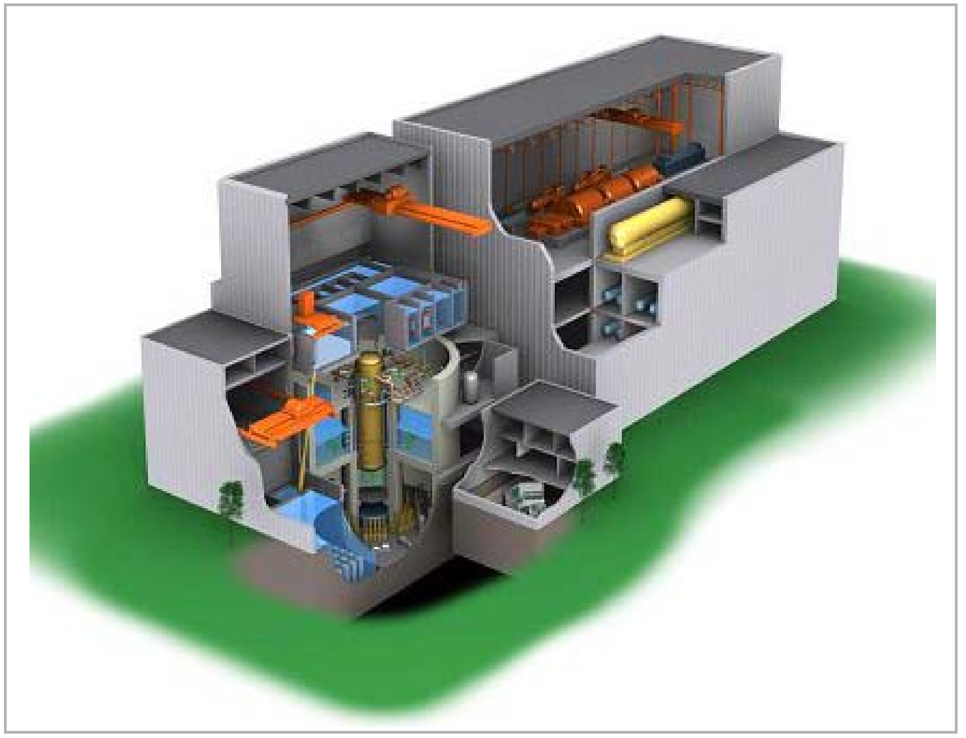
GE Hitachi Nuclear Energy

ESBWR Chapter 3: Section 3.12 Design of Structures, Components, Equipment, and Systems

Advisory Committee on Reactor Safeguards

Jerry Deaver

September 23, 2010



HITACHI

Introduction

Review of Selected Chapter 3 SER Open Issues:

- 3.12-3
- 3.12-17
- 3.12-27

HITACHI

Open Issue 3.12-3

Summary from SER Open Item:
In RAI 3.12-3, the staff requested that the applicant either follow the recommendations in NUREG-1061 for the ISM method of analysis or provide the technical justification for an alternative method.

Response:
- For Independent Support Motion (ISM), GEH prepared a representative calculations for the main steam and feedwater piping within containment to demonstrate that SRSS is an acceptable method to combine loads
- The comparison of Absolute Sum vs. SRSS showed that the majority of the SRSS data were bounded and in all cases were below 10%

Conclusion:
It was agreed that for ISM analysis with 10% being added for piping stresses and support loads, the inertial and seismic anchor motion can be combined by SRSS when there are only two support groups

HITACHI

Open Issue 3.12-17

Summary from SER Open Item:
Justification for using SRSS should be demonstrated by showing that the non-exceedance probability of 84% or higher is satisfied per NUREG-0484

Response:
Technical basis for GE BWR Mark II
The justification is based on probability theory, and qualitatively justified based on:

- *The unlikelihood of load events*
- *Randomness of the amplitude and phasing of the responses*
- *Rapid + and – variation and very short duration of the peak responses A GE*

BWR Mark II study:

- *291 dynamic load cases were evaluated that provides the quantitative technical basis that is representative of ESBWR dynamic events*

Conclusion:
Compliance with NUREG-0484 has been demonstrated

HITACHI

Open Issue 3.12-27

Summary from SER Open Item:

SRP 3.9.2 Section II.2.g states that responses due to inertial effect and relative displacement for multiply-supported equipment and components should be combined by the absolute sum method (ABS). The staff requested that GEH provide a technical justification for using the SRSS combination of the inertial and SAM responses for the Uniform Support Method (USM) of analysis

Response:

GEH provided a revision to DCD, Tier 2, Section 3.7.3.12, which requires that inertia and SAM responses be combined by the absolute sum method for piping support design using the USM method of analysis

Conclusion:

The DCD is compliant with SRP 3.9.2

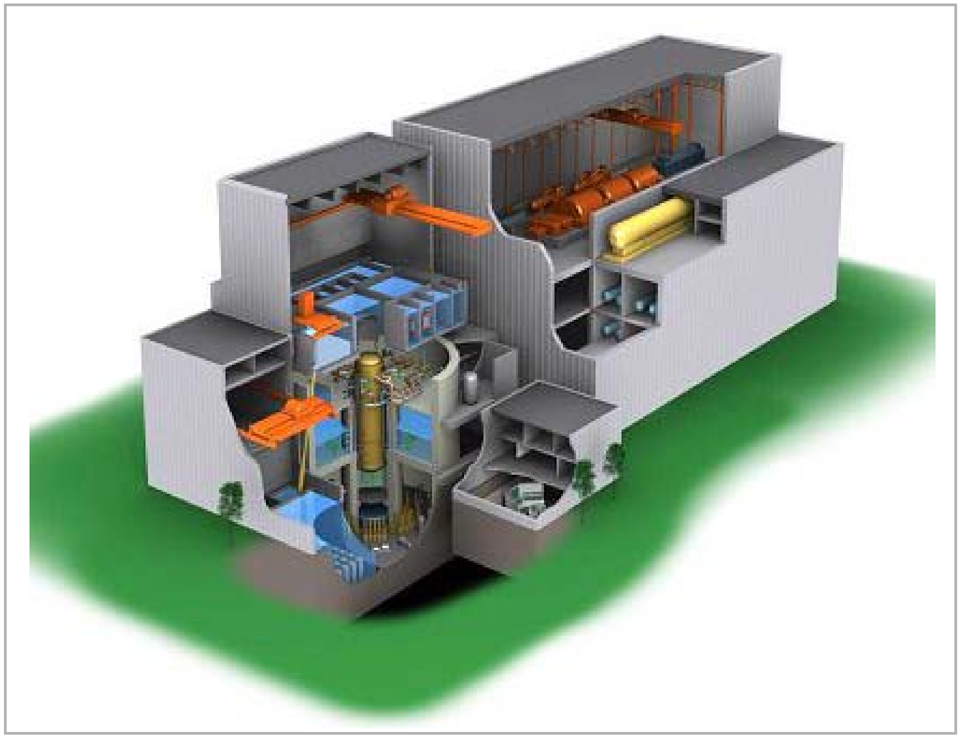
HITACHI

Summary

- The analysis methods used for piping and piping supports is consistent with the SRP requirements
- For specific analytical cases, GEH has provided adequate justification for using the SRSS method for load combination

GE Hitachi Nuclear Energy

ESBWR Chapter 9: Auxiliary Systems



Advisory Committee on Reactor Safeguards

Jerry Deaver

Mike Arcaro

September 23, 2010

Agenda

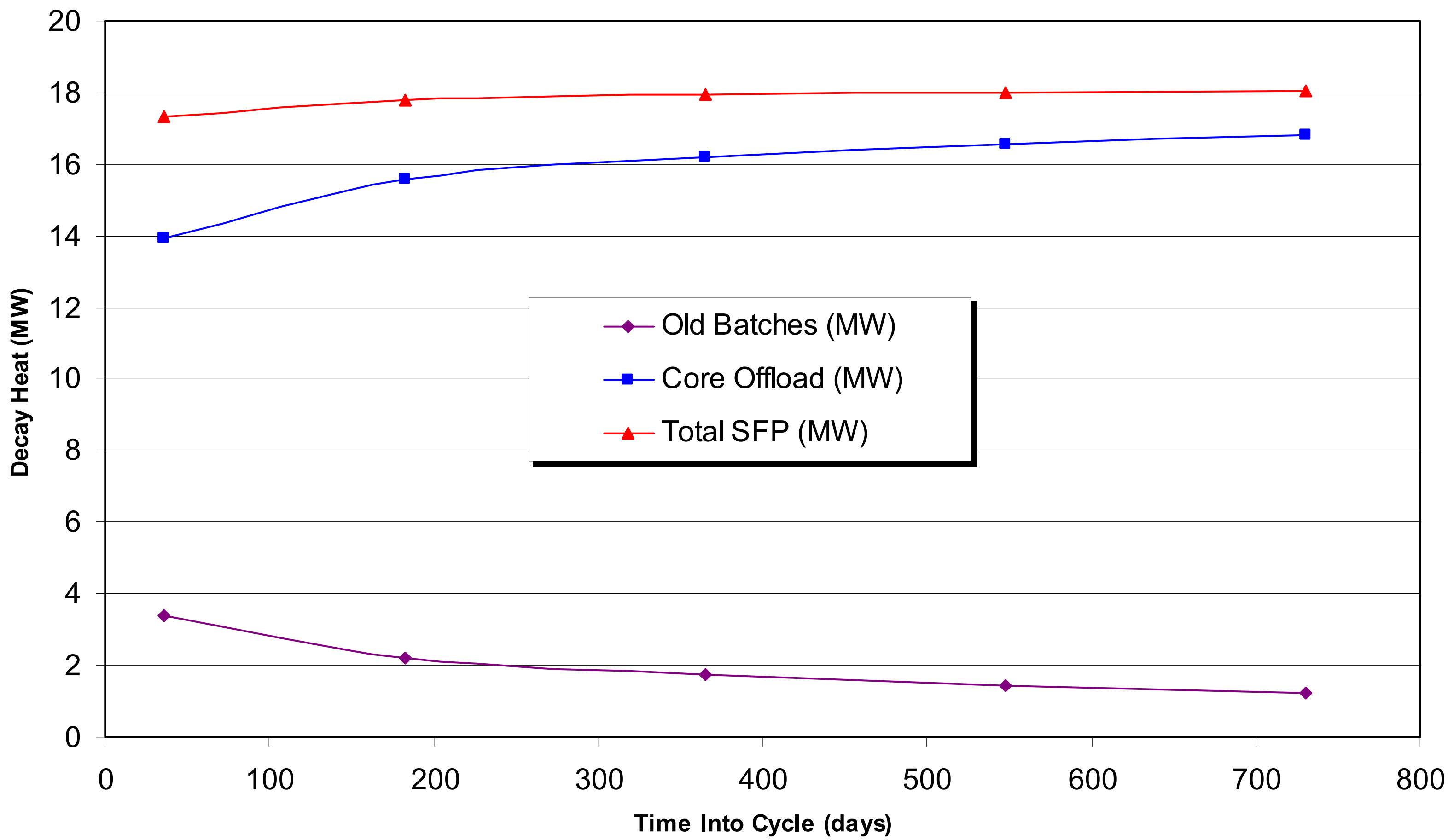
- Spent Fuel Pool Decay Heat Calculation and associated analyses
- Spent Fuel Uncovery- Operating Experience Considerations
- Gas Accumulation in FAPCS- Operating Experience Considerations
- Auxiliary System Regulatory Treatment of Nonsafety- Related Systems (RTNSS) Function Overview
- Plant Service Water System (PSWS) Design Overview
- Reactor Component Cooling Water System (RCCWS) Design Overview
- Nuclear Island Chilled Water System (NICWS) Design Overview
- Instrument Air / Service Air (IA/SA) System Overview
- Summary

Basis for Decay Heat Calculation

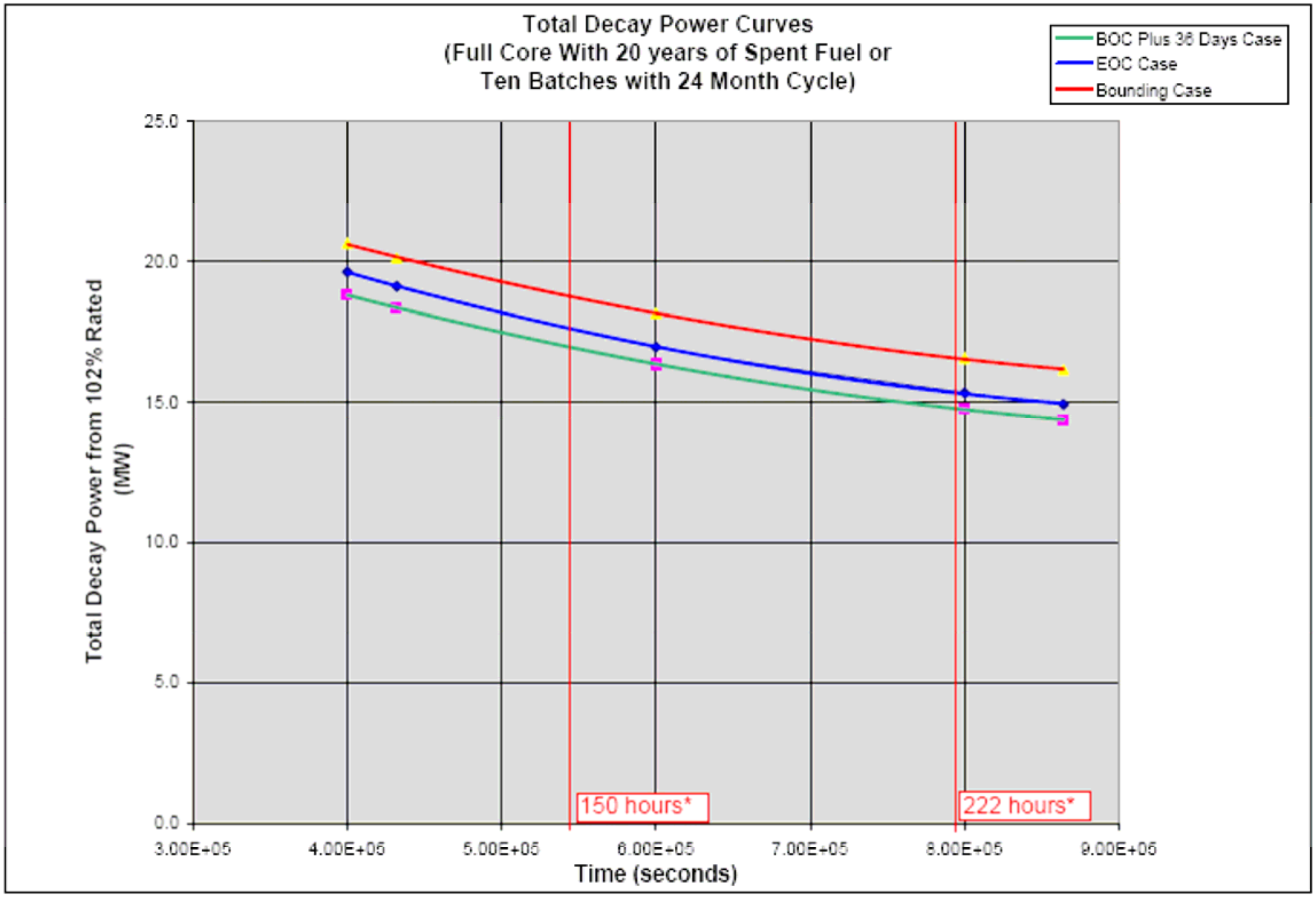
- SRP 9.1.3 rev 1 paragraph III.1.h.iii states:
  "The spent fuel pool cooling system should have the capacity to remove the decay heat from one full core at equilibrium conditions after 150 hours (6.25 days) decay and one refueling load at equilibrium conditions after 36 days decay, without spent fuel pool bulk water boiling."
- The SRP assumed that this was the point in time that the maximum heat load occurs; however, ESBWR specific analysis shows that the maximum heat load occurs at the end of the operating cycle
- GEH has now reanalyzed using the maximum power vs. time input as a basis, and has used a bounding total decay power curve to provide design margin
- Latest Decay Heat Methodology used (audited by NRC staff):
  - **ANSI/ANS-5.1-1994 with 2σ uncertainty**
  - **Includes misc actinides and activation products**

HITACHI

SFP Decay Heat as a Function of Irradiation Time



Energy Curves Used in Analyses



***The boil-off period is from 150 hours to 222 hours based on NUREG-0800, 1981 Version.**

HITACHI

Spent Fuel Pool Boil-off Analysis Results

(Abnormal Condition = Full Core Offload + 20 Years of Spent Fuel)

- ESBWR safety-related spent fuel pool cooling method is attributed to pool boiling for 72 hours
- For the bounding case, a free volume of 1962 m^3 and minimum coverage height of 10.26 m over top of stored fuel assemblies (top of bail handle) is required
- Analyzed at a bounding 72 hour heat load of 4.562×10^6 MJ, which is derived from an extrapolated power curve that applies to 20 years worth of fuel storage at 102% power
- NRC audit responses and impacted DCD sections have been updated to include these results

<u>Conclusion:</u>

Under the bounding boil-off condition after 72 hours, water remains over the top of stored fuel assemblies

HITACHI

Fuel Storage Rack Thermal-Hydraulic Analysis

(Abnormal Condition = Full Core Offload + 10 Years of Spent Fuel)

- An evaluation was performed considering a bounding abnormal heat load of 19 MW and compared with results from a prior ESBWR analysis that used 29 MW
- The rack exit temperature for the 19 MW case was determined to be less than the temperature for the 29 MW case, 80.9°C (limit is 121 °C)
- The maximum fuel cladding temperature for the 19 MW case is <97.12°C which is associated with the 29 MW case
- There is no condition within the fuel assembly that causes boiling, therefore, nucleate boiling is prevented

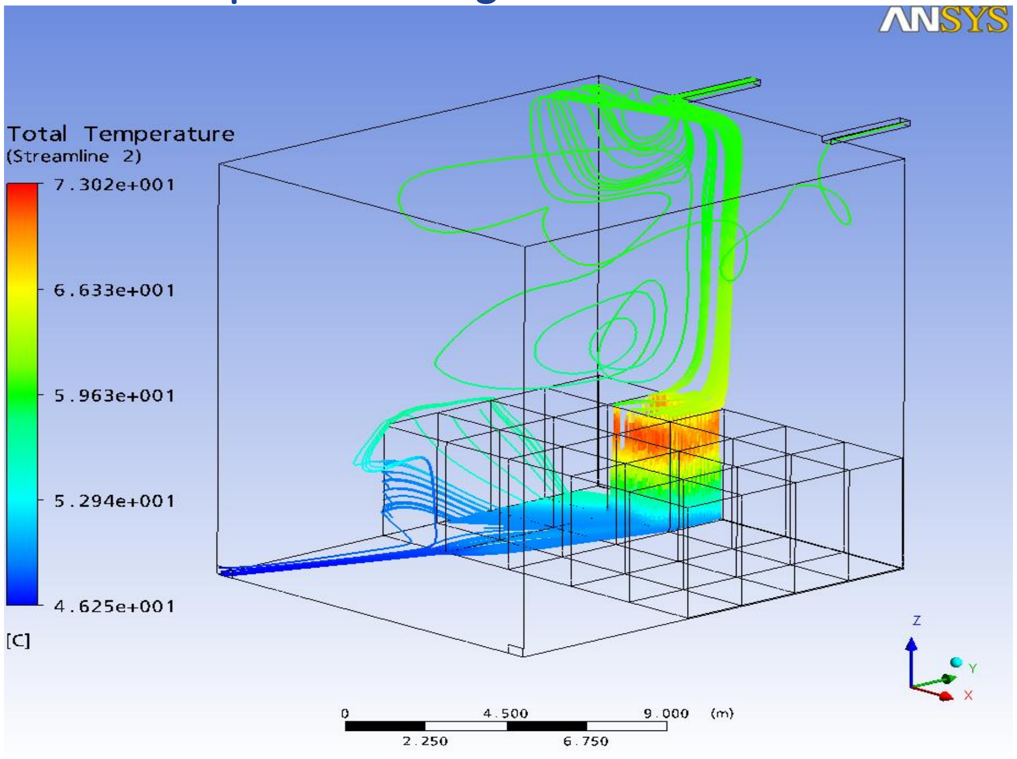
Conclusion:

Evaluation of the bounding thermal-hydraulic case using 19 MW meets all of the design requirements

HITACHI

Spent Fuel Pool Thermal Hydraulic Streamlines

- In LTR NEDO 33373 rev 4, the streamline figures shown have the rack domains in the rack disabled so that the streamlines can not be seen inside the racks
- The figure below shows flow from inlet #1, and the associated flow through the domain of only one of the spent fuel storage racks (#5)
- Racks are modeled as porous domains with characteristic pressure drop
- This clearly shows the expected flow path through a rack and the associated temperatures
- This figure has been added to rev 5 of the LTR



Spent Fuel Uncovery - Operating Experience

Summary from RAI 9.1-128S01 question:

(IE) Bulletin 84-03 and (IN) 84-93, were issued to address the potential failure of refueling cavity seals, failures associated with other seals, and draining of refueling cavities due to and as a consequence of valve misalignments to assure that fuel uncovery while refueling remains an unlikely event.

Response:

DCD revision 7 provided additional details regarding design features associated with the refueling cavity bellows seal (DCD S.6.2.1.1.2 and F 6.2-35), DPV/IC nozzle plugs (DCD S 9.1.4.8 and S13.5.2) and refueling operation features provided to mitigate inadvertent drain down of the reactor cavity (DCD S12.4.4).

Conclusion:

ESBWR design has addressed OE associated with refueling seals that assures that fuel uncovery during refueling is not credible

Gas Accumulation in FAPCS- Operating Experience

Summary from RAI 9.1-151S01 question:

Gas accumulation in nuclear power plant systems has been known to cause water hammer, gas binding in pumps, and inadvertent relief valve actuation that may damage pumps, valves, piping, and supports and may lead to loss of system operability. Address operating experience in the DCD for the FAPCS system which is categorized as a RTNSS system

Response:

- FAPCS is a low pressure system that does not handle reactor coolant and is not subject to accumulation of any amount of non-condensable gas from the reactor
- The piping in this system is designed (line sloop, vents and drain placement) to minimize the risk of gas accumulation, and plant maintenance procedures are required to assure venting

Conclusion:

ESBWR design has adequately addressed OE associated with gas accumulation in FAPCS.

HITACHI

ESBWR Auxiliary System RTNSS Functions

Summary from RAI question:
RAI 22.5-1-DCD Section 14.3.7.3 states that RTNSS systems shall have Tier 1 inputs that include design descriptions and ITAAC. The staff finds that the above position is not implemented consistently throughout the DCD.

Response:
ESBWR Auxiliary Systems with RTNSS functions have been implicitly described in DCD Tier 2 and Tier 1 ITAAC have been included for all RTNSS functions.

Conclusion:
ESBWR Auxiliary Systems described in DCD Chapter 9 provide RTNSS functions and RTNSS requirements are described for each RTNSS system.

Auxiliary System RTNSS Function Overview

RTNSS Function	Description	Availability Controls
FPS Diesel Driven Pump	B - Long Term Core Cooling: RPV At-Power and Spent Fuel Pool; Long Term Containment Integrity	ACLCO 3.7.1
FPS Motor Driven Pump	B - Long Term Core Cooling: RPV At-Power and Spent Fuel Pool; Long Term Containment Integrity	ACLCO 3.7.1
FPS to FAPCS Connection Piping	B - Long Term Core Cooling: RPV At-Power and Spent Fuel Pool; Long Term Containment Integrity	ACLCO 3.7.1
FAPCS (LPCI, SPC Modes)	C - Focused PRA (Uncertainty)	ACLCO 3.7.2 ACLCO 3.7.3
FPS Water Tank	B - Supports core cooling for refill of pools	ACLCO 3.7.1
FPS Diesel Fuel Oil Tank	B - Supports Diesel Driven FPS pump	ACLCO 3.7.1

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Auxiliary System RTNSS Function Overview

RTNSS Function	Description	Availability Controls
Ancillary Diesel Generators	B - Supports FPS Motor Driven Pump, PCCS Vent Fans, CRHAVS AHUs, Emergency Lighting, Q-DCIS	ACLCO 3.8.3
Standby Diesel Generators	C - Supports FAPCS operation	ACLCO 3.8.1, ACLCO 3.8.2
Ancillary Diesel Building HVAC	B – Supports Ancillary Diesel Generators	Maintenance Rule
Electrical Building HVAC Area Cooling	C - Supports PIP Buses, N-DCIS for FAPCS	Maintenance Rule
Fuel Building HVAC Local Cooling	C - Supports FAPCS, N-DCIS for FAPCS	Maintenance Rule

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Auxiliary System RTNSS Function Overview

RTNSS Function	Description	Availability Controls
Reactor Building HVAC Local Cooling	C - Supports N-DCIS for FAPCS	Maintenance Rule
Turbine Building HVAC Local Cooling	C – Supports FAPCS	Maintenance Rule
CRHAVS Air Handling Units	B - Long-term control room habitability	ACLCO 3.7.6
CRHAVS Air Handling Unit auxiliary heaters and coolers	B - Cooling for post-accident monitoring heat loads	ACLCO 3.7.6

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Auxiliary System RTNSS Function Overview

RTNSS Function	Description	Availability Controls
RCCWS	C - Supports Standby Diesel Generators (supports FAPCS) and Nuclear Island Chilled Water Subsystem (NICWS)	Maintenance Rule
Nuclear Island Chilled Water	C – Building HVAC	Maintenance Rule
PSWS	C - Supports RCCWS	Maintenance Rule

ESBWR Cooling Water System Design

Summary from RAI question:

RAI 9.2-24 -Nonsafety-related (NSR) active systems are relied upon to achieve cold shutdown conditions in accordance with Technical Specification requirements. These systems should be highly reliable and capable of achieving and maintaining cold shutdown conditions with no single failure that would result in inability to terminate use of the passive safety-related systems and achieve cold shutdown.

Response:

ESBWR Cooling Water System Audit conducted March 19 and 20, 2009 and response to RAI 9.2-24 submitted.

Conclusion:

ESBWR cooling water systems conform to NRC policies that have been established with respect to the applicable RTNSS functions.

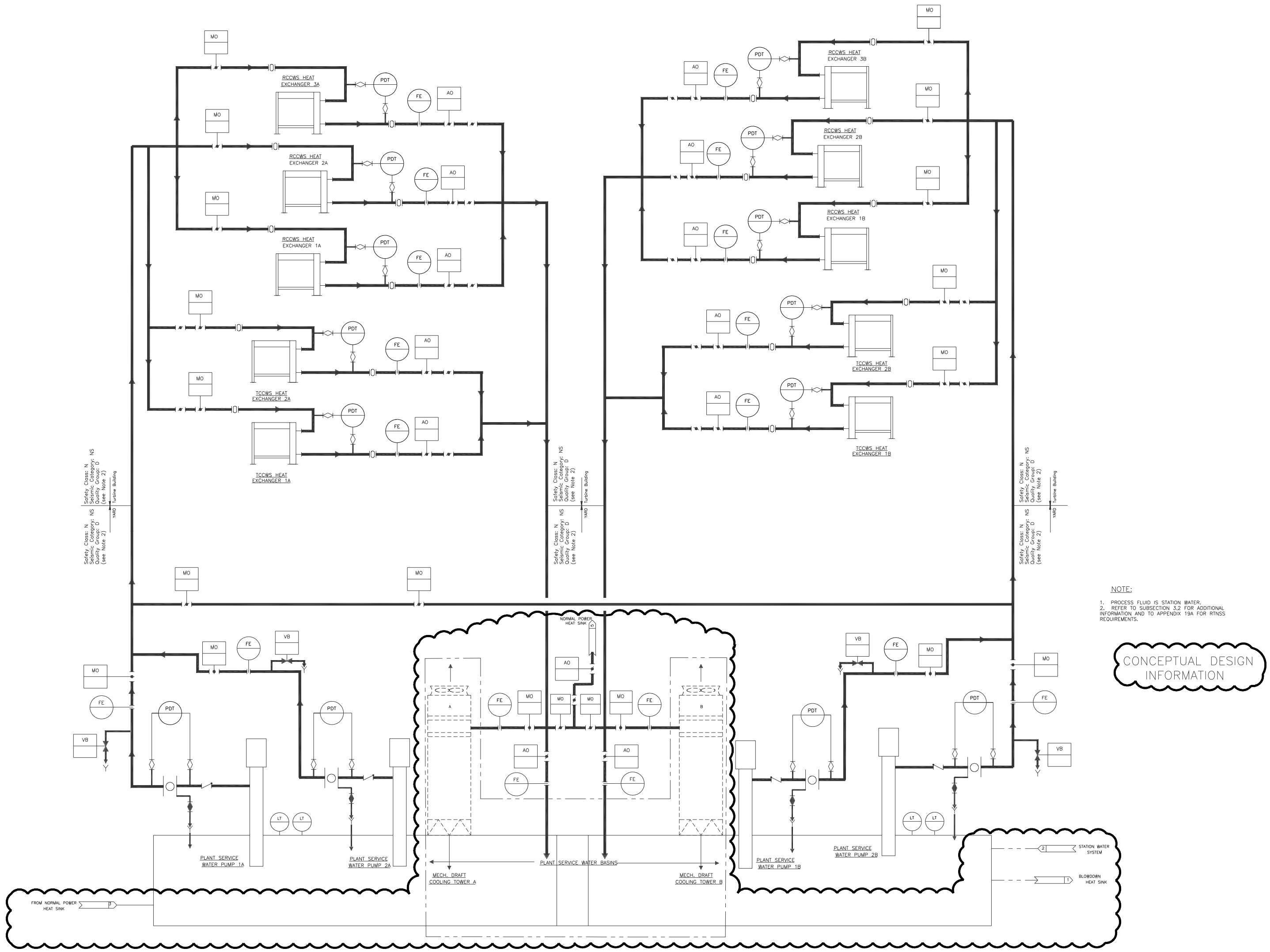
ESBWR Cooling Water System Design

- PSWS, RCCWS and NICWS High Level Requirements
  - Performs Nonsafety-Related Functions with defense-in-depth requirements

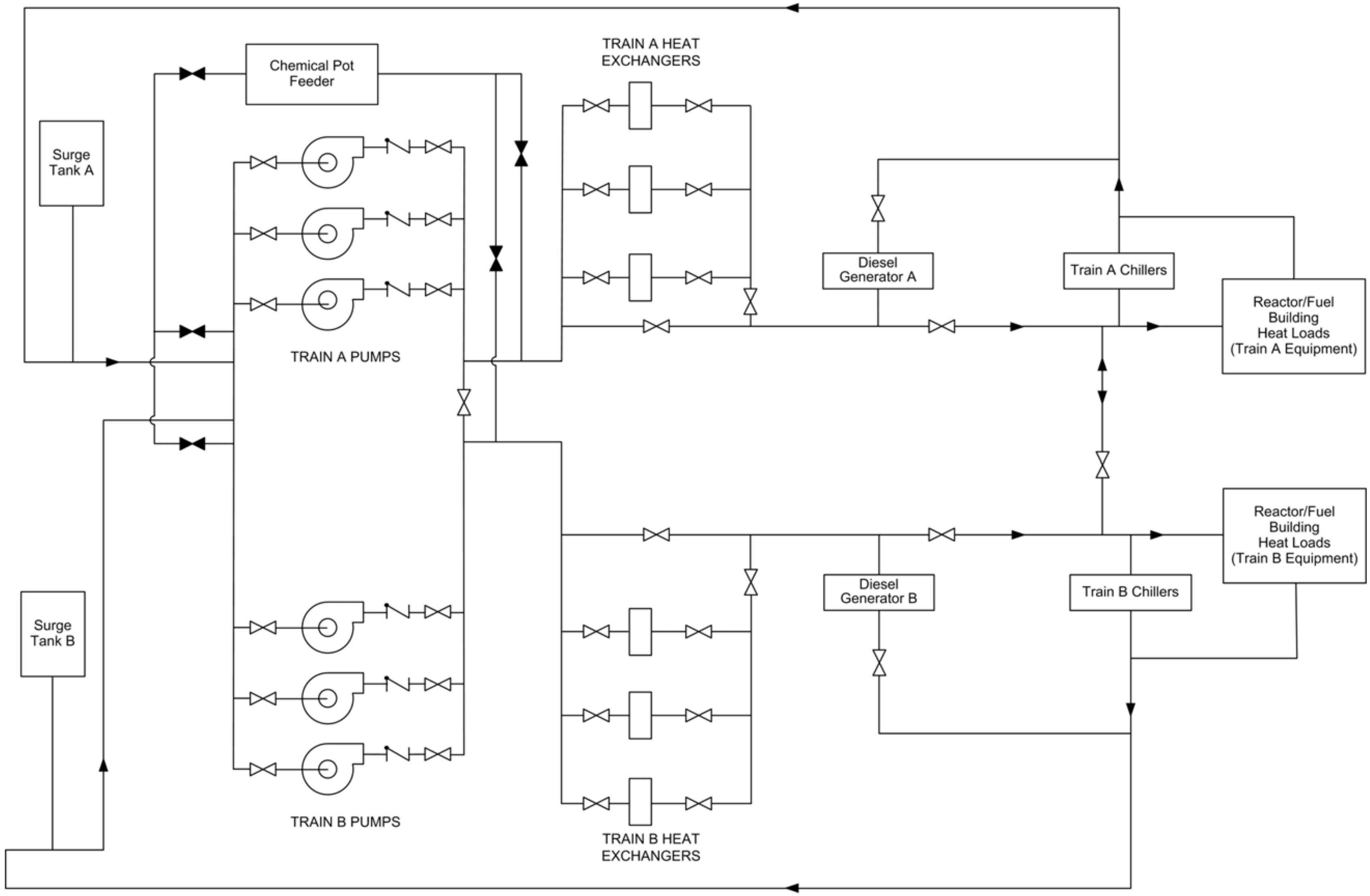
  Because these cooling water systems are also significant contributors to plant availability and plant investment protection (PIP), design requirements for defense-in-depth and PIP (seismic ruggedness, redundancy fire and missile, and flood protection) may be more restrictive than the system RTNSS requirements

  - RTNSS C function to provide cooling (post 72 hour)
    Redundant Trains
    Physical and Electrical Separation of Trains
    Seismic Requirements –IBC-2003 & Position C.2 of RG 1.29 as required
    Ability to Withstand Cat 5 Hurricane Missiles and Flood

DCD Section 9.2 – Water Systems-PSWS



DCD Section 9.2 – Water Systems-RCCWS



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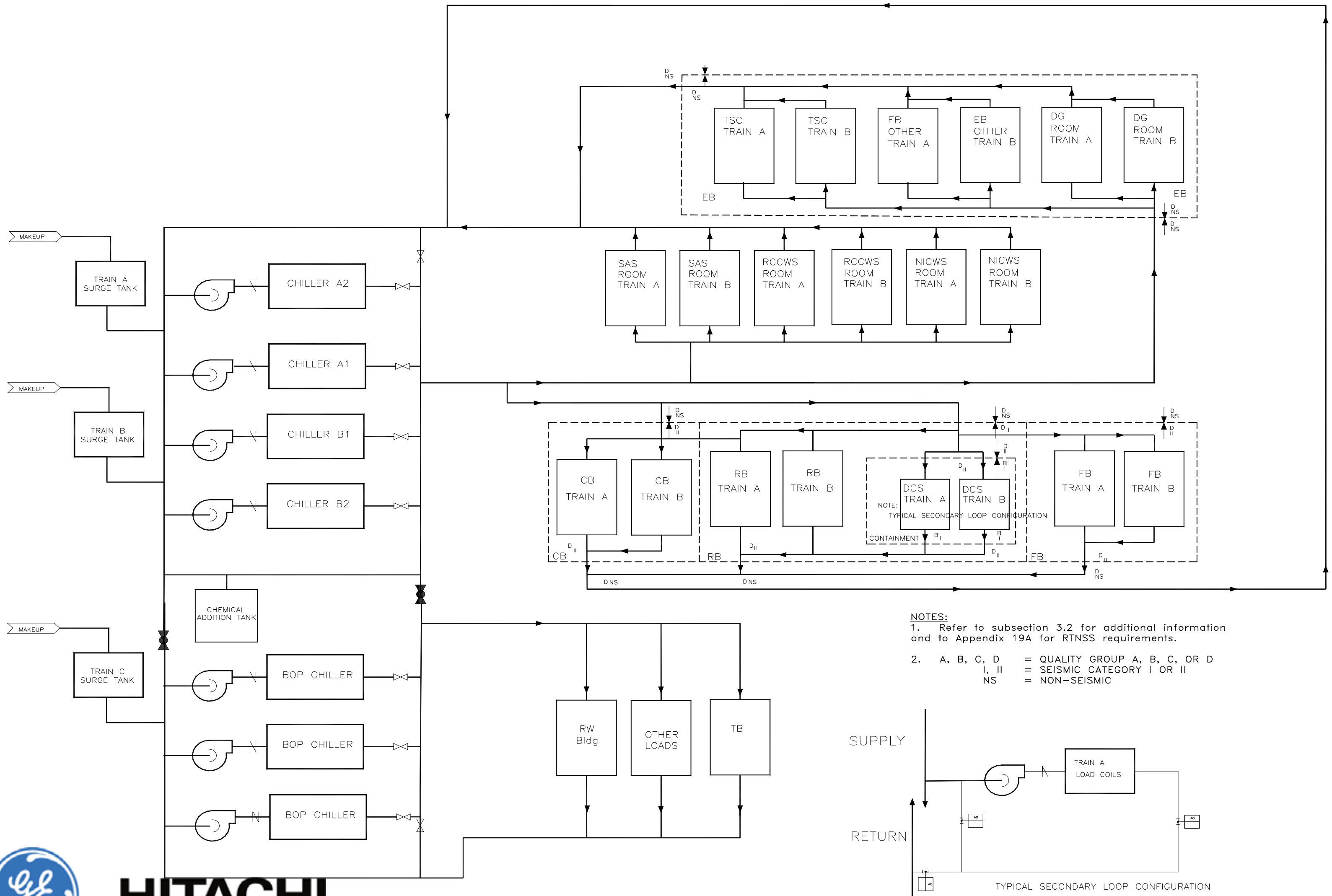
DCD Section 9.2 – Water Systems

Chilled Water System (CWS)



NOTES:
1. Refer to subsection 3.2 for additional information and to Appendix 19A for RTNSS requirements.
2. A, B, C, D = QUALITY GROUP A, B, C, OR D
I, II = SEISMIC CATEGORY I OR II
NS = NON–SEISMIC

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ESBWR Cooling Water System Design- PSWS

- Single train failure during cooldown results in the greatest heat load per PSWS train at 80.8 MW
- Significant margins and conservative assumptions are applied to the heat loads for the PSWS
  - While the PSWS is designed for 1% exceedance conditions, the system is capable of operating under 0% exceedance
- Significant margins and conservative assumptions are applied to the design of the heat removal facility (conceptual design information) for the PSWS
  - Margin applied to the design heat load for the mechanical draft cooling towers reflects the difference between the maximum PSWS train design heat load (Single Train Failure Cooldown) listed in DCD Table 9.2-1 and PSWS Cooling Towers and Basins heat load listed in DCD Table 9.2-2 (3.3% margin)

ESBWR Cooling Water System Design- RCCWS

- Loss of Preferred Power Cooldown with Single Train Failure is the most limiting system heat removal design condition for the RCCWS

  This mode of operation provides sufficient cooling capacity to bring the plant to cold shutdown condition within 36 hours
- The most limiting condition for RCCWS heat exchanger design is a Single Train Failure Cooldown without a LOPP; which has a design heat load of 59.8 MW divided between two heat exchangers
- Significant margins and conservative assumptions are applied to the heat loads for the RCCWS

  While the RCCWS is designed for 1% exceedance conditions, the system is capable of operating under 0 % exceedance
- Significant margins are applied to the RCCWS during the design process to account for uncertainties, component wear and aging effects and fouling of heat transfer surfaces

  RCCWS design temperatures and pressures include a margin of 10°F added to the operating temperature and a margin of 25 psig added to the operating pressure

HITACHI

ESBWR Cooling Water System Design- NICWS

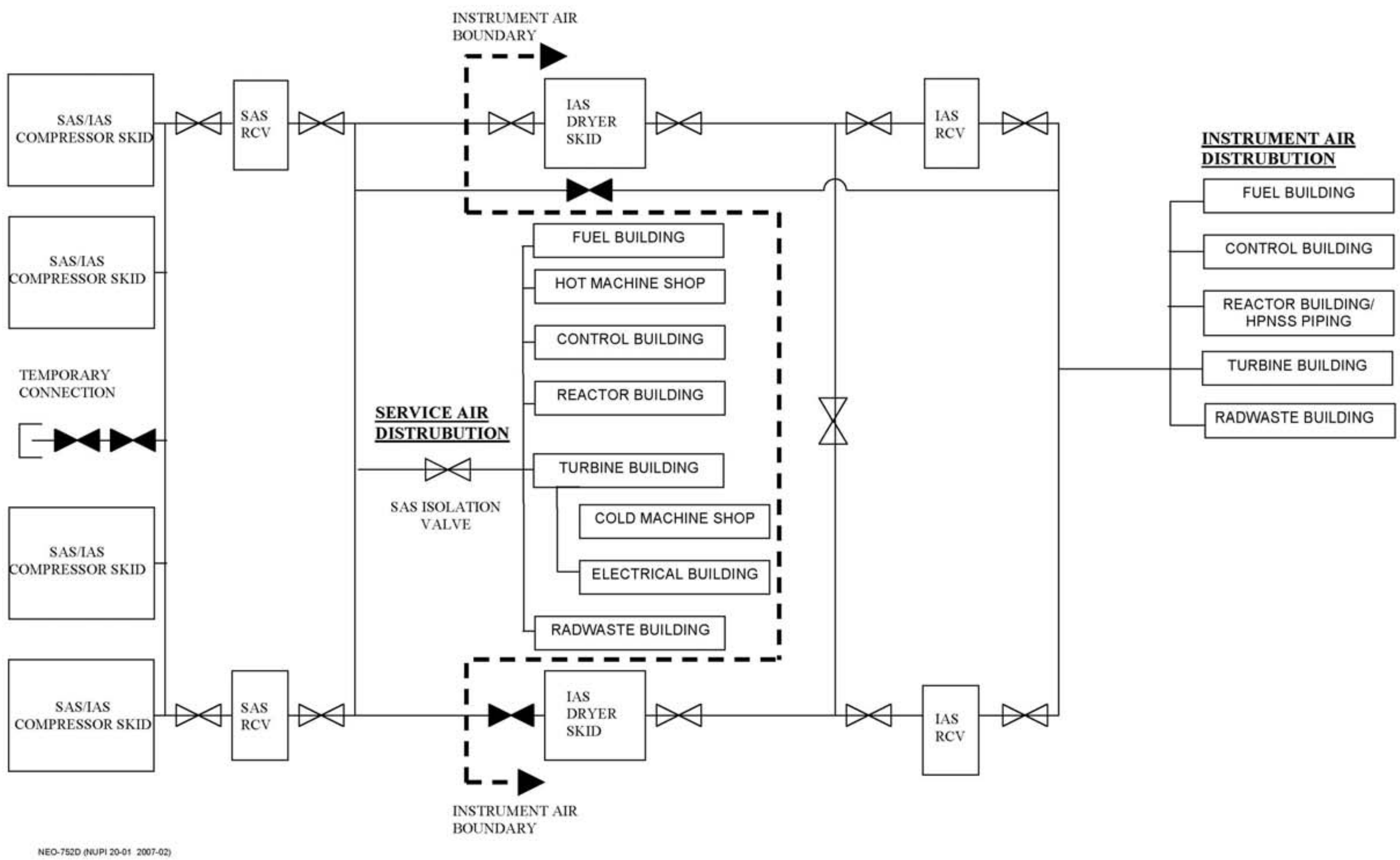
- There is no specific NICWS alignment specified for the 24 hour or 36 hour cool down conditions
- The CWS chiller heat load is 4850 Kw with a total system heat load of 19,110 kW [ref DCD Table 9.2-11]
- NICWS and BOPCWS Chillers will be sized for a heat load of 4,638 kW (1,319 tons) per chiller with a 1380 ton chiller size assumed
- The NICWS consists of two trains with two 50% chillers in each train resulting in a total NICWS heat load of 9.3MW
- Significant margins will be applied to the NICWS during the design process to account for uncertainties
  - A corrosion margin is applied to NICWS piping to account for aging and degradation
  - All building HVAC systems include a 15% margin for projected heating/cooling load and 15% margin for airflow (Ref URD Chapt 9 Sect 8.2.1.1.12)

Instrument Air / Service Air System Overview

- Compressed air operated components having safety-related or RTNSS required functions, either have safety-related accumulators or are fail-safe and do not rely on any of the compressed air systems to perform these functions [DCD S9.3.1]
- IAS Air Quality Concerns [RAI 9.3-41 and RAI 10.2-18S03]

  SS piping and components, oil free, 3 micron particulate, -40 F dewpoint
- Upon failure of IAS dryer, other dryer can accommodate 100% IAS demand
- Separate from the integrated system Instrument and Service Air Preoperational tests, individual components will be tested for proper "failure" (open, close, or as is) to both instantaneous (pipe break) and slow (plugging or freezing) simulated air losses [DCD S14.2.8.1.19]

Section 9.3 – Process Auxiliaries- Air Systems



HITACHI

Summary

- Provided revised decay heat calculation and associated analysis using bounding bounding total decay power curve to show water remains over active fuel and all thermal requirements are met
- Illustrated how OE experience applied to ESBWR design for spent fuel uncovery and gas accumulation in FAPCS
- Described Aux System RTNSS functions and robustness of system design
- Described PSWS design overview
- Described RCCWS design overview
- Described NICWS design overview
- Described Instrument Air / Service Air System Overview

HITACHI

End of Basic Presentation

BACKUP SLIDES

ESBWR Spent Fuel Pool Decay Heat

- ANSI/ANS-5.1-1994 with 2σ uncertainty (7.4% at 5 days)
- GEH Decay heat also considers:
  - Actinides (in addition to those in ANS 5.1)
  - Activation products in structural materials
  - Fission power from delayed neutron-induced fission
- Fuel data is generated with lattice physics code TGBLA
- An Equilibrium cycle is assumed (no credit for initial fuel only operated 1 cycle)

NRC conducted an audit of the containment analysis in December 2006, reviewed the NRC procedure and issued RAI's 6.3-61, 6.3-62, 6.3-62 S01 related to GEH decay heat calculations (the same method is used in the containment and spent fuel pool decay heat calculations.) GEH responded with information which closed the NRC concern.

ESBWR Spent Fuel Pool Decay Heat

	Core	Batch N-1	Batch N-2	Batch N-3	Batch N-4	Batch N-5	Total Old Batches	Total SFP
Decay time (y)	0	2	4	6	8	10		
No. of bundles	1132	476	476	476	476	476	2380	3512
Decay heat* (MW) – EOC case	16.79 (0.373% rated)	0.52	0.27	0.18	0.15	0.14	1.27	18.06**
Decay heat* (MW) – 36-day irradiation	13.90 (0.309% rated)	2.31	0.49	0.26	0.17	0.15	3.39	17.29

*5 days post shutdown
** 18.42 MWt at 102% rated

EOC case is bounding as most heat load comes from the core and core decay heat increases with exposure and irradiation time

Slight difference (~1%) in core decay heat, 0.373% vs. 0.378% from core decay heat calculation for containment analysis due to

- Multi-batch vs. single batch model
- More conservative inputs in exposure and irradiation time for ANS 5.1 calculation for core decay heat

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Fuel Decay Heat Input

Decay Heat Contributer	Decay Power at 5 days after shutdown (MW)	
End Of Cycle Full Core Offload	16.79	
Five Refuel Batches (0 to10 years)	1.27	
Margin	0.94	
Total	19	Used for Fuel Building Spent Fuel Storage Rack Design
		(Full core offload + 10 years prior offload batches)
Five Refuel Batches (10 to 20 years)	0.68	
102% Power Adjustment	0.39	
Total	20.1	Used for Fuel Pool Boil-off Calculation
		(Full core offload + 20 years prior offload batches)

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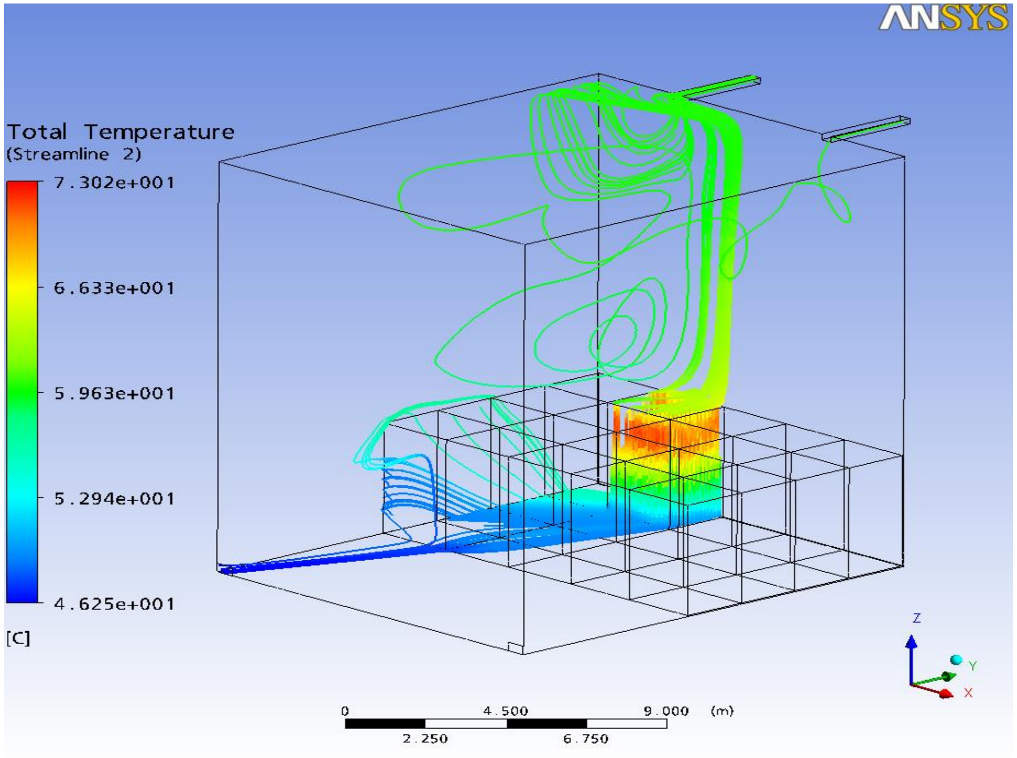
Spent Fuel Pool Thermal Hydraulic Streamlines

- In LTR NEDO 33373 rev 4, the streamline figures shown have the rack domains in the rack disabled so that the streamlines can not be seen inside the racks
- The figure below shows flow from inlet #1, and the associated flow through the domain of only one of the spent fuel storage racks (#5)
- This clearly shows the expected flow path through a rack and the associated temperatures
- This figure has been added to rev 5 of the LTR



Plant Service Water Basin Sizing Considerations

- PSWS Interface Requirements [Tier 1 S4.1]

  The volume of water shall be sufficient such that no active makeup shall be necessary to remove 2.02x107 MJ (1.92x1010 BTU) over a period of seven days. Additionally, the PSWS pumps must have sufficient available net positive suction head at the pump suction location for the lowest probable water level of the heat sink [ref DCD Tier 1 S4.1]

- PSWS basin sizing to meet PRA (Single Active Failure w/LOPP for 7 days) with decay heat removal by ICS (1st 34 hours) then using containment forced cooling and spent fuel pool cooling requiring PSWS operation (for 7 days) [Total 2.3 M gallons]

- PSWS heat loads considered include combined core and spent fuel decay heat loads and heat load due to Diesel Generators and NI Chillers

- TCCW loads auto sequence on SDG at LOOP but loads are within the margin of the analysis

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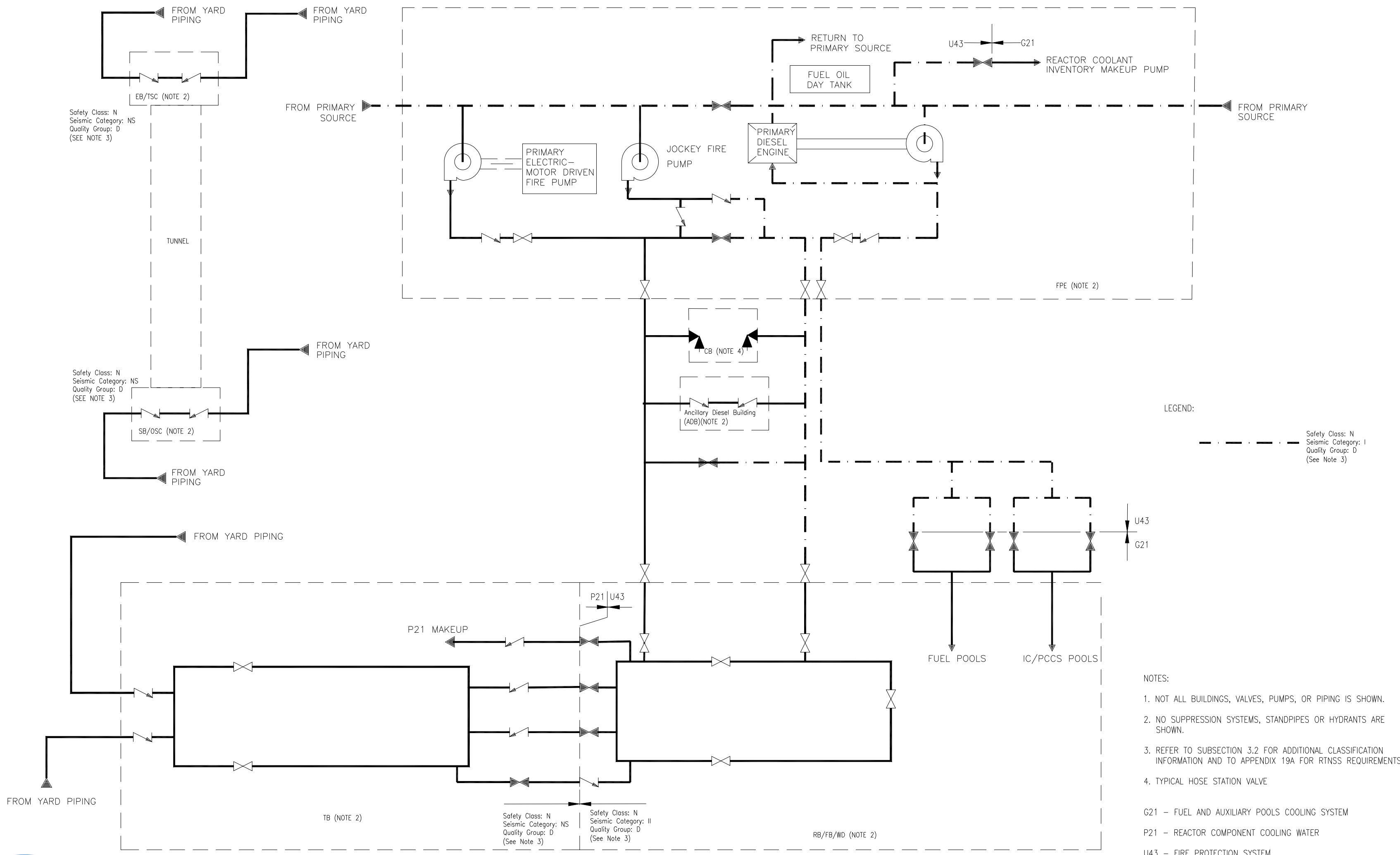
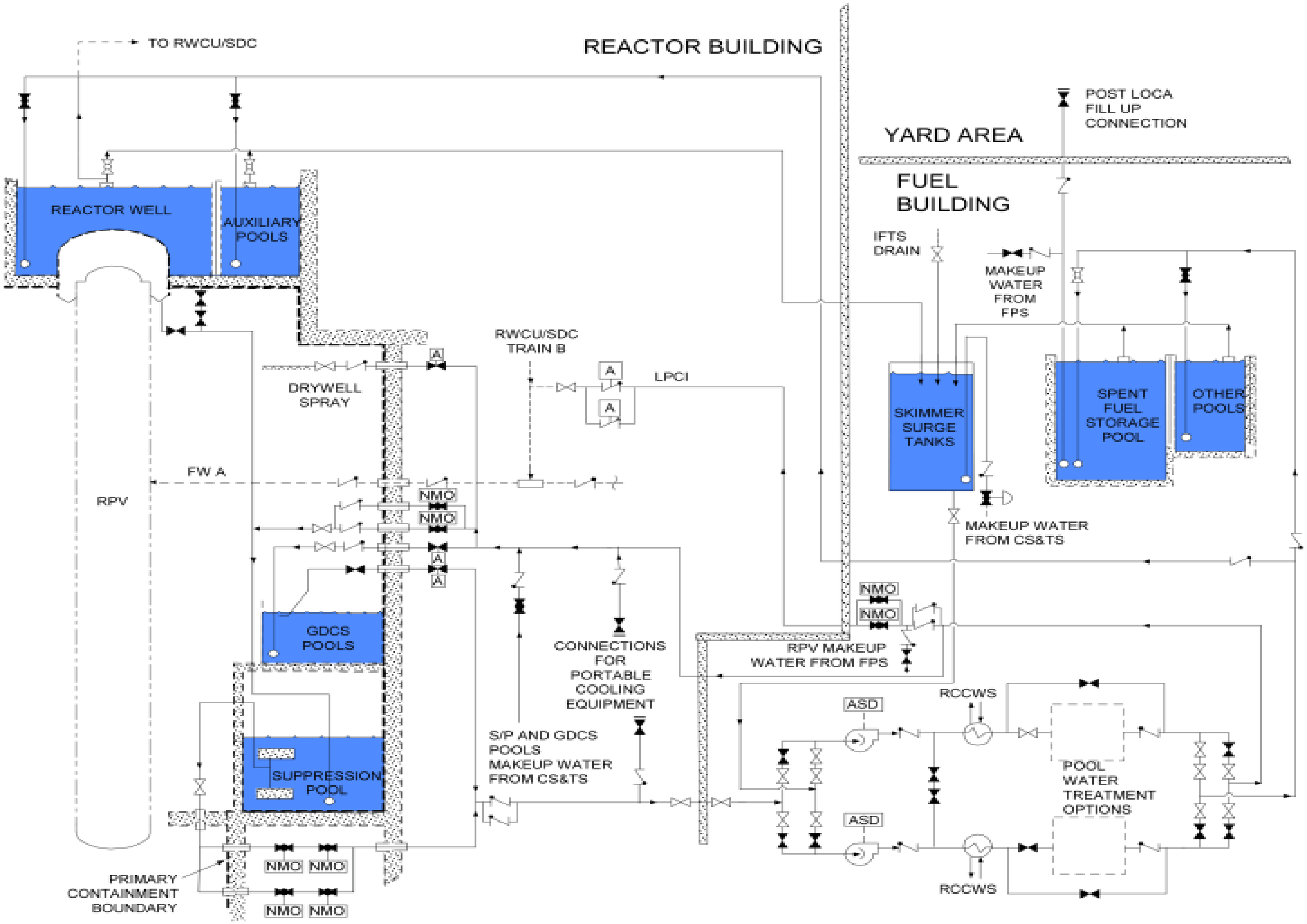
Hydrogen Water Chemistry- Optional ESBWR System

- ESBWR has a reduced risk of cracking through the numerous mitigating actions taken or under consideration (e.g., post-weld anneal of higher risk components)
- Therefore, if a utility prefers to begin its operating life without the addition of hydrogen/ NobleChemTM, the consequences for the foreseeable future are likely small
- Nonetheless, GE recommends the application of HWC at startup
- ESBWR, as presently configured, reflects a lower risk than previous US-based designs with the risk of SCC in the ESBWR similar to the ABWR because it uses similar material and process selections (ten years of ABWR operation results in no evidence of stress corrosion cracking, although inspections have been limited
- ESBWR will include provisions to easily accommodate hydrogen, zinc, and online NobleChem applications (as well as for oxygen)
- The customer may choose not to implement at startup, but these options can be easily implemented at any time.

Fire Protection System



FAPCS Schematic



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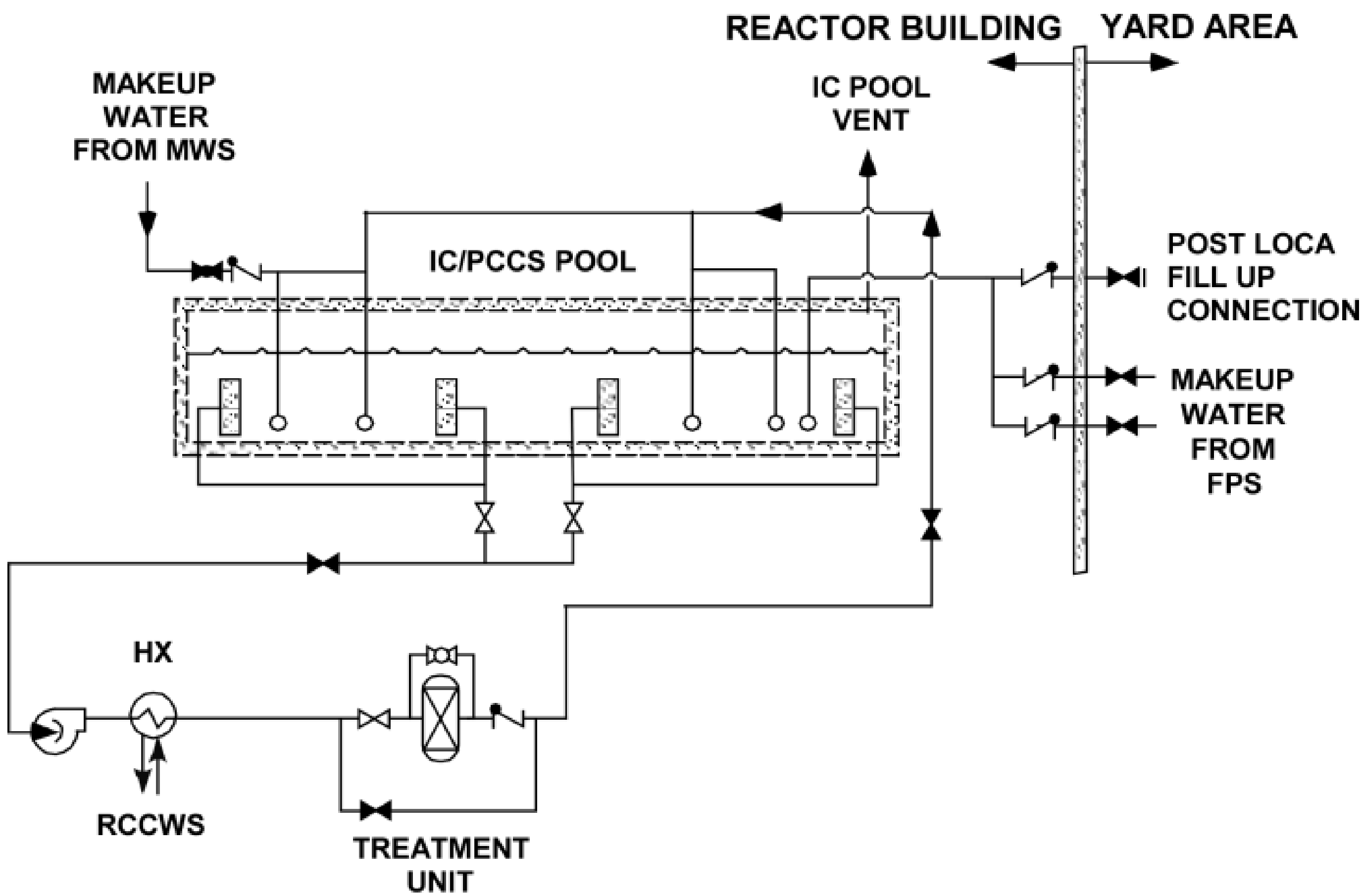
FAPCS – IC/PCCS Subsystem



Clean & Contaminated Water Kept Separate

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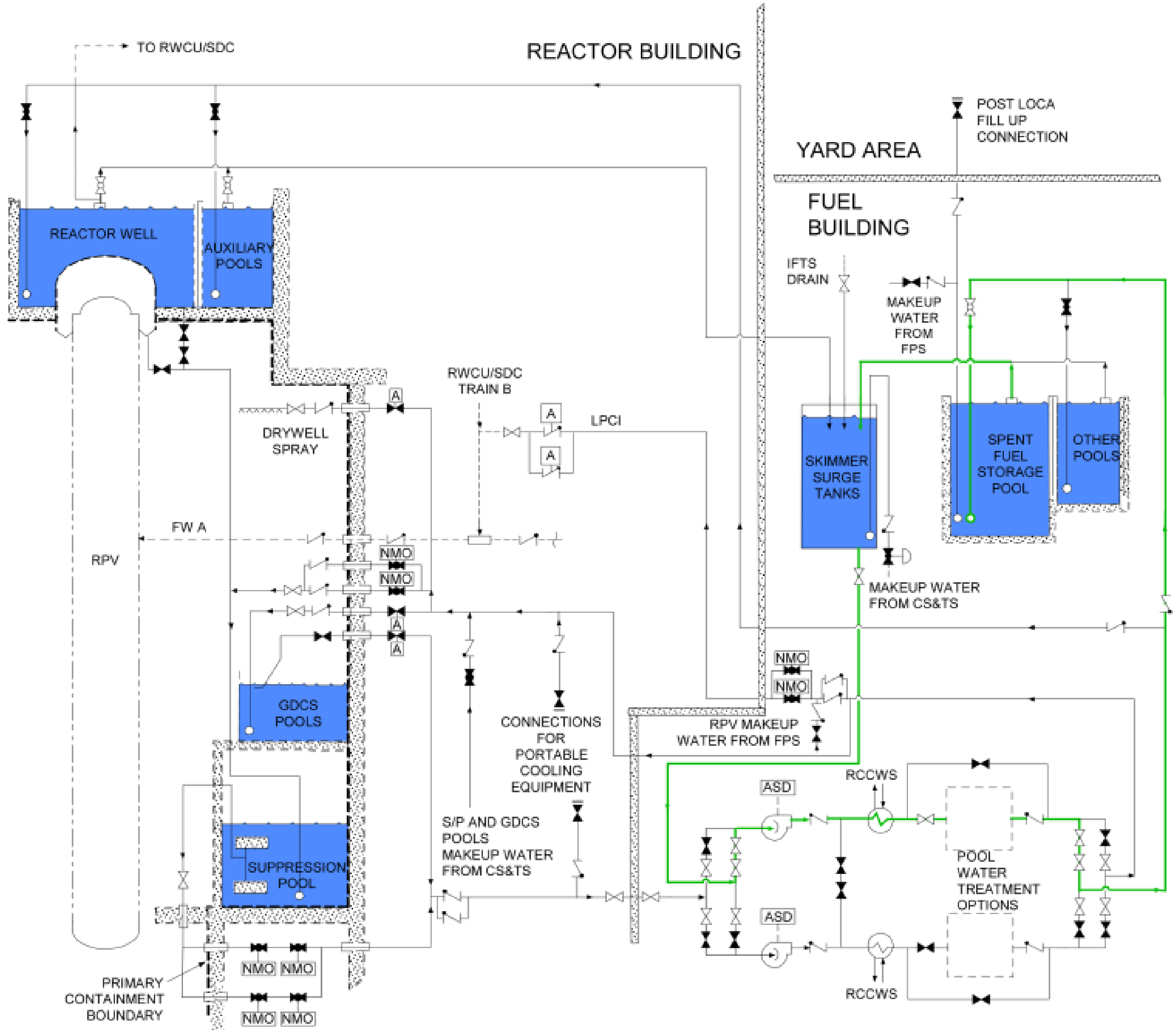
FAPCS – Fuel Pool Cooling Mode



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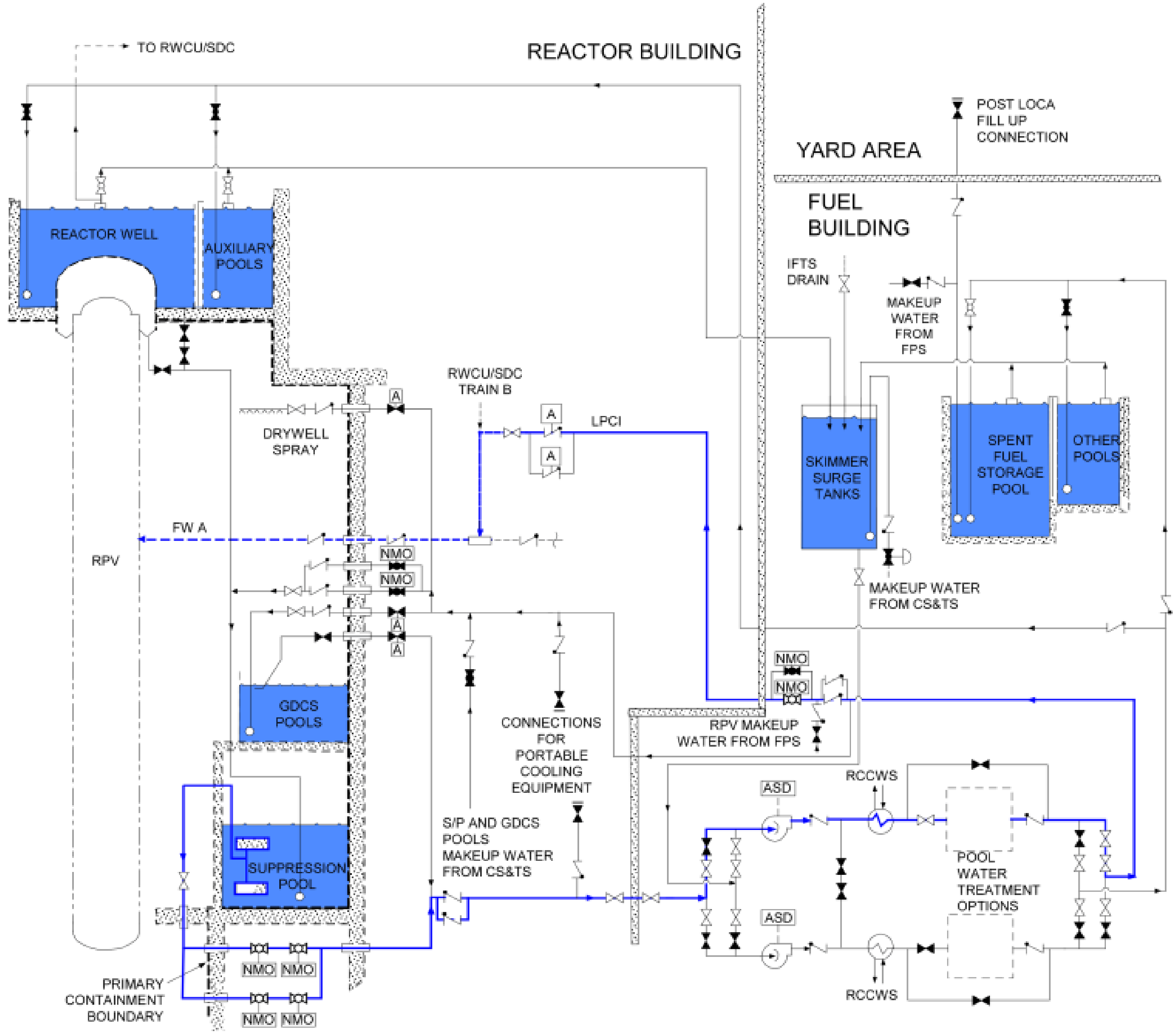
FAPCS – LPCI Mode

Non-safety related LPCI mode



Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Section 3.12 – Piping Design
Kaihwa Hsu - NRO/DE/EMB1

September 23, 2010

RAI 3.12-3

- Independent Support Motion (ISM) Response Spectrum Method.

- SRP 3.12 recommends the acceptance criteria that is listed in NUREG-1061, Vol. 4.

- GEH’s final position meets the acceptance criteria. OI was resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review

<u>RAI 3.12-17</u>

- SRSS method used in the load combination of dynamic loadings.

- Acceptance Criteria listed in NUREG-0484, Rev.1 for using SRSS combination method.

- GEH provided justification that meets the provision of NUREG-0484, Rev.1. OI was resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review

<u>RAI 3.12-27</u>

- Load Combination of Seismic Anchor Movement (SAM) and Seismic Inertia response.

- GEH revised DCD to state that the ABS method is used to combine the inertia and SAM results for both piping and piping support design in USM piping analysis.

- This position meets the recommendation in SPR 3.9.2. OI is resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review

RAI 3.9-254/255

- piping analysis PISYS08 Computer Code.

- PISYS08 post-processor and environmental assisted fatigue evaluation ANSI714 Computer Code

- Software design documents and QA status for PISYS08/ANSI714 Computer Code were not completed.

- The staff identified that inconsistency of PISYS08 and DCD description for the piping analysis method related to RG 1.92.

ACRS Subcommittee Presentation
ESBWR Design Certification Review

RAI 3.9-254/255 (Continued)

- During audit ANSI714 V&V package, the staff noted that the temperature used in the calculation for fatigue environmental factor (Fen) is not consistent with the procedure in NUREG/CR-6909.

- GEH revised PISYS08 test report, DCD and completed software design documents to address staff’s concern. The issue was closed.

- GEH revised the ANSI714 computer code and completed software design documents to address staff’s concern. This issue was closed.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review

Section 3.9

Yuken Wong – NRO/DE/EMB2

Tuan Le – NRO/DE/EMB1

September 23, 2010

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.2.4 – Preoperational Flow-Induced Vibration Testing

<u>Regulations and Regulatory Guidance</u>

- GDC 1 and 4
- Regulatory Guide 1.20, Rev. 3
- SRP Sections 3.9.2 and 3.9.5

ACRS Subcommittee Presentation
ESBWR Design Certification Review

Section 3.9.2.4 – Preoperational Flow-Induced Vibration Testing (cont'd)

RAI 3.9-75

- Clarify the use of both terms "prototype" and "non-prototype" for reactor internals components
- GEH clarified that "prototype" applies to chimney and standby liquid control structures. The ESBWR reactor internals as a whole is classified as non-prototype Category II
- This resolves RAI 3.9-75

Classification of Reactor Internals

- The staff questioned the classification of the ESBWR reactor internals as non-prototype Category II considering the major differences between the ESBWR and ABWR reactor internals
- GEH reclassified ESBWR reactor internals as prototype
- This resolves the issue

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.2.4 – Preoperational Flow-Induced Vibration Testing (cont'd)

RAI 3.9-96

- Explain the basis for selecting the reactor internals components for testing for the first ESBWR plant
- GEH provided an item by item discussion of why each component was selected for further analysis and testing or why it was considered adequate without further detailed analysis or testing
- This resolves RAI 3.9-96

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.2.5 – Dynamic System Analysis of Reactor Intenals under Faulted Conditions

Regulations and Regulatory Guidance

- GDC 2 and 4, and 10 CFR Part 50, Appendix S
- SRP Sections 3.9.2 and 3.9.5
- ASME Code Section III, Subsection NG

RAI 3.9-81

- Demonstrate that there is no significant dynamic amplification of the loads on the reactor internals as a result of the postulated break in the MSL and FW line
- GEH stated that a comparison is made of the periods of the loads and the natural period of the core support structures, and determined that there is no significant dynamic amplification of the blowdown loads
- This resolves RAI 3.9-81

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.3 – ASME Code Class 1, 2, and 3 Components and Component Supports, and Core Support Structures

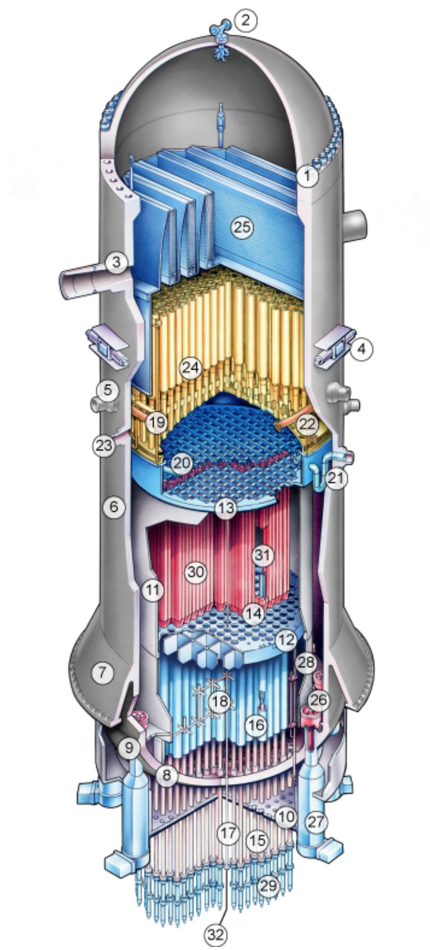
RAI 3.9-177:

- Staff requested that the applicant reinstate the COL information item regarding the availability of design reports and design specification originally listed in DCD Section 3.9.9.4 (Revision 3), in DCD Section 3.9.9 or address the information item through an ITAAC.

In response to this RAI, the applicant committed to:

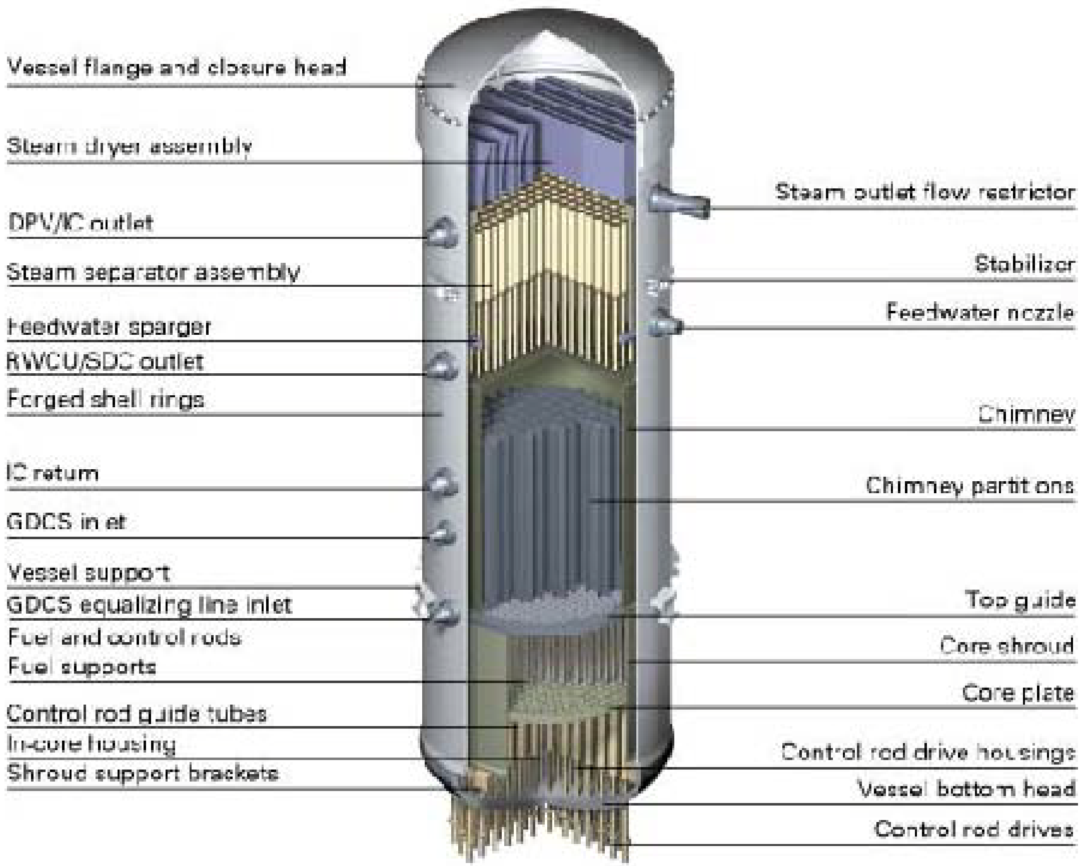
- ITAAC for review of Design Reports
- Completion of Design Specifications for risk significant components prior to Certification.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.2 – Backup Slide – ABWR Reactor Internals



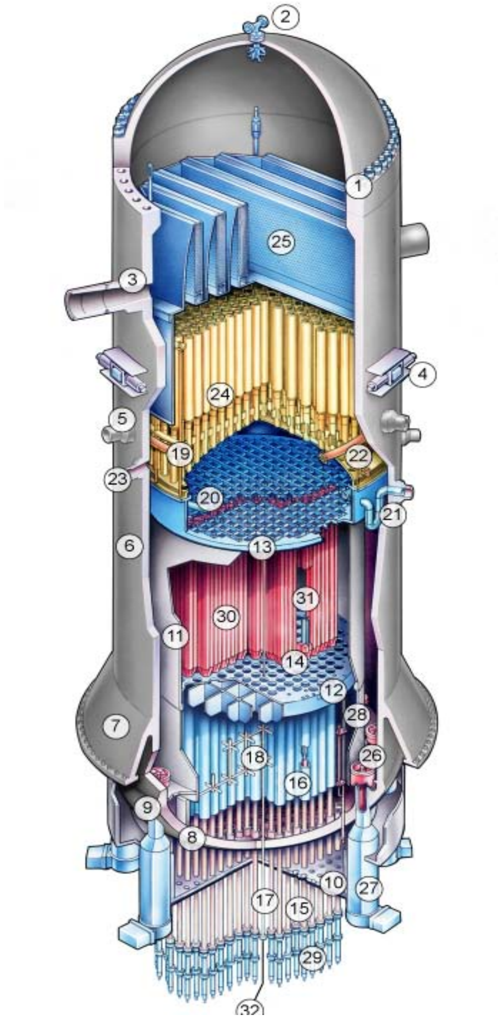
1 - Vessel flange and closure head
2 - Vent and head spray assembly
3 - Steam outlet flow restrictor
4 - RPV stabilizer
5 - Feedwater nozzle
6 - Forged shell rings
7 - Vessel support skirt
8 - Vessel bottom head
9 - RIP penetrations
10 - Thermal insulation
11 - Core shroud
12 - Core plate
13 - Top guide
14 - Fuel supports
15 - Control rod drive housings
16 - Control rod guide tubes
17 - In-core housing
18 - In-core guide tubes and stabilizers
19 - Feedwater sparger
20 - High pressure core flooder (HPCF) sparger
21 - HPCF coupling
22 - Low pressure flooder (LPFL)
23 - Shutdown cooling outlet
24 - Shroud head and steam separator assembly
25 - Steam dryer assembly
26 - Reactor internal pumps (RIP)
27 - RIP motor casing
28 - Core and RIP differential pressure line
29 - Fine motion control rod drives
30 - Fuel assemblies
31 - Control rods
32 - Local power range monitor

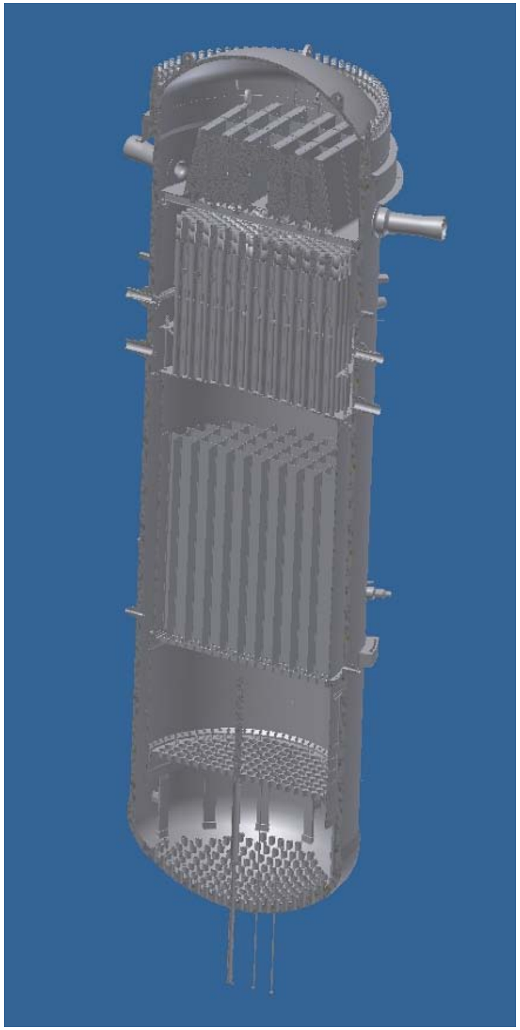
ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.2 – Backup Slide – ESBWR Reactor Internals



ACRS Subcommittee Presentation
ESBWR Design Certification Review

Section 3.9.2 – Backup Slide – ABWR vs. ESBWR





ACRS Subcommittee Presentation
ESBWR Design Certification Review

Section 3.9.2 – Backup Slide – ABWR vs. ESBWR

Description	ABWR	ESBWR	Difference
Power (MWt)	3926	4500	14.6%
Main steam flow (ton/hr)	7640	8757	14.6%
Core coolant flow rate (Mlb_m/hr)	115.1	76.0	-34.0%
Feedwater flow rate (Mlbm/hr)	16.8	19.3	14.6%
Vessel height (m)	21.1	27.6	30.9%
Fuel Bundles	872	1132	29.8%
Core diameter (m)	5.2	5.9	13.9%
Fuel assembly length (in)	176	149	-15.3%
Main steam pipe diameter (in)	28	30	7.1%
Chimney	No	Yes	N/A
Standby liquid control lines	No	Yes	N/A
High pressure core flooder coupling/spargers	Yes	No	N/A

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.8 – Seismic Category I Structures
Samir Chakrabarti – NRO/DE/SEB2

September 23, 2010

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Regulations, Regulatory Guidance, and Key Industry Codes & Standards

- Appendix A to 10 CFR Part 50, GDC 1, 2, 4, 5, 16, and 50
- Appendix B to 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"
- SRP 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5
- Regulatory Guides 1.94, 1.57, 1.136, 1.142, 1.143, 1.199
- ASME Section III, Division 2, Subsection CC, "Code for Concrete Reactor Vessels and Containments"
- ASME Section III, Division 1, Subsection NE, "Class MC Components"
- ACI 349, "Code Requirements for Nuclear Safety-Related Concrete Structures"
- ANSI/AISC N690, "Specification for Safety-Related Steel Structures for Nuclear Facilities"

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Review Highlights

- Staff performed five design audits to review design reports, review calculations, and discuss open issues
- Staff performed confirmatory analysis of nuclear island foundation base mat
- Majority of the review questions required additional technical information which resulted in significant enhancement of the DCD content

Review Status

- All issues identified during review have been resolved
- Resolution of PCCS Hydrogen Detonation Issue Included in Section 6.2.2

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Closure of Open Items Discussed in Last ACRS Meeting

RAI 3.8-107

In view of significant nonlinear behavior of containment structure due to thermal loading, the staff questioned the appropriateness of combining results from thermal analysis with the elastically calculated results for other loads by linear superposition.

- **Resolution**: GEH performed an additional study
  - Study used detailed 3D ABAQUS/ANACAP FEM
  - Two cases analyzed:

    (1) A linear analysis for pressure combined with nonlinear cracking analysis for thermal (ESBWR design approach)

    (2) A nonlinear analysis for both pressure and temperature with concrete cracking
  - Results: Comparisons of stresses show that the ESBWR design approach is generally conservative. Where not, the resulting stresses/strains are still less than Code limits
- **Disposition**: RAI resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Closure of Open Items Discussed in Last ACRS Meeting

RAI 3.8-79

The staff requested GEH to demonstrate that there would be no unacceptable

seismic interaction between seismic category (SC) I structures and adjacent non-safety-related structures, e.g., Turbine Building, Service Building, and Radwaste Building.

- **Resolution**: GEH revised their seismic criteria for non-safety-related structures
  - Seismic criteria for analysis and design included in updated DCD
  - Method of analysis is the same as a SC I structure
  - Will utilize stick model or FEM using procedures described in DCD 3.7.2.3
  - Soil structure interaction (SSI) analysis will be performed using soil spring/dashpot approach or FEM approach in accordance with DCD App. 3A
  - Seismic gap criteria between adjacent structures are to show gaps are greater than calculated maximum relative displacements considering out-of-phase motion
  - ITAAC were revised to state that analysis and design of SC II structures are the same as for SC I structures, including load combinations and acceptance criteria
- **Disposition**: RAI resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Closure of Open Items Discussed in Last ACRS Meeting

RAI 3.8-94

The staff requested GEH to explain why the extremely large bearing capacities reported in the DCD are considered reasonable values which can be met at potential plant sites.

- **Resolution**:
  - Earlier analysis was based on a conservative method which did not account for embedment, and considered vertical load in each of the three seismic directions (i.e., N-S+V, E-W+V, and V)
  - GEH revised the analysis approach for calculating maximum soil-bearing pressures using more realistic SASSI (computer code) SSI forces as input into the "Modified Energy Balance" (MEB) method that includes effects of uplift.
  - As a check, GEH demonstrated that the MEB calculated soil pressures are higher than the maximum SASSI calculated soil pressure results.
- **Disposition**: RAI resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

<u>Closure of Open Items Discussed in Last ACRS Meeting</u>

RAI 3.8-96

The staff requested GEH to explain some of the assumptions made in the evaluation for sliding stability of plant structures to satisfy the factors of safety in SRP 3.8.5

Key Technical Issues

- Use of static coefficient of friction beneath the foundation along with full passive pressure at the side of the foundation to resist sliding; static versus dynamic coefficient of friction
- Use of cohesion resistance at bottom of basemat
- Need to consider other potential sliding interfaces in addition to soil shear failure (i.e., basemat to concrete mud mat, concrete to soil)
- Foundation walls not designed for full passive soil pressure
- Use of 100-40-40 seismic combination method for a two dimensional stability evaluation

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Closure of Open Items Discussed in Last ACRS Meeting

RAI 3.8-96 Technical Resolution

GEH revised their approach for evaluating sliding stability

- Full passive pressure and cohesion of soil no longer relied upon for sliding resistance
- Shear keys added beneath foundations to increase sliding resisting areas
- Require roughening of mud mat top surface
- Use of reduced coefficient of friction for concrete to soil interface
- Sliding resistance relied upon static friction at the bottom of basemat, lateral soil pressures on embedded walls and shear keys (perpendicular to the direction of motion), and friction at basemat and shear key vertical edges (parallel to the direction of motion)
- Design of foundation walls adequate for lateral soil resisting pressures used for sliding stability evaluation
- Factor of safety calculated as a function of time throughout the SSE time history, considering the phasing between the vertical and horizontal seismic force components - shown to meet SRP 3.8.5 criteria

Disposition: RAI resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Closure of Open Items Discussed in Last ACRS Meeting

RAI 3.8-120

GEH proposed to use ASTM A-709 HPS 70W material for containment liner as an alternate to ASME SA-516, Gr.-70, which was not yet approved by ASME or endorsed by NRC. Additionally, the staff requested GEH to explain how the change to this material affects the analysis and design of the containment.

- **Resolution**: ASME approval of ASTM A-709 HPS 70W material was subsequently given in ASME Code Case N-763. The staff has accepted this code case for use in the ESBWR (SER Section 6.1.1.3.1, RAI 6.1-12). GEH also explained that use of this new higher strength material has no significant effect on the analysis and design of the containment.
- **Disposition**: RAI resolved.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.8 – Seismic Category I Structures

Closure of Issue Subsequent to Last ACRS Meeting

RAI 3.8-125

During the staff's review of DCD Section 3.8, the design of the spent fuel racks was revised such that they are no longer anchored to the pool floor. The racks are evaluated as free-standing racks on the pool floor and thus can slide and tip. GEH was requested to demonstrate adequacy of the spent fuel pool (SFP) structure (walls, floor, and liner plate) to resist structural loads imposed by free-standing fuel storage racks (FSRs).

- **Resolution**: Analysis performed by GEH demonstrates that FSRs do not impact pool walls under SSE loads. The mass of the FSRs was included in the Fuel Building seismic analysis. Spent fuel pool concrete floor is 5.5 m thick and is adequate to withstand FSR loads. To transfer impact loads at the locations of the FSR legs, the design provides bearing pads that rest on embedded plates in the SFP basemat. Sliding of FSR legs are within boundary of bearing pad dimensions and the edges of the embedment plates.

- **Disposition**: RAI resolved.

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review

Section 9.4,"Heating, Ventilation, and Air Conditioning," and Section 6.4, "Control Room Habitability System"

September 24, 2010

Purpose

- **Brief the Subcommittee on the staff's review of the ESBWR design certification application, Chapter 9.4, "Heating, Ventilation, and Air Conditioning," and Section 6.4, "Control Room Habitability System"; ventilation issues**
  - Address follow up items from the previous briefing on this issue held on May 19, 2010.
  - Address related follow up items from briefings held on August 17, 2010
- **Answer the Subcommittee's questions**

Project and Technical Review Team

- **Project Managers**
  - Dennis Galvin, Project Manager (9.4)
  - Bruce Bavol, Project Manager (6.4)
- **Technical Reviewers**
  - Jim O’Driscoll (6.4, 9.4.1 - 9.4.8) – Lead
  - Ed Forrest
  - Syed Haider
  - Shie-Jeng Peng
  - Brad Harvey (2.3)
  - Craig Harbuck (16)

Staff Follow-Up Items

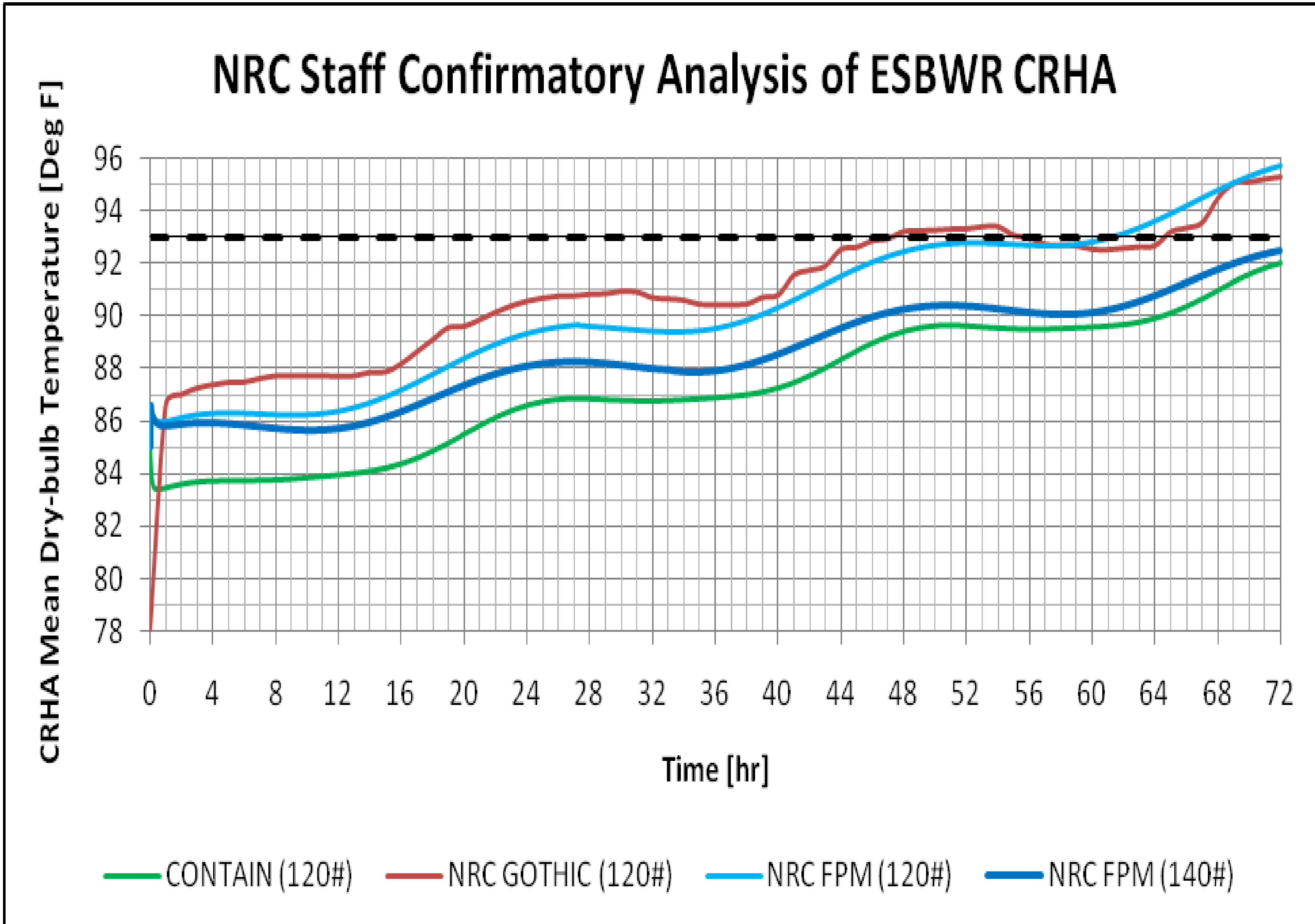
- **Provide and discuss heat up profiles for three models; CONTAIN 2.0, GOTHIC, and NRC First Principles Model (FPM)**
- **Discuss details of the Tech Spec Surveillance on Control Room Habitability Area (CRHA)heat sink temperatures**
- **Discuss details of verification of related site characteristics**
- **Discuss how assumptions used in the Reactor Building heat up calculation are assured**

Confirmatory Analyses

- **Staff review focus:**
  - **Suitability of applicant's approach using CONTAIN**
  - **Understanding of sensitivities**
    - **Heat sink properties**
    - **Heat sink initial temperature**
    - **Outside environmental conditions**
- **Summary of work performed:**
  - **Review of Applicants CONTAIN analysis**
  - **1 Run using updated GOTHIC model.**
  - **Review of GEH FPM / Development of Staff FPM**
  - **Over 24 sensitivity runs performed using CONTAIN and NRC FPM of GEH ESBWR CRHA.**

Confirmatory Analyses

- **Summary of findings:**
  - **Heat up rates of all models agree.**
  - **CONTAIN and FPM behave similarly in sensitivity studies.**
  - **FPM sensitivity result are 2 to 4 ^{o}F higher than CONTAIN due to:**
    - **More heat is assumed to enter CRHA from adjacent rooms in FPM**
    - **Steel structures not modeled in FPM**
    - **Higher initial temperature of FPM heat sinks**
    - **½ Mass of concrete touching soil modeled in FPM**
  - **Staff conclusion is that there is no benefit to reconcile models further. Studies support use of CONTAIN. Applicants initial conditions are appropriately conservative. Difference in models results are small.**


NRC Staff Confirmatory Analysis of ESBWR CRHA
CRHA Mean Dry-bulb Temperature [Deg F]
96
94
92
90
88
86
84
82
80
78
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
Time [hr]
CONTAIN (120#)
NRC GOTHIC (120#)
NRC FPM (120#)
NRC FPM (140#)

Details of CRHA Heat sink TS Surveillance

- LCO 3.7.2 requires maintaining heat sink temperature "within established design limit" (SR 3.7.2.1) (CRHA thermal analysis)
  - ≤ 74 °F for CRHA
  - ≤ 78 °F for Q-DCIS & N-DCIS equipment rooms
  - ≤ 104 °F for HVAC equipment rooms and safety portions of Control Room Habitability Area Ventilation System (CRAVS)
- CRHA boundary passive heat sinks limit the CRHA temperature to the acceptance criterion of 33.9°C (93°F) for 72 hours post-DBA with no internal forced air recirculation or cooling.

Technical Specification 3.7.2 "CRHAVS"

- **LCO 3.7.2 ensures that CRHA**
  - Average air temperatures will be maintained within acceptable limits for 72 hours following an event that includes loss of CRHAVS cooling, and
  - Heat sink bulk average temperatures are within design-basis analysis assumptions.
- **LCO 3.7.2 bases state that the CRHA heat sinks are operable when the air and heat sinks in the CRHA and adjacent spaces are maintained within the average temperature limits of SR 3.7.2.1.**
- **LCO 3.7.2 Required Action A.2 requires restoring the bulk average temperature of each CRHA heat sink to within limits within 24 hours.**
  - The 24-hour Completion Time is based on engineering judgment. Staff considers that 24 hours is reasonable and consistent with staff analysis.
  - Restoration of CRHA heat sink bulk average temperatures to within limits may be verified by
    - administrative evaluation considering the duration and extent of the CRHA average air temperature excursion outside limits, and/or
    - direct temperature measurement of CRHA heat sink structural materials.
  - Determination of CRHA heat sink bulk average temperatures is the subject of licensee procedures.

Ambient Design Temperature Site Parameters

2% Annual Exceedance	Max	DB	96 °F
		MCWB	79 °F
		WB	81 °F
	Min	DB	-10 °F
1% Annual Exceedance	Max	DB	100 °F
		MCWB	79 °F
		WB	82 °F
	Min	DB	-10 °F
0% Exceedance	**Max**	**DB**	**117 °F**
		MCWB	80 °F
		WB	**88 °F**
	Min	**DB**	**-40 °F**
Max Avg DB for 0% Exceedance Max Temp Day			**103.5 °F**
Min Avg DB for 0% Exceedance Min Temp Day			**-26.5 °F**
Max HH Avg WBGT Index for 0% Exceedance Max WB Day			**86.6 °F**

Maximum Average Dry Bulb Temperature for 0% Exceedance Maximum Temperature Day

Site Parameter Value: <u>103.5 °F</u>

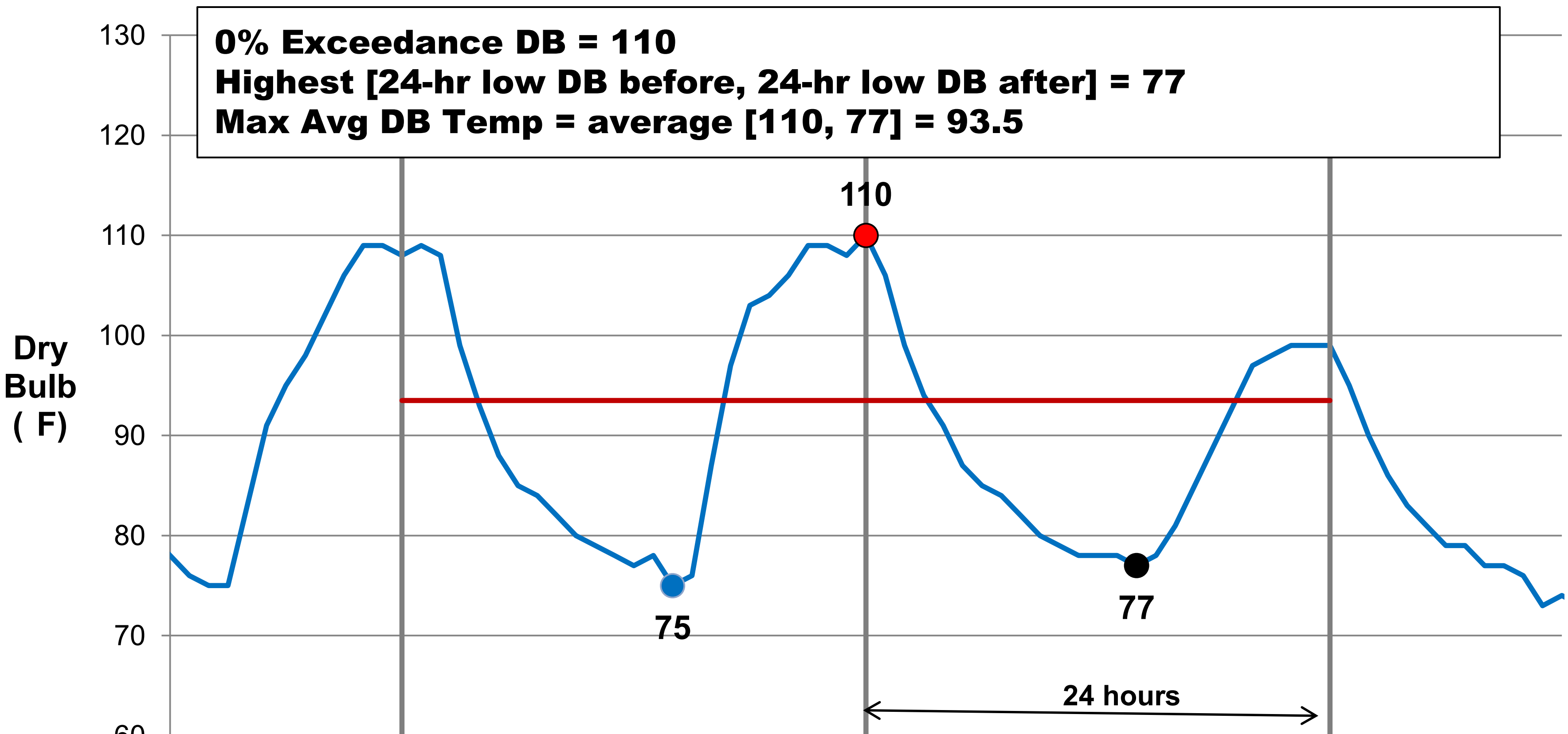
- **Defined as the average of:**
  - **0% exceedance maximum dry bulb site parameter value of 117 °F**
  - **Dry bulb temperature resulting from a daily temperature range of 27 °F**

Determining the Corresponding Site Characteristic Value:

- **Defined as the average of:**
  - **Site-specific 0% exceedance maximum dry bulb**
  - **Dry bulb temperature that corresponds to the higher of the <u>two</u> lows <u>occurring within 24 hours</u> before and after the 0% exceedance maximum dry bulb**

Verification of Related Site Characteristics
Example Calculation #1

- **Maximum Average Dry Bulb Temperature for 0% Exceedance Maximum Temperature Day: <u>93.5 °F</u>**



Minimum Average Dry Bulb Temperature for 0% Exceedance Minimum Temperature Day

Site Parameter Value: <u>-26.5 °F</u>

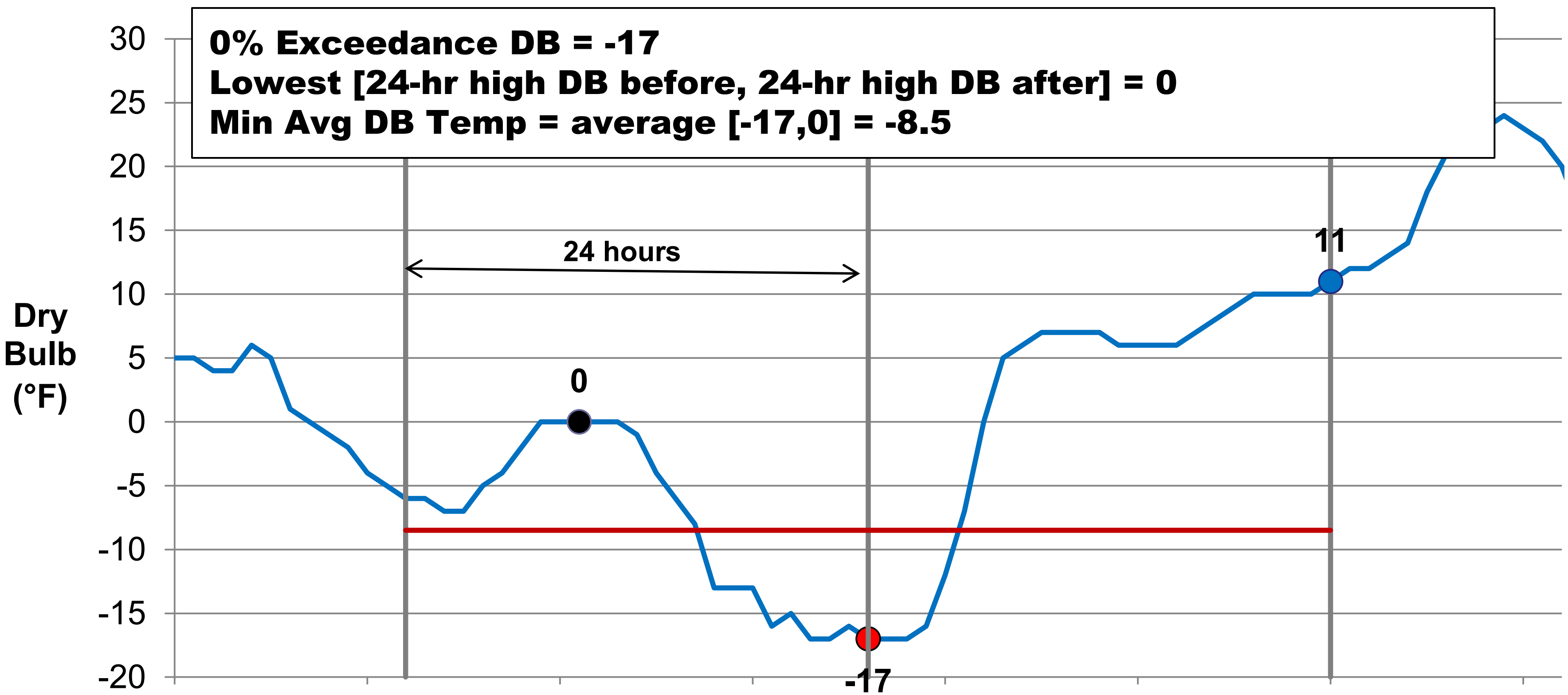
- **Defined as the average of:**
  - **0% exceedance minimum dry bulb site parameter value of -40 °F**
  - **Dry bulb temperature resulting from a daily temperature range of 27 °F**

Determining the Corresponding Site Characteristic Value:

- **Defined as the average of:**
  - **Site-specific 0% exceedance minimum dry bulb**
  - **Dry bulb temperature that corresponds to the lower of the <u>two</u> highs <u>occurring within 24 hours</u> before and after the 0% exceedance minimum dry bulb**

Verification of Related Site Characteristics
Example Calculation #2

- **Minimum Average Dry Bulb Temperature for 0% Exceedance Minimum Temperature Day: <u>-8.5 °F</u>**



Maximum High Humidity Average Wet Bulb Globe Temperature Index for 0% Exceedance Maximum Wet Bulb Temperature Day

WBGT Index = 0.7×WB + 0.3×DB

Site Parameter Value: <u>86.6 °F</u>

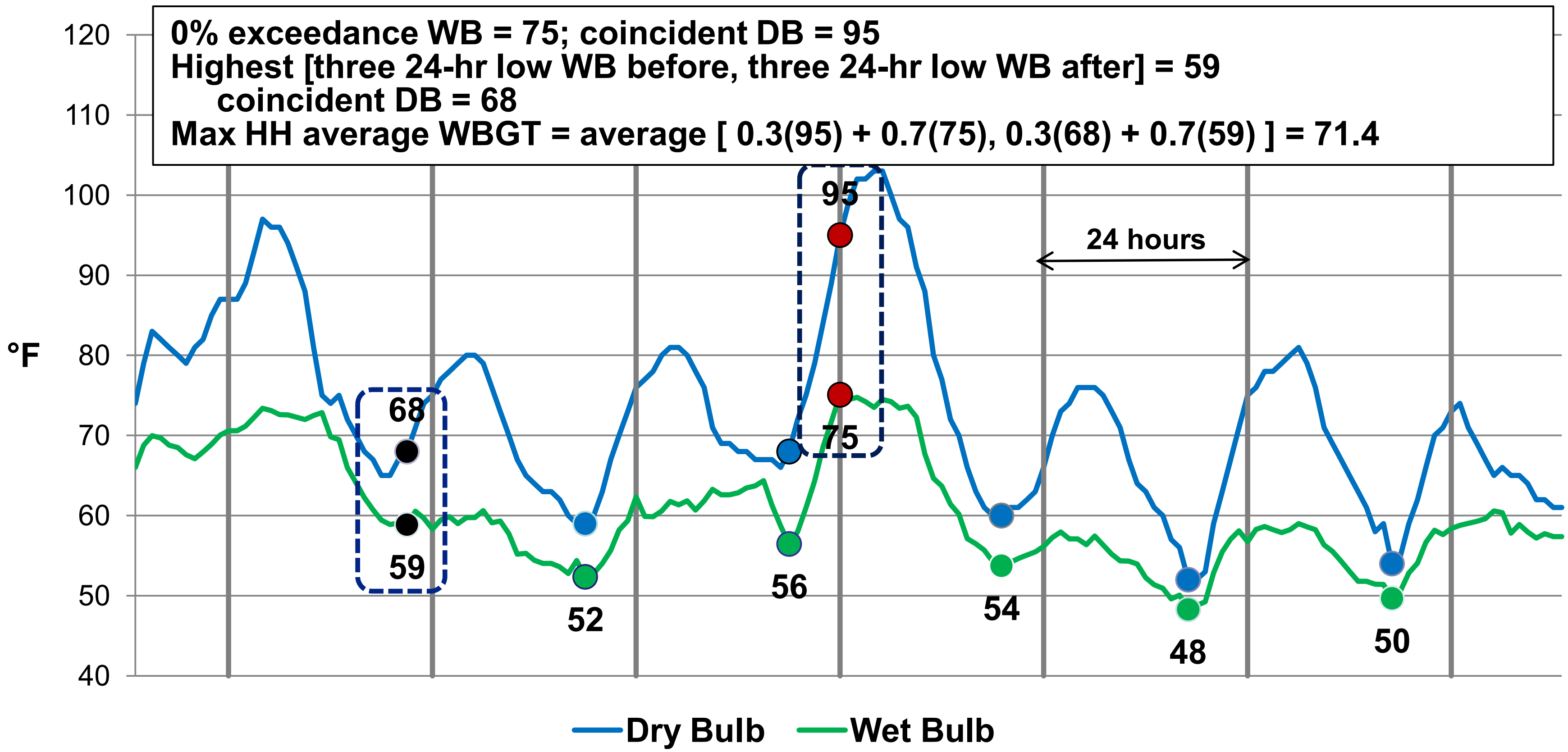
- **Defined as the average of:**
  - **WBGT index for the 0% exceedance wet bulb site parameter value of 88 °F (and a concurrent dry bulb value of 92 °F)**
  - **WBGT index resulting from a high humidity diurnal dry bulb temperature swing of 8 °F (dry bulb temperature of 84 °F and concurrent wet bulb temperature of 84 °F)**

Determining the Corresponding Site Characteristic Value:

- **Defined as the average of:**
  - **WBGT index for the site-specific 0% exceedance wet bulb**
  - **WBGT index resulting from wet bulb temperature that corresponds to the highest of the <u>six</u> low wet bulb temperatures <u>occurring in each of the three 24-hour periods</u> before and after the 0% exceedance wet bulb**

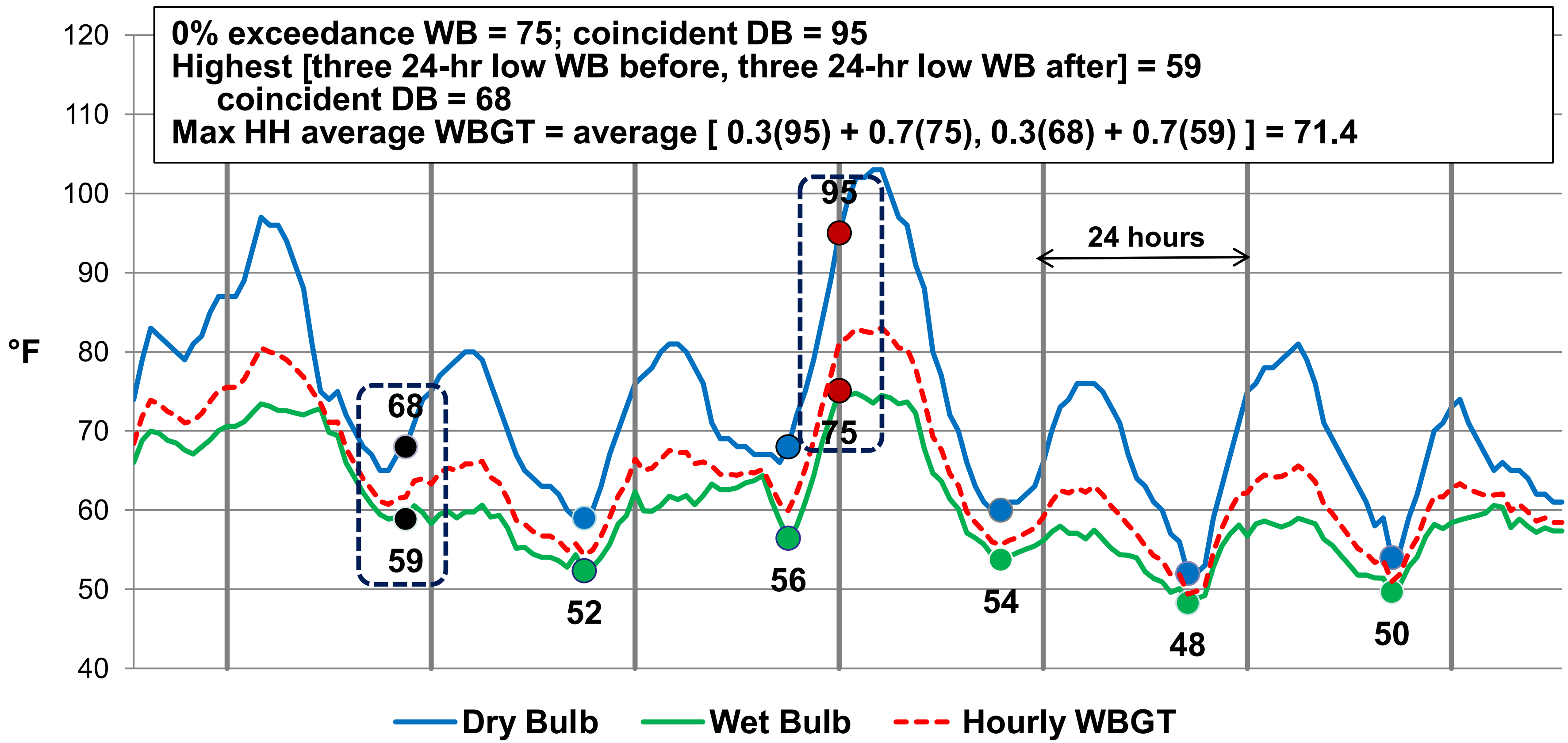
Verification of Related Site Characteristics
Example Calculation #3 (sheet 1 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 71.4 °F**



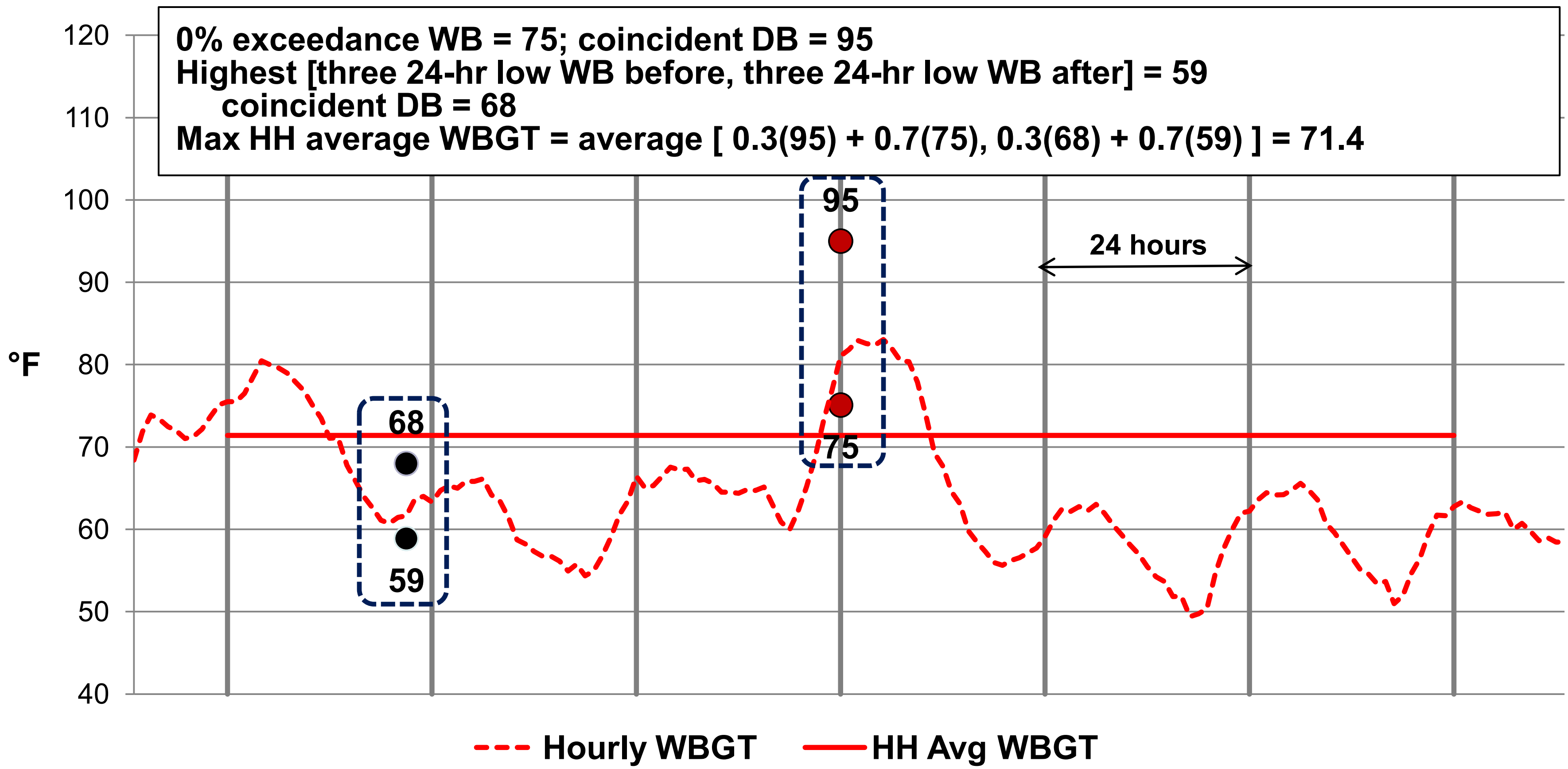
Verification of Related Site Characteristics
Example Calculation #3 (sheet 2 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 71.4 °F**



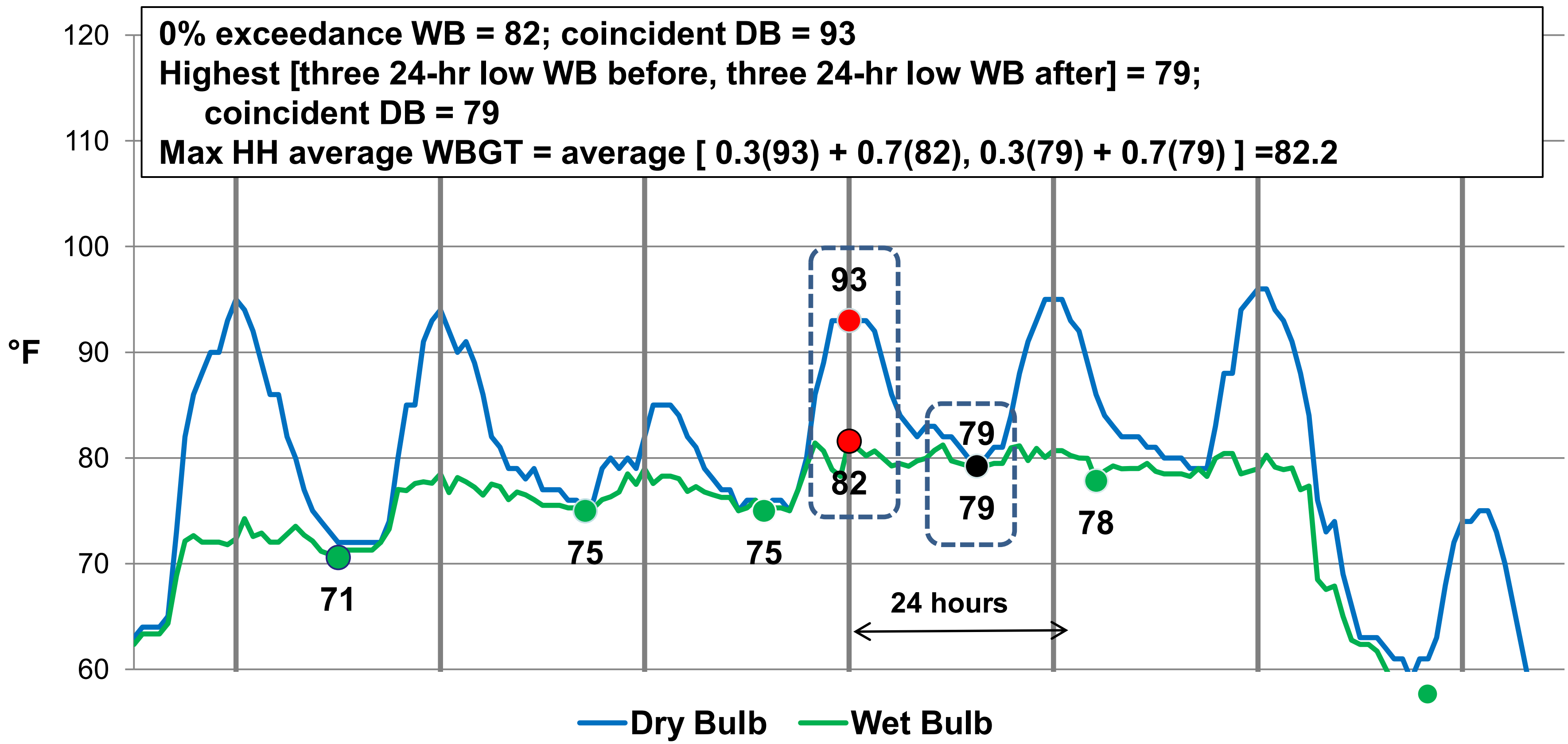
Verification of Related Site Characteristics
Example Calculation #3 (sheet 3 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: _71.4 °F_**



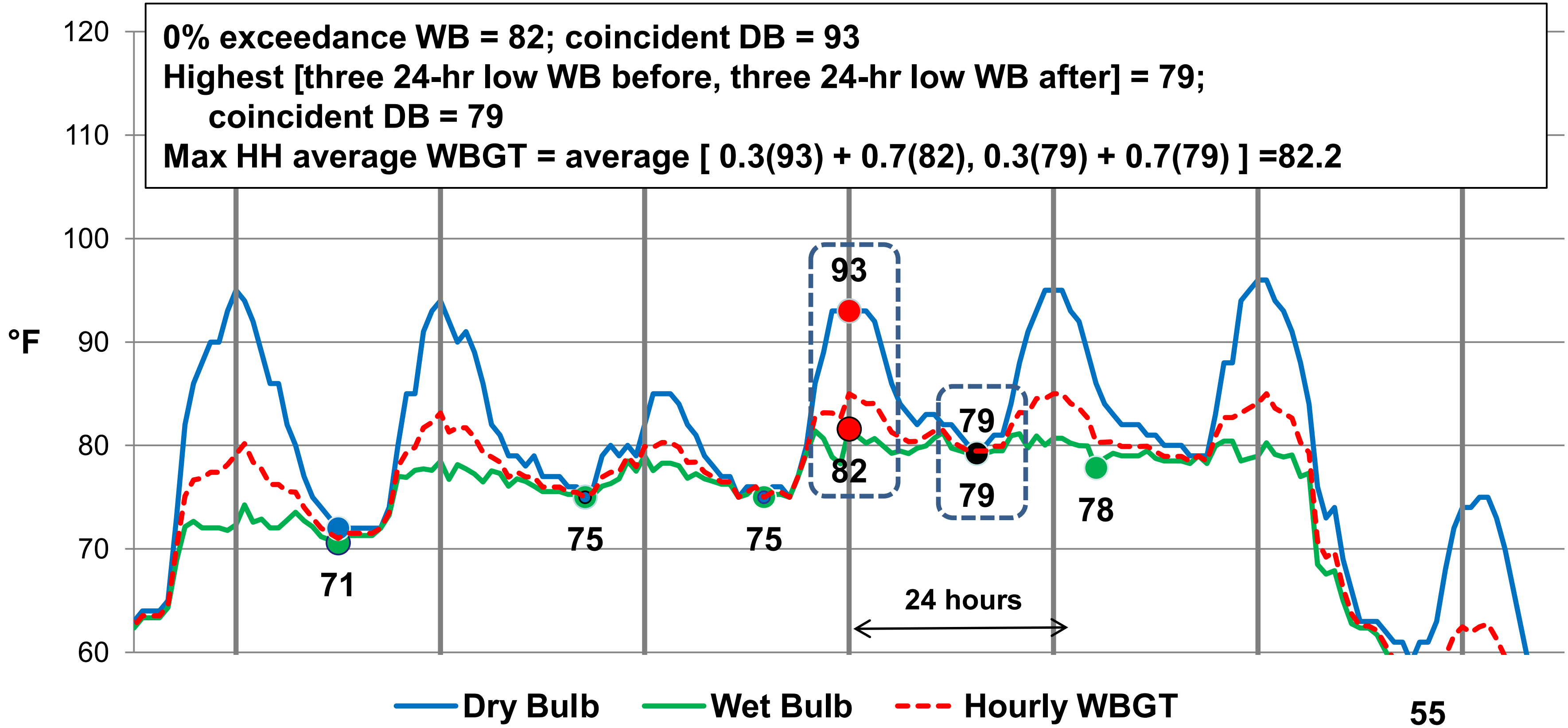
Verification of Related Site Characteristics
Example Calculation #4 (Sheet 1 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 82.2 °F**



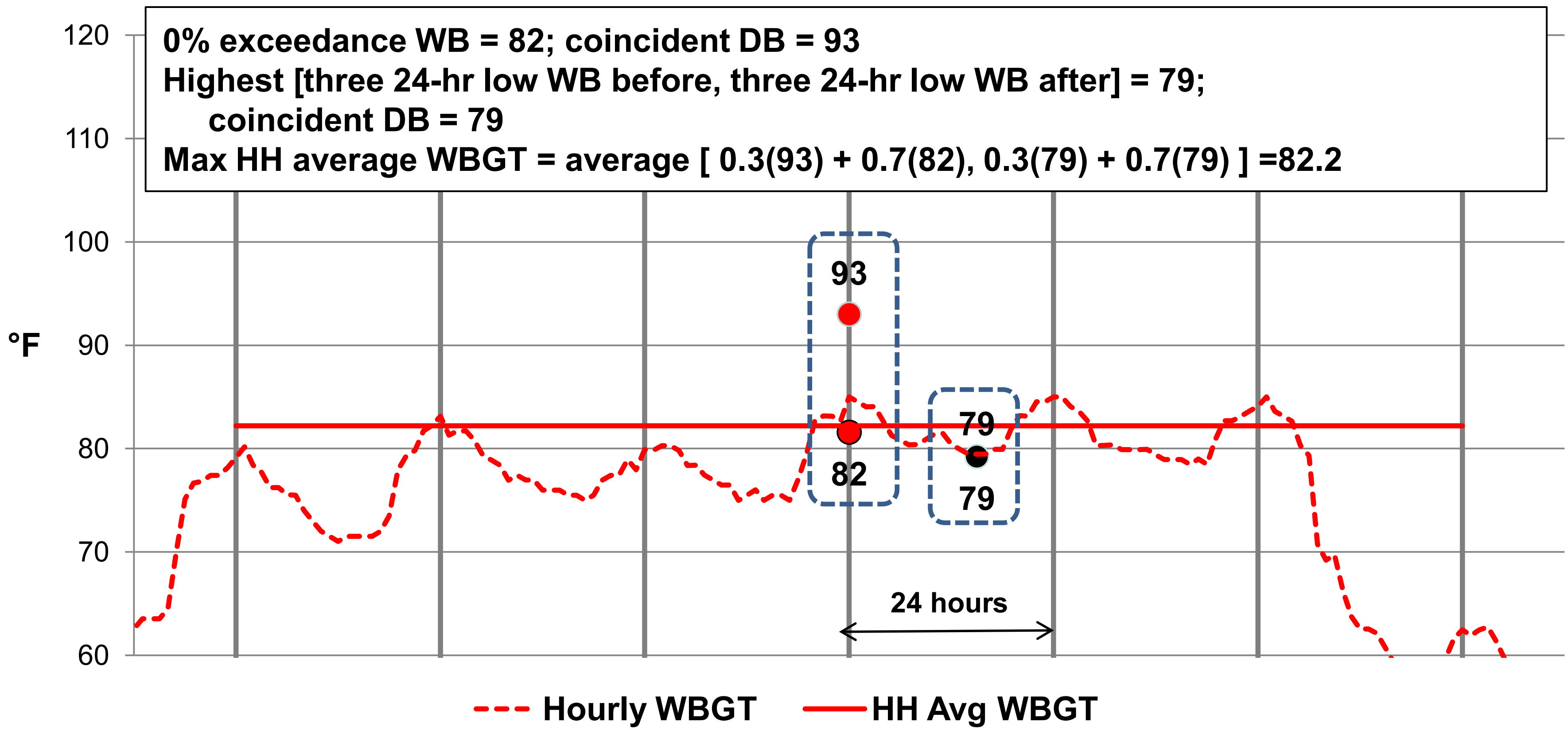
Verification of Related Site Characteristics
Example Calculation #4 (sheet 2 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 82.2 °F**



Verification of Related Site Characteristics
Example Calculation #4 (sheet 3 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 82.2 °F**



Assurance of RB Heat Up Analysis Assumptions

- **Staff reviewed the need for a reactor building heat sink temperature LCO similar to control building heat sink temperature LCO 3.7.2, “CRHAVS”**
  - ➢ CRHAVS meets LCO criterion 3; its passive cooling function depends on heat sink initial temperatures and is part of primary success path for DBA mitigation by supporting CR habitability required by GDC 19
- **1988 letter from NRR to Owners Groups (OGs) (“Split Report”) - Staff’s review of the BWROG’s LTR regarding the application of the LCO criteria of the 1987 Commission Interim Policy Statement on TS improvements to the**
  - ➢ BWR4 custom TS (Hatch 1) and standard TS (Hatch 2), and
  - ➢ BWR6 standard TS (Grand Gulf 1)
- **Staff agreed with relocation of LCOs for**
  - ➢ ECCS and RCIC pump room air coolers from pilot plant custom TS (Hatch 1)
  - ➢ Area temperature monitors from pilot plant standard TS (Grand Gulf 1).
- **Purpose of these LCOs was to maintain equipment qualification (§50.49)**
  - ➢ LCOs should not duplicate regulations;
  - ➢ Improved STS do not include LCOs on **monitoring instrumentation** except for post-accident monitoring; **area temperature monitors are not in primary success path for accident mitigation and are not used to detect degradation of reactor coolant pressure boundary; equipment room temperatures are not initial conditions for any DBA**
- **OPERABILITY definition ➔ necessary support system functions**
  - ➢ RIS 2005-20, Rev. 1; operability assessment of degraded or nonconforming equipment
  - ➢ EQ is one factor in determining equipment operability
- **Conclusion: §50.36 requires no LCO for reactor building heat sink temperatures**

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Presentation to the ACRS Subcommittee

Staff's Review of Spent Fuel Storage and Fuel and Auxiliary Pools Cooling System (FAPCS)- Sections 9.1.2 and 9.1.3

Presented by

Larry Wheeler & Raul Hernandez- NRO/DSRA/SPB

September 23, 2010

Regulatory Guidance

- Standard Review Plan (SRP) 9.1.2 (New and Spent Fuel Storage)
- SRP 9.1.3 (Spent Fuel Pool Cooling and Cleanup System

RTNSS Guidance

- Regulatory Treatment of Nonsafety Systems (RTNSS)
  - SECY 94-084 and SECY 95-132
    - Highly reliable
    - Enhanced design quality & reliability

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Staff Review Summary

- **Key open item - Reactor Building Buffer Pool and Spent Fuel Pool (SFP) decay heat and pool drain-down (follow-up to RAIs). The staff previously found the following acceptable.**

  - No potential drain paths that can drain the buffer pool or SFP volume
    - SFP transfer gates and buffer gates are safety related, seismic category I
    - Anti-siphon holes on submerged piping are no lower than 9.2 m (30.2') above the top of stored fuel assembly (TSFA)
  - Maximum bounding SFP heat load
  - Bounding water makeup to the SFP is 200 gallons per minute (GPM) (post 72 hours), calculated is 159 GPM.

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Staff Review Summary

- **Buffer Pool and SFP (continued)**

  - Pool level instrumentation measures collapsed water level (no false reading due to steam vapors above the actual water level)

  - **Buffer pool will maintain 7.3 m (24') above TSFA during a loss of FAPCS for 72 hours**

  - **Stored fuel in the SFP remains covered during a loss of FAPCS for 72 hours**

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Staff Review Summary

- **August 16, 2010 ACRS Subcommittee noted an issue related to NEDO-33373; basis for the heat loads used in the SFP thermal-hydraulic. GEH calculations for decay heat were determined to be non-conservative.**

  - The SFP heat load for the full core offload and discharged fuel decay used 36 days into fuel cycle

  - The updated SFP heat load for the full core offload and discharged fuel decay uses end of fuel cycle and is determined to be more conservative

  - Staff presently performing review of a new Technical Specification SFP water level

Staff Review Summary

- **The staff found the following acceptable for FAPCS and its RTNSS 'B' function**
  - **Long term core cooling**
    - Fire protection system interface which allows Isolation Condenser/Passive Containment Cooling System (IC/PCCS) pools to be filled with water to extend cooling period from 72 hours to 7 days
    - Piping interface is safety related ASME III Class 3, Seismic Category I
    - Availability Controls (AC 3.7.2/3.7.3)

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Staff Review Summary

- **The staff found the following acceptable for FAPCS and its RTNSS 'C' functions**
  - Low pressure cooling injection mode
    - Requires FAPCS pump to take a suction from the suppression pool and pump it into the RPV via Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) loop A and then Feedwater loop B
    - Availability Controls (AC 3.7.2/3.7.3)
    - Piping is non safety related, Seismic Category II
    - All RTNSS structures, systems and components are within the scope of the ESBWR Design Reliability Assurance Program (D-RAP)

Staff Review Summary

- **The staff found the following acceptable for FAPCS and its RTNSS 'C' functions (continued)**

- Suppression pool cooling mode
    - Requires water to be drawn from the suppression pool, cooled by the FAPCS, and returned to the suppression pool
    - Availability Controls (AC 3.7.2/3.7.3)
    - Piping is non safety related, Seismic Category I or II
    - Two physically separated 100 % cooling trains, each with one FAPCS pump and heat exchanger
    - Procedures to assure avoidance of water hammer and gas binding
    - Provision are provided to protect FAPCS components from fire, missile generating events, internal flooding, or seismic event up to and including a safe shutdown earthquake (SSE)for fuel pool cooling function
    - All RTNSS structures, systems and components are within the scope of the ESBWR Design Reliability Assurance Program (D-RAP)

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Staff Review Summary

- **The staff found the following acceptable for FAPCS and its RTNSS 'C' functions (continued)**
  - Standby diesel generators provide backup AC power to FAPCS post 72 hours (AC 3.8.1/3.8.2)

Staff Review Summary

- **Operating Experiences (OE). The staff found the following acceptable (RAIs 9.1-128 and 9.1-151).**

  - Gas accumulation that could enter a system and result in component or system damage was adequately addressed

  - Refueling cavity bellows seal (RCBS) postulated failures were adequately addressed

Conclusions

- **Staff's review concludes for FAPCS:**
  - RTNSS 'B' and 'C' functions are highly reliable and meets single failure criteria and are subject to enhanced design, quality, reliability, and availability provisions
  - Staff reviewing the new SFP heat load **(open item)**

ACRS Subcommittee Presentation
ESBWR Design Certification Review

Discussion/Committee Questions

U.S.NRC

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Staff's Review of Plant Service Water System (PSWS), Reactor Component Cooling Water System (RCCWS), and Nuclear Island Chilled Water System (NICWS) Sections 9.2.1. 9.2.2 and 9.2.7

Presented by

Larry Wheeler - NRO/DSRA/SPB

September 23, 2010

Regulatory Guidance

- SRP 9.2.1 (Station Service Water System)

- SRP 9.2.2 (Reactor Auxiliary Cooling Water System)

RTNSS Guidance

- Regulatory Treatment of Nonsafety Systems (RTNSS)
  - SECY 94-084 and SECY 95-132
    - Highly reliable
    - Enhanced design quality & reliability

Staff Review Summary

- **RTNSS ‘C’ Water Systems focus of March 19-20, 2009 audit (RAI 9.2-24).The staff found the following acceptable.**

  - Adequate design margin between the cooling tower capacity and the bounding heat loads (PSWS), between the RCCWS heat exchanger capacity and the maximum heat loads, and between the nuclear island chilled water system (NICWS) chiller capacity and the maximum heat loads

  - Single failure considerations have been properly addressed due to the redundancy of the design, components emergency power supply availability, and components failure position on a loss of preferred power (LOPP)

Staff Review Summary

- **March 19-20, 2009 audit (RAI 9.2-24) (continues)**

  - PSWS pumps must have sufficient available net positive suction head at the pump suction location for the lowest probable water level of the heat sink

  - RCCWS and NICWS pumps must have sufficient available net positive suction head at the pump suction location for the lowest probable water level of the surge tank

Staff Review Summary

- **March 19-20, 2009 audit (RAI 9.2-24) (continues)**

  - PSWS, RCCWS, NICWS RTNSS components are in the Maintenance Rule, 10 CFR 50.65, which requires performance monitoring of SSCs

  - PSWS, RCCWS, NICWS RTNSS components have adequate MCR instrumentation for system monitoring

  - During a LOPP, PSWS, RCCW, NICWS pumps and valves and can be powered from the two non safety-related on-site standby diesel generators

Staff Review Summary

- **March 19-20, 2009 audit (RAI 9.2-24) (continues)**
  - Procedures to assure avoidance of water hammer and gas binding
  - Redundant PSWS, RCCWS, and NICWS trains
  - All RTNSS structures, systems and components are within the scope of the ESBWR Design Reliability Assurance Program (D-RAP)

Conclusions

- **Staff's review concludes for PSWS, RCCWS, & NICWS:**
  - RTNSS function is highly reliable and meets single failure criteria and which are subject to enhanced design, quality, and reliability.
  - Meets applicable SRP 9.2.1/9.2.2 guidance

ACRS Subcommittee Presentation
ESBWR Design Certification Review

Discussion/Committee Questions

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

Staff's Review of Instrument Air System (IAS)- Section 9.3.6

Presented by

David Shum- NRO/DSRA/SPB

September 23, 2010

Instrument Air System

<u>System Description</u>

- Provides dry, oil free, filtered compressed air to pneumatically operated valve operators, instrumentation, and components in non-safety-related systems located outside containment, and to HPNSS loads inside containment during refueling operations.
- Non-safety-related system, not needed for safe shutdown.
- Not RTNSS.
- Meets the requirement of (ANSI/ISA) 7.0.01, “Quality Standard for Instrument Air.”
- Has no air compressors of its own, receives compressed air from the SAS.
- Has two identical 100% capacity filtration/dryer trains in parallel
- Has a cross-tie between the distribution headers of the SAS and IAS used to bypass the IAS in the unlikely event that both IAS dryer trains failed simultaneously.

<u>Concern Raised during ACRS 2007 Subcommittee and 2008 Full Committee Meetings</u>

- Based on earlier operating experience gained from operating plants, an issue concerning impacts of moisture and contamination of the instrument air resulting from the bypass of lower quality/contaminated SAS was raised.

Operating Experience

In July 1981, Generic Issue 43, “Contamination of Instrument Air Lines,” was initiated.

- In December 1987, NUREG-1275, Volume 2, “Operating Experience Feedback Reported - Air Systems Problems,” was published.
- In August 1988, Generic Letter 88-14, “Instrument Air Supply System Problems Affecting Safety-Related Equipment,” was issued to request each licensee/applicant to review NUREG-1275, Volume 2, and to perform a design and operations verification of the IAS to verify that:
  - Actual instrument air quality is consistent with the manufacturer's recommendations for individual components served.
  - Maintenance practices, emergency procedures, and training are adequate to ensure that safety-related equipment will function as intended on loss of instrument air.
  - The design of the entire IAS including air or other pneumatic accumulators is in accordance with its intended function.

Operating Experience (Continued)

- Also, the staff in Generic Letter 88-14 requested each licensee/applicant to provide a discussion of their program for maintaining proper instrument air quality.
- The staff assessed the effectiveness of Generic Issue 43 and Generic Letter 88-14.
- In October, 2005, the staff published its findings in NUREG-1837, “Regulatory Effectiveness Assessment of Generic Issue 43 and Generic Letter 88-14,” and in general, concluded that licensee and agency activities, such as the Maintenance Rule, Generic Letter 88-14, design-basis reconstitution, and others, have significantly improved air system and component performance and, thereby, resulted in improved reactor safety.
- SRP 9.3.1 endorsed the use of ANSI/ISA-S7.3-R1981 which was superseded by ANSI/ISA 7.0.01-1996 in November, 1996 that establishes the following design guidelines for IAS:
  - System design including components such as filters, compressors, air treatment systems, air receivers, drain traps, aftercoolers and moisture separators, pressure regulators, pressure-relief devices, and valves and piping.
  - Air quality standard including pressure dew point, particle size, lubricant content and contaminants.
  - Air supply pressure.
  - Initial start-up test and periodical tests to verify the system performance and the above cited air quality.

Staff Review

Staff's Review of ESWR IAS and SAS

The staff reviewed and verified that the ESBWR IAS and SAS designs meet or exceed the guidelines of ANSI/ISA 7.0.01, specificly:

- Size of air particle from SAS is less than 10 microns.
- Size of air particle in IAS is less than 3 microns.
- Moisture content is continuously monitored.
- The IAS is tested periodically

(ANSI/ISA 7.0.01 defines instrument quality air as having a maximum 40 micron particulate size.)

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Conclusions

Overall, since the air quality of the ESBWR IAS and SAS designs meet or exceed the guidance of ANSI/ISA 7.0.01; the operation of the IAS bypass occurs only in an unlikely event that both IAS dryer trains would fail simultaneously during refueling outage; and staff's favorable findings of Regulatory Effectiveness Assessment of Generic Issue 43 and Generic Letter 88-14, the staff concludes that the above cited issue raised during previous ACRS meetings concerning the impact of moisture and contaminants from the SAS on IAS is resolved.

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Presentation to the ACRS Subcommittee

Staff Presentation of Thermal-Hydraulic Analysis for ESBWR Fuel Racks (NEDO-33373)

Presented by

James Gilmer - NRO/DSRA/SRSB

September 23, 2010

Open Item Description

- The CFD (CFX Code) results for the storage rack temperature presented at the August 16, 2010 meeting do not show flow through the individual racks are cooled.
  - Figure 5-10 from topical report illustrated streamlines from SFP inlets to outlets, but appeared to bypass the heated rack location in the pool.
  - This is a presentation issue related to not selecting the streamlines in the rack zones to make the figure less cluttered.
- Figure 5-10a has been added to Revision 5 of the report showing streamline flow and vertical temperature distribution in an individual rack.

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CFD Model Discussion

- GEH used a porous media model for the spent fuel racks. Fuel bundles are not modeled individually. Heat is added directly to the flow.
- GEH used a conservative pressure drop to determine the loss coefficients used in the porous media formulation. Mass flow through the racks is determined from the balance of the buoyancy driving forces and the pressure drop through the racks.
- The approach used by GEH is reasonable and consistent with common practices for modeling fuel bundle flows under these types of conditions.

Conclusions
(unchanged from previous presentation)

- Rack design allows adequate natural circulation cooling of spent fuel
- Significant thermal margin will exist between the calculated fuel temperature and the design allowable temperature
- Staff review concludes that the thermal-hydraulic analyses and design of racks meets applicable GDC 61 requirements and SRP 9.1.2 guidance

ACRS Subcommittee Presentation
ESBWR Design Certification Review

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review

Chapter 7, “Instrumentation and Controls”

September 24, 2010

Chapter 7 Review Team

- Technical Review Staff
  - Ian Jung, Branch Chief, ICE2
  - Hulbert Li
  - Joseph Ashcraft
  - Dinesh Taneja
  - Deanna Zhang
  - Eugene Eagle
  - Sang Rhow
  - Kimberley Corp

- Project Manager
  - Dennis Galvin

Chapter 7 Overview

The staff is required to evaluate safety of the I&C system design in accordance with the Commission's regulations by following SRP guidance

The staff's safety evaluation is based on the design information provided in the design control document (DCD) and the referenced technical reports. The staff's evaluation is documented in the SER as follows:

7.1 Overview of I&C systems, including:

- Conformance to regulations – GDCs, IEEE-603, TMI Action Items
- Software development activities – LTRs NEDE-33226P and NEDE-33245P
- Diversity and defense-in-depth – LTR NEDO-33251
- Setpoint methodology – LTR NEDE-33304P
- Data communication
- Secure development and operational environment (SDOE) – LTR NEDE-33295P

Chapter 7 Overview (cont.)

7.2 Reactor Trip System

7.3 Engineered Safety Features Systems

7.4 Safe Shutdown Systems

7.5 Information System Important to Safety

7.6 Interlock Logic

7.7 Control Systems

7.8 Diverse Instrumentation and Control Systems

General Finding

- The staff has evaluated safety of the I&C system design and finds the design to be safe and in compliance with applicable regulations
- I&C design follows safe design principles:
  - **Independence**
  - **Determinism**
  - **Redundancy**
  - **Diversity and Defense-in-Depth**
- Safety-related I&C design employs **Simplicity** in many aspects
- I&C systems are designed to conform with the following applicable regulatory requirements:
  - 10 CFR Part 52
  - 10 CFR Part 50, including 50.55a(h) (IEEE Std. 603)
  - 10 CFR Part 50 Appendix A (GDC)
  - 10 CFR Part 50 Appendix B (QA)
  - 10 CFR Part 50.34 (TMI items)

Independence

- The staff found that the I&C system design provides sufficient independence in compliance with IEEE-603 (10 CFR 50.55a(h)) and GDC 21
  - Safety-related platforms are organized into four physically separated and electrically isolated divisions
  - Communication independence is achieved using following design features:
    - Inter-divisional data communication in safety-related systems is limited to:
      - Voting logic
      - Bypass
      - Data authentication
    - Inter-divisional data communication in RTIF/NMS platform is point-to-point unidirectional via optical fibers. Faulty or loss of data communication is interpreted as a trip signal (fail safe)
    - Inter-divisional data communication in SSLC/ESF platform uses redundant Ethernet networks for 2/4 voting logic. Networks are doubly buffered to prevent data corruption to adversely impact both networks

Independence (cont.)

  - ICP platforms do not use multiplexing for data communication, I/O is hard wired
  - Data communication from safety to non-safety related I&C systems is unidirectional

- Any failure in a division does not prevent other redundant safety divisions from performing their intended safety function
- Diverse and independent diverse protection system (DPS) is provided as a defense-in-depth feature to cope with an unlikely scenario of a primary system malfunction (CCF or multiple independent failures)

Determinism

- Determinism means that a required safety function is always accomplished within the required time period specified by Chapter 15 DBA analyses
- Based on the following, the staff found that the real time performance of the safety-related I&C systems is deterministic and conforms to IEEE-603 (10 CFR 50.55a(h)) and BTP HICB-21:
  - Q-DCIS data communication protocols are deterministic
  - RTIF/NMS platform performs a cyclic real-time execution. The operating system is clock-driven and not event-driven, and it does not incorporate “interrupts”
  - SSLC/ESF platform runs cyclic programs that include both the application and diagnostics and do not incorporate “interrupts”
  - ICP platforms do not have an operating system
  - All platforms always react in the same way according to the order of events occurring at the point in time of plant conditions

Redundancy

- The staff found that the I&C system design provides sufficient redundancy in compliance with IEEE-603 (10 CFR 50.55a(h)) and GDC 21
  - All safety-related platforms are organized into four redundant divisions
    - 4 redundant divisions of RTIF/NMS platforms
    - 4 redundant divisions of SSLC/ESF platforms
    - 4 redundant divisions of ICP platforms
  - Each division has its own set of sensors, and no sharing of sensors between safety divisions is allowed
  - DPS utilizes 2/4 voting logic

Redundancy (cont.)

- RTIF/NMS platform uses dual redundant communication rings for intra-divisional data communication
- SSLC/ESF platform uses doubly buffered redundant networks for 2/4 voting logic
- Within each SSLC/ESF division, triply modular redundant (TMR) controllers are used for high reliability
- N-DCIS platforms use double or triple redundant controllers for high reliability and availability

Diversity and Defense-in-Depth

- The staff found that the I&C system design provides sufficient diversity in compliance with 10 CFR 50.62 for ATWS mitigation
- The I&C system design also provides diverse backup for RTIF/NMS and SSLC/ESF to address software CCF concern in accordance with the SRM to SECY-93-87, item II.Q
- LTR NEDO-33251, "ESBWR I&C Diversity and Defense-in-Depth," provides I&C system architecture and the analysis in conformance with BTP HICB-19 guidance
- DPS design is based on different technology, equipment, design personnel, signals, and functionality
- Diversity is provided both within Q-DCIS (three platforms RTIF/NMS , SSLC/ESF, and ICP are diverse from each other) and externally by a non-safety DPS
- DPS is classified as RTNSS and is developed via a rigorous, highly structured process similar to ones used for safety systems

Simplicity

- The staff found that the I&C system design employs simplicity in many aspects, which contribute to the staff's safety finding:
  - Each Q-DCIS division is independently monitored and controlled from its dedicated redundant set of safety related VDUs
  - Safety related components cannot be controlled from the non-safety related VDUs
  - Data communication from safety to non-safety related I&C systems is unidirectional
  - I&C system design meets "Independence – Isolation – Separation" requirements
  - Inter and intra-divisional communication is limited
  - ESBWR is a passive plant and the safety-related ESF functions are limited
  - Maintenance tool is not continuously connected

Logic Diagrams

- DCD contains adequate control logic design information for the staff to make a reasonable safety assurance finding
- Information described in the DCD will be used to develop logic diagrams
- Logic diagrams are produced and used during the I&C development life-cycle process
- Logic diagrams are finalized during the hardware/software design specification phase of the I&C system development lifecycle

Conclusion

- The staff has evaluated safety of the I&C system design and finds the design to be safe
- I&C systems are in conformance with the applicable regulatory requirements:
  - 10 CFR Part 52
  - 10 CFR Part 50, including 50.55a(h) (IEEE Std. 603 requirements)
  - 10 CFR Part 50 Appendix A (GDC)
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  - 10 CFR Part 50.34 (TMI items)
- I&C implementation DAC/ITTAC provided in Tier 1 are acceptable
- DCD Revision 8:
  - Provides clarity of I&C design information
  - No impact on I&C design
  - No impact on safety finding

Chapter 7 ACRONYMS

- ATWS Anticipated Transient Without Scram
- CCF Common Cause Failure
- DBA Design Basis Accident
- DCD Design Control Document
- DPS Diverse Protection System
- ESF Engineered Safety Feature
- GDC General Design Criteria
- ICP Independent Control Platform
- I&C Instrumentation and Control
- I/O Input and Output
- IEEE Institute of Electrical and Electronics Engineers
- LTR Licensing Technical Report
- N-DCIS Non Safety-related Distributed Control and Information System
- NMS Neutron Monitoring System
- QA Quality Assurance
- Q-DCIS Safety-related Distributed Control and Information System

Chapter 7 ACRONYMS (cont.)

- RG Regulatory Guide
- RTIF Reactor Trip and Isolation Function
- RTNSS Regulatory Treatment of Non-Safety System
- SER Safety Evaluation Report
- SSLC Safety System Logic and Control
- TMR Triply Modular Redundant
- VDU Video Display Unit

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review

Chapter 7, “Instrumentation and Controls”

September 24, 2010

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  - No impact on safety finding

Chapter 7 ACRONYMS

- ATWS Anticipated Transient Without Scram
- CCF   Common Cause Failure
- DBA   Design Basis Accident
- DCD   Design Control Document
- DPS   Diverse Protection System
- ESF   Engineered Safety Feature
- GDC   General Design Criteria
- ICP   Independent Control Platform
- I&C   Instrumentation and Control
- I/O   Input and Output
- IEEE Institute of Electrical and Electronics Engineers
- LTR   Licensing Technical Report
- N-DCIS Non Safety-related Distributed Control and Information System
- NMS   Neutron Monitoring System
- QA   Quality Assurance
- Q-DCIS Safety-related Distributed Control and Information System

Chapter 7 ACRONYMS (cont.)

- RG Regulatory Guide
- RTIF Reactor Trip and Isolation Function
- RTNSS Regulatory Treatment of Non-Safety System
- SER Safety Evaluation Report
- SSLC Safety System Logic and Control
- TMR Triply Modular Redundant
- VDU Video Display Unit

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 4 – Reactor Design

Presented by

James Gilmer - NRO/DSRA/SRSB

September 23, 2010

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Topical Report Briefings

The following topical reports have been approved by the staff:

- May 2010 Subcommittee meeting
  - NEDC-33240P - GE14E Fuel Assembly Mechanical Design Report
  - NEDC-33242P - GE14E Fuel Rod Thermal-Mechanical Design Report
  - NEDE-33243P – Control Blade Nuclear
  - NEDE-33244P – Control Blade Mechanical Design
  - NEDC-33239P – Nuclear Design Report
  - NEDC-32197P – Gamma Thermometer

- October 2009 Subcommittee meeting
  - NEDC-33237P – Critical Power Correlation
  - NEDC-33413P – Critical Power Testing

Summary of Technical Issues

- Approximately 258 technical RAIs were closed for Chapter 4 and related topical reports
  - Section 4.2 – 34 RAIs
  - Section 4.3 – 32 RAIs
  - Section 4.4 – 92 RAIs
  - Section 4.5 – 32 RAIs
  - Section 4.6 – 39 RAIs
  - Section 4.8 – 17 RAIs
  - Section 4.9 – 12 RAIs

- No outstanding issues from ACRS from previous briefings

Conclusion

Staff finds the ESBWR fuel assembly and control blade design to be acceptable

- Meets regulatory requirements including applicable GDCs
- Analyses and testing demonstrating conservative design

ACRS Subcommittee Presentation
ESBWR Design Certification Review

Discussion/Committee Questions