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Subcommittee on ESBWR

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10 proceeding of the United States Nuclear Regulatory
11 Commission Advisory Committee on Reactor Safeguards,
12 as reported herein, is a record of the discussions
13 recorded at the meeting.
14
15 This transcript has not been reviewed,
16 corrected, and edited, and it may contain
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1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 (ACRS)

6 + + + + +

7 SUBCOMMITTEE ON ESBWR

8 + + + + +

9 THURSDAY

10 SEPTEMBER 23, 2010

11 + + + + +

12 ROCKVILLE, MARYLAND

13 + + + + +

14 The Advisory Committee met at the Nuclear

15 Regulatory Commission, Two White Flint North, Room

16 T2B1, 11545 Rockville Pike, at 8:30 a.m., Michael L.

17 Corradini, Chairman, presiding.

18 SUBCOMMITTEE MEMBERS:

19 MICHAEL L. CORRADINI, Chairman

20 SAID ABDEL-KHALIK, Member

21 J. SAM ARMIJO, Member

22 JOHN W. STETKAR, Member

23 CONSULTANTS:

24 THOMAS S. KRESS

25 GRAHAM B. WALLIS

26

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

2 8:31 a.m.

3 Opening Remarks and Objectives

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

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

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

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

1 The Subcommittee will gather information,
2 analyze relevant issues and facts and formulate
3 proposed positions and actions as appropriate for
4 deliberation by the f ull Committee. The rules for
5 participation in today's meeting have been announced
6 as part of the notice of this meeting, previously
7 published in the *Federal Register* on August 30th,
8 2010.
9 A portion of this meeting may be closed to
10 protect information that is proprietary to GEH Nuclear
11 Energy and its contractors, pursuant to 5 U.S.C.
12 552(B)(c)(4). A transcript of the meeting is being
13 kept and will be made available as stated in the
14 *Federal Register* notice.
15 It's requested that speakers first
16 identify themselves and speak with sufficient clarity
17 and volume, so that they can be readily heard. Also,
18 to remind everybody, please silence your cell phones
19 and Blackberrys and any other thing you have with you.
20 We have not received any requests from
21 members of the public to make oral statements or
22 written comments. We have a phone line open, and the
23 GEH engineers and staff are online; is that correct?
24 PARTICIPANT: That's correct, we're here.
25 CHAIRMAN CORRADINI: Okay, and if you need

1 to put it on mute u ntil we need to talk to you. Let
2 me just remind everybody that neither the staff nor
3 GEH plans to present any proprietary information when
4 we're going through these chapters of 6, 7 and 9.
5 However, if we ask questions, if the
6 members ask questions, particularly on some I&C issues
7 and the details are proprietary, I think we're going
8 to organize ourselves to do it in a fashion that we
9 collect them all and do it at a particular time during
10 the day, so we can close the session.
11 All right. Other than that, I want to
12 remind everybody that this is our last set of
13 subcommittee meetings on the last set of chapters.
14 The staff has closed all open items on these chapters.
15 I know that will not deter the members from asking
16 probing and exhilarating questions.
17 So that's the main point of this. I have
18 already been asked by some of the members that we're
19 going to finish on time and on budget at five o'clock
20 tomorrow afternoon. So we will -- I will, and I
21 apologize, sometimes move us along if we need to.
22 We've broken it down that we're going to
23 start with Chapter 3 today, and then a small amount on
24 Chapter 4, since most of those issues have been closed
25 and been reviewed in past subcommittee meetings, and

1 finish up today with Chapter 9, regardless how long it
2 takes.
3 So I'd like to turn it to Amy Cubbage to
4 kind of kick us off. Amy?
5 Staff Opening Remarks
6 MS. CUBBAGE: Thank you. Just to add to
7 what you said there, for Chapter 3, I'd just like to
8 note that we're not covering every subsection of
9 Chapter 3. We picked selected areas where there were
10 significant open items, and areas of ACRS interest in
11 previous meetings.
12 So we're going to start off with Section
13 3.8 today and then go on to selected topics from 3.9
14 and 3.12. If the Committee has any questions in other
15 areas of Chapter 3, please let us know and we'll try
16 to get the appropriates staff here to answer those
17 questions during the course of the day. With that,
18 I'll just turn it over to GE Hitachi to begin.
19 Chapter 3 - Section 3.8 RAIs/GEH
20 MR. NIOGI: My name is Sujit Niogi. I'm
21 from the GE Hitachi, and I'm going to cover Chapter
22 3.8 open items. The following the NRC RAIs will be
23 discussed in this presentation: 3.8 -79, Seismic
24 Category 2 issue; 3.8-94, soil-bearing capacity. 3.8-
25 96; stability analysis of the structure; 3.8-107, SSDP

1 computer program validation; 3.8 -120, reactor shield
2 wall; 3.8-125, impact of spent fuel rack on spent fuel
3 pool structure.
4 NRC RAI 3.8-79, confirmed that the Seismic
5 Category 2 and Seismic Category NS structures, which
6 are in close proximity approximately to Seismic
7 Category 1 structures, are designed to Seismic
8 Category 1 requirements. The following structures are
9 in close proximity to Category 1 structures: Seismic
10 Category 2, reactor building, service building and
11 ancillary diesel building. Seismic Category NS fuel
12 building.
13 Seismic Category 2 and seismic Category NS
14 structures listed above are designed to withstand SSE
15 loads. The method of analysis of these structures are
16 the same as the Seismic Category 1 structures,
17 including the load combinations and the acceptance
18 criteria.
19 During SSE event, the structures will not
20 collapse and impact the Seismic Category 1 structure.
21 Also, the -- in the structures are large enough to
22 preclude impact due to out of phase displacements
23 during SSE events.
24 It was demonstrated that a Seismic
25 Category 2 and Seismic Category 1 NS structures which

1 are in close proximity to Seismic Category 1
2 structures, are designed to SSE requirements. The
3 gaps between the structures are large enough to
4 prelude impact during SSE event.
5 DR. WALLIS: Impact with what?
6 MR. NIOGI: Impact with another structure.
7 DR. WALLIS: Oh, another structure. Oh,
8 particularly the Seismic Category 1.
9 MR. NIOGI: So it may be that the Seismic
10 Category 2 are NS, doesn't matter. It's not going to
11 impact any other structure.
12 DR. WALLIS: It's a strange structure that
13 falls without hitting something.
14 MR. NIOGI: Beg your pardon?
15 DR. WALLIS: It's a strange structure that
16 falls without hitting something.
17 MR. NIOGI: It's not going to fall,
18 because are designing Category 2 as NS, not to fall at
19 all.
20 DR. WALLIS: So the impact you're talking
21 about isn't a falling of something?
22 MR. NIOGI: It's not the falling. It is a
23 gap between during the out of phase displacement, the
24 --
25 DR. WALLIS: Oh, I see. So impact you

1 don't -- impact to me means something hitting
2 something, but you mean -- you mean an influence of
3 something. Okay, I see. Thank you.
4 MR. NIOGI: So out of phase displacement
5 is not going to --
6 DR. WALLIS: But you're using impact in
7 the modern way instead of the classical sense.
8 MS. CUBBAGE: I think they do mean impact,
9 no?
10 CHAIRMAN CORRADINI: Out of phase.
11 Graham's just asking if things are falling. Your
12 answer is they're not designed to fall, but they're
13 not going to out of phase bump into each other?
14 MR. NIOGI: Right.
15 DR. WALLIS: You could use the word
16 "bump."
17 MR. NIOGI: Bump, yes bump. Contact.
18 CHAIRMAN CORRADINI: Contact.
19 MR. NIOGI: Contact.
20 DR. WALLIS: You mean they don't have any
21 effect on the neighboring structures.
22 MR. NIOGI: Right.
23 DR. WALLIS: That's what you sort of mean.
24 You don't mean they actually don't hit them?
25 MR. NIOGI: No, no. Okay. We have enough

1 -- between the two structures not to do that.

2 DR. WALLIS: They're independent.

3 MR. NIOGI: They're independent. NRC RAI

4 2.8 3.8-94. Confirmed, that a soil -bearing demand is

5 less than the soil -bearing capacity due to static and

6 dynamic loading conditions. Provide t he technical

7 basis for not considering the -- during an event.

8 Bearing and sliding calculation which uses SASSI

9 results.

10 The staff noted valleys exists between

11 successive peaks in the site shear waves. The staff

12 requested that these valleys should b e filled in to

13 accommodate the expected variability in site shear

14 wave profiles.

15 GEH used the energy balance method to

16 calculate the soil -bearing pressure and consider both

17 form and size. GEH demonstrated that the soil-bearing

18 demand is less than the allowable soil -bearing

19 pressure. The results are documented in DCD Tier 1.

20 They're in 5.1-1 and DCD Tier 2, Table 2.0-1.

21 GEH used the energy balance method, which

22 takes into account the effects of uplift in the linear

23 response calculated by SASSI. We thus concluded that

24 this simplified method provides a reasonable estimate

25 using the linear analysis results on the amount of

1 uplift displacement due to passing of the base mat
2 dimension.
3 As shown in Figure 1, as shown in
4 Figure 1, the extent of uplift is not extensive, and a
5 large portion of the base mat remains in contact with
6 the soil. GEH complied with the NRC request and
7 filled the spectral valleys between the peaks, as
8 shown in Figure 2. The dotted line was when the
9 valleys are not filled on, and the solid line is when
10 the valleys are filled in.
11 CHAIRMAN CORRADINI: The staff said the
12 low frequency region. In fact, there isn't much of a
13 valley in --
14 MR. NIOGI: Yes. They said there is not
15 much, but in several cases, we do have valleys in the
16 -- several valleys in the low frequency range.
17 CHAIRMAN CORRADINI: And that's what
18 requires -- or that's what, that's the impetus that
19 the staff has to fill in to do, so that you eliminate
20 those large changes.
21 MR. NIOGI: Large changes, yes.
22 CHAIRMAN CORRADINI: Okay.
23 MR. NIOGI: It was demonstrated the soil -
24 bearing demand is less than the soil -bearing capacity
25 in static and dynamic loading conditions.

1 DR. WALLIS: So this is 5g, this maximum
2 almost?
3 MR. NIOGI: Yes, it is almost 5g.
4 DR. WALLIS: Oh.
5 MR. NIOGI: This is our analysis from the
6 ground elevation. The technical basis for not
7 considering the effect of uplift in the seismic demand
8 loading in the bearing and sliding calculation, which
9 uses SASSI analyses results have been demonstra ted.
10 Spectral valleys between the peaks have been filled
11 in.
12 NRC RAI 3.8 -96. Confirmed, that the
13 Seismic Category 1 structures meet the sliding
14 stability requirements of SRP 3.8.5. Justify, use the
15 static correlation of friction beneath the base mat,
16 and along the vertical surfaces of the walls.
17 Justify, use a full passive pressure at
18 the side of the vertical surfaces of the walls in the
19 sliding resistance. How did GEH consider other
20 potential sliding interfaces in addition to the soil
21 shear failure that is base mat to concrete mud mat and
22 concrete to soil.
23 It does confirm that the Seismic Category
24 1 structures meet the sliding stability requirements
25 of the SRP 3.8.5, considering passive pressure

1 resistance. Resistance due to friction at the bottom
2 of the base mat, and along the vertical surfaces of
3 the walls. GEH used reduced friction in the vertical
4 walls to calculate friction resistance due to passive
5 pressure.
6 In this evaluation, passive pressure was
7 needed to comply with SRP 3.8.5 requireme nts. GEH
8 added shear keys to the reactor building, fuel
9 building complex and service complex to increase the
10 sliding resistance. See Figure 3.
11 In Figure 3, you can see that.
12 CHAIRMAN CORRADINI: So these were added?
13 I just want to understand. These were added because,
14 if I remember back last time we discussed this, there
15 was -- the staff wanted you to look at variation in
16 the sliding coefficient, and these were added to add
17 extra margin to -- that even if the sliding
18 coefficient was lower, you still met the requirement?
19 MR. NIOGI: I would not say adding extra
20 margin. I would say that yes, we needed that CRT to
21 get that stability factor SRP against sliding 1.1.
22 CHAIRMAN CORRADINI: Okay. Thank you.
23 MR. NIOGI: By roughening the surface face
24 of the mud mat concrete, friction resistance is
25 increased between the mud mat and base mat. Added

1 drafts in the soil under the mud mat to increase the
2 shear resistance. Building structures meet the
3 sliding stability requirements of the SRP 3.8.5.
4 Static coefficient of frequency of .7
5 beneath the base mat and the reduced coefficient of
6 friction of 0.5 for the vertical surface of the wall
7 is adequate to provide sliding stability. Additional
8 reinforcement was added to the vertical walls to
9 resist passiv e pressure, to increase the friction
10 relation between the base mat, mud mat and soil.
11 NRC RAI 3.8 -107. NRC staff reviewed the
12 SSDP computer program validation package, but found
13 that the validation did not satisfy items of interest,
14 such as how does SSDP apply the concrete code used the
15 U.S., and how are the code additions that are accepted
16 by the NRC is incorporated in SSDP to keep it current?
17 How does SSDP identify critical sections
18 of a structure. In the RCCV structure, how does SSDP
19 evaluate that shear stress to demonstrate compliance
20 with the ASME code? GEH was requested to verify the
21 equations using the SSDP by comparing the quantity
22 results with the equations presented in the concrete
23 textbook.
24 SSDP calculates stresses of concrete and
25 INPO st rength of force and --. Calculated stresses

1 are compared with the allowable stresses specified in
2 applicable codes. The SSDP has supplemental
3 subroutines for the tangential shear and transverse
4 shear.
5 It is confirmed that the provided section
6 satisfies the code requirements. The validation of
7 SSDP provides confirmation that the calculation result
8 meets the requirements of the code additions which are
9 specified for the project.
10 The equations used in the SSDP computer
11 codes were verified by comparing t he results with the
12 results from the equation presented in the concrete
13 design textbook. The validation of SSDP confirms that
14 the calculation results satisfied the requirements of
15 the codes. The coefficients using the SSDP computer
16 code were verified with hand calculation.
17 DR. WALLIS: How do you verify an equation
18 by hand calculation?
19 MR. NIOGI: Well --
20 DR. WALLIS: Either the equation is right
21 or not, it seems to me --
22 MR. NIOGI: The numbers.
23 DR. WALLIS: When you use it to calculate?
24 MR. NIOGI: Yes. You use the equation. I
25 mean you come up with the number, the same number.

1 DR. WALLIS: You don't, you don't verify F
2 equals MA by using it to calculate them?
3 MR. NIOGI: No. I think we should say the
4 numbers are verified, yes. The computation has the
5 same number.
6 DR. WALLIS: Well, compared with what
7 then?
8 CHAIRMAN CORRADINI: Well, I think --
9 well, at least the way -- maybe it's the words that
10 you've used today. What I interpreted you to mean was
11 that you went to handbook calcul ations and did a
12 calculation and confirmed it compared to what the
13 computer calculation.
14 DR. WALLIS: The result. You didn't
15 compare the equation.
16 (Simultaneous discussion.)
17 DR. WALLIS: You just compared it to
18 nothing.
19 CHAIRMAN CORRADINI: Yes. That's what I
20 interpreted it to mean.
21 DR. WALLIS: Right, right. Well, yes.
22 But I'm just asking him what he means.
23 MR. NIOGI: Right, yes.
24 DR. WALLIS: And you know what --
25 CHAIRMAN CORRADINI: Is my interpretation

1 correct or -- is my --

2 MR. NI OGI: Yes, your interpretation is

3 fine. We should have said that hand calculated

4 results, yes.

5 DR. WALLIS: You know, the predictions or

6 something.

7 MR. NIOGI: Right, yes.

8 DR. WALLIS: Okay.

9 MR. NIOGI: Thanks for pointing it out,

10 and it was -- yes. We should have said that, yes.

11 NRC RAI 3.8 -120. NRC indicated in their review that

12 the material thickness for reactor shield wall in some

13 locations is better than ten inches. ASTM 8516 is

14 only available up to eight and a quarter inch, inches

15 thick.

16 ASTM 8709 is only available up to four

17 inches. NRC requested GEH to explain how reactor

18 shield wall will be fabricated. The staff also raised

19 a concern related to welding A -709 material to the

20 containment steel liner and accept the report case for

21 this type of welding.

22 GEH plans to fabricate using four inch

23 maximum thickness steel using multi -layer vessel

24 construction technique. Multi -layer construction has

25 been very effective for cylindrical pressure vessels

1 more than 16 inches thick. The const ruction
2 techniques allow the multi -layer shells to act as a
3 solid wall.
4 DR. WALLIS: Well, they can't be attached
5 all along the interface.
6 MR. NIOGI: They behave as a monolithic
7 structure.
8 DR. WALLIS: Because of friction at the
9 interface?
10 MR. N IOGI: Yes. We show the friction
11 technique, you know. You can have it --. There are
12 four different techniques discussed.
13 DR. WALLIS: To me, if they were heated
14 sufficiently, then they would buckle out from each
15 other, these layers.
16 MR. NIOGI: Well --
17 DR. WALLIS: Out of a fire or something.
18 MR. NIOGI: It is being used for model, to
19 show that technique in the pressure vessel.
20 DR. WALLIS: Yes. It's all right as a
21 pressure vessel. It's just, I can think of events
22 which might delaminate or separate these layers?
23 MR. NIOGI: Do you want me to discuss
24 this, bring my metal engineer?
25 DR. WALLIS: I'm not sure. I'm just

1 asking you --

2 MEMBER ARMIJO: What is the shape of the

3 shield wall?

4 MR. NIOGI: It's a cylindrical shape.

5 MEMBER ARMIJO: Well, you have -- these

6 are nested cylinders?

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

8 DR. WALLIS: As long as it's under

9 pressure, it's fine. But it seems to me if you've got

10 say an impingement of a steam jet on the wall or

11 something --

12 MR. NIOGI: Right.

13 DR. WALLIS: Then it would be known that

14 you can separate steel liners from concrete by

15 impinging a steam jet and it's happened.

16 MR. NIOGI: Yes.

17 DR. WALLIS: So it seems to me there are

18 situations where these layers would tend to separate

19 from each other.

20 MR. NIOGI: Right. In the case of liner,

21 where the jet will impinge the liner, you know, the

22 thickness of the liner is an issue here is a --. But

23 you're talking about an impingement, you know, that --

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

25 MR. NIOGI: That's right, and also in the

1 case of liner, you know, it is backed by concrete.
2 It's not backed by the steam.
3 DR. WALLIS: The shield wall blocks the
4 gamma radiation?
5 MR. NIOGI: Yes. That's the --
6 DR. WALLIS: It's not a structural --
7 (Simultaneous discussion.)
8 MEMBER KRESS: So its purpose wouldn't be
9 bothered by separation or a big bond between the
10 layers? It would still work for what it's supposed to
11 do?
12 MR. NIOGI: Well, we don't want just to
13 have thick steel sitting there and not doing anything,
14 right? So we'd like to revise that material.
15 MEMBER KRESS: I see.
16 MR. NIOGI: So we do it --
17 MEMBER KRESS: To support something.
18 MR. NIOGI: --to support something, yes.
19 Definitely, the pipe full blast steam.
20 MEMBER KRESS: Pipes and things like that,
21 yes.
22 DR. WALLIS: During seismic events, it
23 stays monolithic?
24 MR. NIOGI: Yes.
25 DR. WALLIS: It does?

1 MR. NIOGI: Yes, it does. Yes.

2 DR. WALLIS: How are the layers bonded?

3 Do you weld them in particular --

4 MR. NIOGI: I must talk to our engineer.

5 I want to, you know, in that case I need to have to

6 metal specialist to help me out. Do you want me to

7 bring him in?

8 MEMBER ABDEL-KHALIK: Yes, please.

9 MR. NIOGI: Okay.

10 MR. CRESS: Yes, pleas e. My name is

11 Mirali Cress (ph). I'm the welding engineer, and

12 Sujit was talking about the multi -layers in sections.

13 Yes, we would like to do something like that and

14 probably, if you to -- if there is any fear of

15 separation or something, we can weld them in certain

16 areas, so that it will remain layer.

17 Normally, we can use press-fitting also,

18 so that it is tied, and this being just the radiation

19 shielding, you shouldn't be having any kind of

20 stresses or structure will get displaced or something.

21 So ev en if something happens, we could

22 weld them in some areas, where it could remain intact.

23 DR. WALLIS: Yes, if it's just a radiation

24 shield. I was bothered by the term, the statement

25 here that the multiple layers act as a solid wall,

1 because I can think of situations where they might not
2 act as a solid wall.
3 CHAIRMAN CORRADINI: In heating
4 situations, I'd agree with you.
5 DR. WALLIS: Yes, right. But it's not
6 those situations -- it's not designed for those
7 situations, so therefore it's all right.
8 CHAIRMAN CORRADINI: So just to be clear,
9 just so we're clear about it, so the situations it's
10 designed for is structural -- is of course is the
11 shield, but also structural support, and you said
12 restraints were attached to it, if I remember what you
13 had said.
14 MR. NIOGI: Restraints are attached to it.
15 DR. WALLIS: I'm looking at this. It says
16 "pressure vessel" in the drawing. It's not a pressure
17 vessel?
18 MR. NIOGI: It's not a pressure vessel.
19 DR. WALLIS: So it's all there. So I'm
20 just looking. The words kind of misled me here.
21 CHAIRMAN CORRADINI: Open can.
22 MR. NIOGI: Open can, exactly. That's
23 like BWR, you know, mark one to three. You have a
24 shield obviously made of steel and concrete, you know.
25 This is concrete. We reduce the phase b y using the

1 shield.

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

3 okay.

4 MR. NIOGI: Yes.

5 DR. WALLIS: Well, it's big enough and

6 strong enough. It could act as shield for other

7 purposes.

8 (Laughter.)

9 MEMBER KRESS: I think they made that

10 point, that t hey could do something more than just

11 have it sit there.

12 MR. NIOGI: Our radiation technique is

13 complying with ASME code fully utilized. Welding of

14 dissimilar material with as similar land material has

15 been satisfactorily addressed.

16 NRC RAI 3.8-125. Confirm that the impact

17 of the spent fuel storage racks will not adversely

18 impact the spent fuel pool walls.

19 DR. WALLIS: Now by "impact," you don't

20 mean collision. You mean the effect.

21 CHAIRMAN CORRADINI: No, I think he means.

22 MR. NIOGI: I'm really meaning impact.

23 DR. WALLIS: You mean an exchange of

24 momentum, bumping?

25 MR. NIOGI: Yes.

1 DR. WALLIS: Okay.

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

5 DR. WALLIS: Second impact is -- it means
6 effect or something, yes. The first impact is
7 physical. The second impact is an effect.

8 MR. NIOGI: An effect.

9 DR. WALLIS: Okay.

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

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

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

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

1 MR. NIOGI: Right, yes.

2 DR. WALLIS: There's water in this spent

3 fuel --

4 MR. NIOGI: There's water, yes.

5 DR. WALLIS: And the racks are submerged

6 in water?

7 MR. NIOGI: Submerged in water.

8 DR. WALLIS: And the last time we met, we

9 had some questions about how you treated the added

10 mass for this situation?

11 CHAIRMAN CORRADINI: This was for PCCS.

12 DR. WALLIS: Yes, but I didn't see

13 anything about PCCS in this presentation, or even in

14 the SER.

15 MS. CUBBAGE: We came back in a separate

16 meeting and addressed those issues.

17 DR. WALLIS: That was all resolved, was

18 it?

19 MR. NIOGI: Yes.

20 MS. CUBBAGE: Yes.

21 CHAIRMAN CORRADINI: For PCCS.

22 DR. WALLIS: It was resolved? I thought

23 we just had questions. It was resolved?

24 CHAIRMAN CORRADINI: Well, we had a

25 subcommittee meeting back in November, where they

1 showed us the additional calculations.

2 DR. WALLIS: I think I have questions

3 about the validity of the calculations.

4 CHAIRMAN CORRADINI: It seem to remember

5 at the mo ment you were -- I seem to remember at that

6 moment you were satisfied.

7 DR. WALLIS: Just evaporated? Well, I

8 read a report. Well, okay, all right.

9 CHAIRMAN CORRADINI: At the time you were

10 satisfied.

11 DR. WALLIS: At the time, I read a report.

12 I don't know. It just disappeared into the system.

13 CHAIRMAN CORRADINI: But this one is spent

14 fuel.

15 MR. NIOGI: This is spent fuel.

16 DR. WALLIS: You're not going to talk

17 about PCCS then, because that's already been resolved

18 somewhere?

19 CHAIRMAN CORRADINI: Well, we're not going

20 to talk about it today.

21 DR. WALLIS: Okay. I'll have to look back

22 at what date it was that I wrote my report.

23 CHAIRMAN CORRADINI: Well, I can find it

24 for you if you want.

25 MEMBER KRESS: Unless they used the same

1 technique for added mass here. So if he has issues
2 with it in the PCCS, there might be issues here. It
3 would be nice to know how they treated the added mass.
4 CHAIRMAN CORRADINI: If you want to ask
5 the question to them, then, about your --
6 MEMBER KRESS: They might not be prepared
7 to answer that, but --
8 DR. WALLIS: No. I mean the staff in some
9 way is satisfied. I don't know why.
10 MEMBER KRESS: Well maybe Amy --
11 DR. WALLIS: Then we'll ask them.
12 MEMBER KRESS: --could discuss it. You
13 were happy with what they did?
14 MS. CUBBAGE: We were happy with what they
15 did at the time, and we left with no action items from
16 the Subcommittee.
17 MEMBER KRESS: You're going to give us a
18 talk after this one?
19 MS. CUBBAGE: We are.
20 DR. WALLIS: There was a time we talked
21 about sloshing as well. I remember the time, and I
22 was not satisfied with added mass. But anyway, let's
23 move on.
24 CHAIRMAN CORRADINI: Yes. In this case,
25 the racks are very submerged.

1 DR. WALLIS: I don't think that's as much
2 an issue as it was -- the PCCS is a bigger issue.
3 MR. NIOGI: Right.
4 DR. WALLIS: That's a bigger issue.
5 CHAIRMAN CORRADINI: They're near -- I
6 mean from the standpoint of submergence, these are
7 many meters below the water level.
8 DR. WALLIS: Can't move without pushing
9 the water around.
10 MEMBER KRESS: The water has to move that.
11 CHAIRMAN CORRADINI: The PCCS is sitting
12 with the water level near the upper drum, if that --
13 if my memory --
14 DR. WALLIS: It doesn't matter for added
15 mass, and that is for sloshing.
16 MR. NIOGI: Sloshing.
17 MR. DEAVER: Right. Our racks are more
18 than ten meters below the water surface.
19 MEMBER ARMIJO: What is the gap between
20 the racks and the walls? Is it how many feet, inches.
21 MR. NIOGI: No. Six inches, a little less
22 than six inches.
23 MEMBER ARMIJO: Inches, and what's the
24 maximum amplitude of the rack?
25 MR. DEAVER: I heard that it's

1 millimeters, in the north-south direction, and in the
2 east-west direction it's 60 millimeters.
3 MEMBER ARMIJO: That's not very much.
4 MR. DEAVER: Not very much.
5 MEMBER KRESS: Is each rack free-standing?
6 MR. DEAVER: They're free-standing. What
7 we had to do --
8 MEMBER KRESS: They can impact each other?
9 MR. DEAVER: What we did is we had to
10 couple all the racks, link them toget her. We have a
11 base plate that they sit in that restrains the
12 separation.
13 MEMBER KRESS: At the bottom, at the
14 bottom there.
15 MR. DEAVER: Yes, at the bottom, and also
16 at the top.
17 MEMBER KRESS: They're linked at the top
18 also?
19 MR. DEAVER: They are.
20 MEMBER KRESS: So they have to move --
21 MR. DEAVER: They have to use this as a
22 complete unit.
23 MEMBER KRESS: I see.
24 MR. DEAVER: It eliminated a lot of the
25 complexity of impacts and non-linear analysis.

1 MEMBER KRESS: Yes. That would make a big
2 difference on the amplitudes too.
3 MR. DEAVER: Yes.
4 MEMBER ARMIJO: So is this sort of an egg
5 crate structure, the entire fuel rack structure is one
6 thing --
7 MR. DEAVER: Yes.
8 MEMBER ARMIJO: Bonded to some big plate
9 on the bottom of the pool?
10 MR. DEAVER: It sits in a base plate that
11 has vertical plates that restrain motion.
12 MR. NIOGI: Shear logs at the day. So
13 there's not going to be space --
14 MEMBER ARMIJO: And that's sort of welded
15 to the liner or --
16 MR. NIOGI: No. It's not welded to the
17 liner.
18 MEMBER ARMIJO: It sits on the liner?
19 MR. NIOGI: No. The shear log is welded
20 to a base plate, and the base plate is then in turn
21 welded to the embedment plate, which is resting on the
22 -- which is embedded into the concrete base mat.
23 So you have two layers of embedment. One
24 is shear log welded to the base plate upper rack,
25 which is then connected to the embedded plate, which

1 is connected to the base mat of the fuel group.

2 MEMBER ARMIJO: And where is the liner?

3 MR. NIOGI: The liner is then comes and is

4 welded on the top of the base mat, and with a leak

5 system that the water cannot go through. I don't know

6 if there is a --

7 MEMBER ARMIJO: If there's a sketch or

8 somewhere later in the day, if you could just give me.

9 MR. NIOGI: Sure. The board I can draw

10 right now, you know.

11 MEMBER ARMIJO: So I could understand.

12 MR. NIOGI: The board I can draw right

13 now, you know.

14 MEMBER ARMIJO: I'd just like to see what

15 it looks like.

16 DR. WALLIS: Can we dig out this PCCS?

17 CHAIRMAN CORRADINI: I'm trying.

18 DR. WALLIS: At some time in the future.

19 CHAIRMAN CORRADINI: I have your November

20 letter. You don't mention after that any concerns

21 there. It was mainly about hydrogen at the time.

22 DR. WALLIS: I had about three p ages on

23 added mass in one of the reports.

24 CHAIRMAN CORRADINI: That was earlier.

25 MS. CUBBAGE: It may have been in advance.

1 DR. WALLIS: That was earlier?

2 CHAIRMAN CORRADINI: That was earlier, and

3 we came back -- they came back. If my memory is, I

4 have, I'm looking. They came back with a series of

5 calculations and varied the parameter.

6 DR. WALLIS: Maybe I wasn't here, because

7 I don't remember it being resolved. But anyway, the

8 staff is satisfied. That's what matters.

9 CHAIRMAN CORRADINI: I'll keep on looking,

10 but memory is, my memory is we were in January of `09,

11 approximately then where we were talking about added

12 mass effects, we came back, staff came back and at the

13 November Subcommittee meeting, and that's we --

14 You were happy about that, but we then

15 went off, talking about the fan performance and

16 hydrogen effects, and that's how -- that was the major

17 open item that came out of the November meeting.

18 DR. WALLIS: Yes.

19 CHAIRMAN CORRADINI: That's what I have at

20 this --

21 DR. WALLIS: Okay. Well, but you'll look

22 into it and we'll figure it out.

23 CHAIRMAN CORRADINI: Okay, right.

24 MEMBER ARMIJO: Because of this way you've

25 designed it, even though you have a very small gap,

1 what is the amplitude, the maximum amplitude of this
2 rack, moving towards the liner? Is it half an inch or
3 a tenth of an inch?
4 (Simultaneous discussion.)
5 MR. NIOGI: Toward the wall, yes.
6 MEMBER ARMIJO: Toward the wall, yes. You
7 say it's sufficient gap, so there's two numbers I'm
8 interested in. What is the gap and how much of it do
9 you use in your SSE?
10 MR. DEAVER: Yes. We just have a few
11 millimeters of gap, but you have to consider that the
12 pool, we're working to the minimum dimensions of the
13 pool, and so in reality, when you get the real as-
14 built, we're going to find --
15 MEMBER ARMIJO: I'm just looking for how
16 much margin you have between your calculation of how
17 much. When you say it's sufficient gap --
18 CHAIRMAN CORRADINI: What Sam's asking --
19 what Sam's asking is when it wiggles, how much is t he
20 open area after it wiggles?
21 MEMBER ARMIJO: Yes, right. How much is
22 left over?
23 MEMBER KRESS: How close is this --
24 CHAIRMAN CORRADINI: How close are you
25 going to get? That's what I guess he's asking.

1 MEMBER ARMIJO: 90 percent of your gap, 80
2 percent of your gap, ten percent?
3 MEMBER KRESS: In a pool like this, it's
4 difficult. It's vibration motions, because you have
5 to have some model for what happens to the water. Did
6 you treat the water at all in these calculations?
7 MR. DEAVER: Oh yes, definitely.
8 MEMBER KRESS: You had an added mass
9 calculation?
10 MEMBER ARMIJO: Then you have an answer
11 somewhere.
12 MR. DEAVER: Is this -- do we want to get
13 back to them?
14 CHAIRMAN CORRADINI: I think that's the
15 best thing to do.
16 MR. NIOGI: Yes . I think we should get
17 back to you with the number, because this is Chapter
18 9.9, you know.
19 DR. WALLIS: It helps with these wordy
20 statements if you provide a figure and some numbers.
21 CHAIRMAN CORRADINI: Yes, it would.
22 MR. NIOGI: A figure?
23 DR. WALLIS: A figure and some numbers.
24 This is the way it shakes, this is what we calculate,
25 this is what the gap was, and this is what it is when

1 it shakes. That would be very clear and we'd go away
2 and have to be happy.
3 MR. DEAVER: What happens at the top of
4 the rack. It will sway --
5 (Simultaneous discussion.)
6 DR. WALLIS: Yes, that's what --
7 otherwise, we can talk forever.
8 MEMBER ARMIJO: You've got that down. I
9 understand.
10 MR. DEAVER: Well actually, it's not
11 totally locked down.
12 CHAIRMAN CORRADINI: So we'll take it as -
13 - you guys will take it as an action item, and I've
14 written it down that we'll come back. Wayne enjoys
15 these little tasks.
16 MR. MARQUINO: It give me something to do.
17 CHAIRMAN CORRADINI: Right, okay.
18 MR. NIOGI: So that -- this is considered
19 my presentation.
20 CHAIRMAN CORRADINI: Okay, all right.
21 Other questions on these RAIs?
22 (No response.)
23 CHAIRMAN CORRADINI: Okay. Thank you very
24 much. I think the way we're doing this is staff is
25 now coming up Amy?

1 MS. CUBBAGE: Yes.

2 CHAIRMAN CORRADINI: Okay.

3 MR. NIOGI: Thank you. Thank you very

4 much.

5 CHAIRMAN CORRADINI: Thank you very much.

6 (Off mic discussions.)

7 CHAIRMAN CORRADINI: Dave, are you going

8 to kick us off here?

9 MR. MISENHIMER: Yes.

10 CHAIRMAN CORRADINI: Okay, all right. Go

11 ahead, I'm sorry.

12 Chapter 3 - Section 3.8 RAIs/Staff

13 MR. MISENHIMER: Okay. I've Dave

14 Misenhimer. I'm the project manager for Chapter 3,

15 and today Samir Chakrabarti is going to address the

16 significant RAIs open i tems that are related to

17 Section 3.8.

18 MR. CHAKRABARTI: Okay. Good morning.

19 I'm Samir Chakrabarti. I'm the NRC technical reviewer

20 for ESBWR Section 3.8, and we have with us here today

21 our technical consultants from BNL, which is Joe

22 Braverman and Ric h Morante, to help us with any

23 questions that you may have.

24 We have completed our review of Section

25 3.8, and in the first line there's basic regulations

1 and standards that we use for the review. It was a
2 very extensive review that spanned over about fi ve
3 years, I would say, and I also picked it up in the
4 middle of somewhere.
5 But fortunately, BNL Consultants, they
6 have the same guys who performed the review also, and
7 that ensures some continuity in the relation. We had
8 five design audits that were per formed to review
9 calculations and discuss various issues with the
10 applicant.
11 We have performed the confirmatory
12 analysis of the base mat calculation --
13 DR. WALLIS: When the base mat -- you
14 asked about whether or not it moves. Does it matter
15 how much water is underneath it?
16 MR. CHAKRABARTI: Say that again?
17 DR. WALLIS: Does it matter how wet the
18 soil is? So you said you confirmed analysis of this,
19 and that you were concerned about the base mat moving
20 in the soil, I think?
21 MR. CHAKRABARTI: Yes.
22 DR. WALLIS: Does it matter how wet the
23 soil is?
24 MR. CHAKRABARTI: Well, that's the
25 coefficient of friction that we used.

1 DR. WALLIS: But it changes a lot, doesn't
2 it, depending on how wet it is, or does it not?
3 MR. BRAVERMAN: Yes. If you're speaking
4 about -- this is Joe Braverman from BNL. If you're
5 speaking about the confirmatory analysis that we
6 performed, we primarily did independent analysis of
7 the reactor building foundation. We were looking at
8 three areas.
9 One of the areas was that y ou initially
10 assumed the concrete base mat was one thickness, and
11 in reality, there were two variations of that.
12 CHAIRMAN CORRADINI: Joe, I think -- Joe?
13 I think you're going to have to get it closer to you.
14 I don't think they're catching what you're saying.
15 MR. BRAVERMAN: Okay. I'll start again.
16 In the confirmatory analysis that BNL performed, we
17 were looking at three areas. One is G assumed that
18 the concrete base mat was a constant thickness, and
19 the reality, there's some variations in it.
20 Also, they use a thick shell element, a
21 final element representation for the base mat which is
22 a single like shell element that has through the
23 thickness capability, of being able to use 3D solid
24 element representation, because we questioned how
25 accurate that would be.

1 The third thing is they used a Naturine
2 (ph) computer code, and BNL followed an ANSYS computer
3 code. So we looked at those differences, and we
4 analyzed seismic loading, dead weight, hydrostamin
5 (ph). So it wasn't intended to study the effec t of
6 the soil and how they modeled the building.
7 DR. WALLIS: No. But the presentation we
8 heard was about the base mat actually moving or
9 lifting up and so on, and I just wondered what the
10 soil was in those kind of calculations.
11 MR. BRAVERMAN: Okay, but that's not part
12 of the confirmatory analysis.
13 DR. WALLIS: No, but I just -- but it was
14 -- you reviewed and accepted GEH's analysis for these
15 other phenomena.
16 MR. BRAVERMAN: Oh yes.
17 DR. WALLIS: So I'm asking if the staff
18 understands how the w etness of the soil affects
19 whether or not the base mat moves or lifts off or does
20 various other things? So I'm just asking if the staff
21 understands that, and therefore accepts what GEH
22 submitted?
23 MR. BRAVERMAN: Yes, we did review that,
24 and we accepted it on the following basis. The SSI
25 analysis used the SASSI code. The SASSI code does not

1 have non-linear, does not have non -linear capability.
2 It cannot lift off, because the springs aren't
3 compression -- not the springs. The contact between
4 the soil a nd the base mat takes compression and
5 tension.
6 So they did a separate calculation based
7 on the energy balance method, and that formulation
8 does have lift -off capability. So we have relied on
9 that analysis to see what extent of uplift there is,
10 and it's not significant.
11 DR. WALLIS: And in terms of the friction
12 coefficient, is the wetness of the soil considered?
13 MR. BRAVERMAN: Well, in the lift -off
14 analysis, friction does not enter. Friction entered
15 in the sliding and overturns.
16 DR. WALLIS: In th e sliding, right. In
17 the sliding analysis, is the wetness of the soil
18 considered?
19 MR. BRAVERMAN: In the sliding, the effect
20 of the moisture content in the soil wouldn't, would
21 not --
22 DR. WALLIS: Has no effect.
23 CHAIRMAN CORRADINI: Why doesn't it? I'm
24 listening to Graham ask you all these questions. Now
25 I'm curious. Why doesn't it?

1 DR. WALLIS: I've slid around a lot on wet
2 soil. Now maybe I don't weigh enough to make any
3 difference.
4 (Laughter.)
5 CHAIRMAN CORRADINI: You need to be
6 heavier.
7 MR. NIOGI: I can answer these questions.
8 CHAIRMAN CORRADINI: Identify yourself
9 please.
10 MR. NIOGI: This is Sujit Niogi from GE
11 Hitachi. What we did, you know, this is what was
12 mentioned, that if we can slide on a wet surface.
13 Yes. So we know t hat situation. So what we did, we
14 have a trough in in the soil. So the concrete mud
15 mat, when you pour, you pour on the trough on the
16 soil. You get these GRA resistance, like a shear key.
17 CHAIRMAN CORRADINI: They added --
18 remember that's what he described. They added what he
19 calls a shear key, essentially like a ring of concrete
20 around the base.
21 DR. WALLIS: That holds it in place?
22 CHAIRMAN CORRADINI: Well, that gives you
23 extra margin so when you wiggle it doesn't move as
24 much.
25 DR. WALLIS: So you wiggle. When the

1 soil's wet, it doesn't move?

2 MR. NIOGI: In addition to that, below the

3 mud mat, below the mud mat we have also a trough in

4 the soil.

5 MEMBER ARMIJO: Are these like

6 corrugations?

7 MR. NIOGI: Yes, corrugations.

8 MEMBER ARMIJO: Okay.

9 MR. NIOGI: Right, like a tool deck.

10 MR. BRAVERMAN: Also the entire reactor

11 building foundation is embedded in the soil, so it's

12 not like a structure resting on the top surface that

13 can slide.

14 DR. WALLIS: No, no. I understand that.

15 But the forces can be pretty big when you shake the

16 soil?

17 CHAIRMAN CORRADINI: Oh yes.

18 DR. WALLIS: And actually the shaking of

19 the soil can change the friction coefficient itself,

20 because if it moves the liquid around.

21 MR. CHAKRABARTI: I think question is the

22 friction coefficient that we assumed, how it is

23 impacted by water in the salt marsh or water in the

24 soil. What we have assumed in this analysis, the

25 friction coefficient is based on shear failure of the

1 soil, and because it has been taken as a tang ent of
2 the angle of friction.
3 Now that value, whether it is impacted by
4 salt water in that soil, I guess not. We have assumed
5 tangent total frictional figure of the soil, and to
6 make sure that the soil absorbs friction, and it does
7 not slide on the surface.
8 DR. WALLIS: I don't know. I'm just
9 speculating. It seems to me that if you shake a wet
10 soil with a seismic sort of stresses, you're going to
11 squeeze the water out of it. But I'm just curious
12 about this, that's all, and I'm not an expert on it,
13 except maybe in the squeezing of water out of the
14 soil.
15 But I'm just curious how you handled it,
16 and you can assure me that it's handled properly?
17 MR. BRAVERMAN: I have no information with
18 me at hand.
19 CHAIRMAN CORRADINI: He's asking for a
20 judgment.
21 DR. WALLIS: No, but I guess --
22 MR. BRAVERMAN: In my judgment, I don't
23 think it will have a significant variation. Plus
24 they're not relying primarily on just the friction
25 alone, as I mentioned. They have a large frontal area

1 that's embedded --

2 DR. WALLIS: So it has to sort of move a

3 whole lot of soil.

4 MR. BRAVERMAN: Yes. It's not just

5 friction. It's all of the resisting --

6 (Simultaneous discussion.)

7 DR. WALLIS: That probably, that probably

8 does it. Yes, okay. Well --

9 CHAIRMAN CORRADINI: The applicant stated

10 in the response to RAI 3.8-96 that by roughening the

11 top surface of the mud mat concrete, friction

12 resistance is increased between the mud mat and base

13 mat, added troughs in the soil under the mud mat to

14 increase shear resistance.

15 DR. WALLIS: That's right.

16 CHAIRMAN CORRADINI: Is this a skill of

17 the CRHAV? Is there some kind of analysis that

18 relates this to whatever friction factor you assumed,

19 or is this just --

20 MR. NIOGI: The roughening of the concave

21 surface, you know, for every layer of concrete, it is

22 in the ACI (ph) code. It is accepted by the code, you

23 know. We are just honoring the code.

24 CHAIRMAN CORRADINI: How

25 MEMBER ABDEL-KHALIK: How do you relate to

1 the assumed friction factor?

2 MR. NIOGI: It is -- that code will tell

3 you that this is the number you can use, .7. We are

4 just using the applicable standard and the code used

5 to get this number. Coefficient of friction is always

6 experimental, and we come to the number that will be

7 more conservative.

8 MR. CHAKRABARTI: Yes, if I may explain.

9 What we have shown in the evaluation is slipping at

10 different interfaces. First is the mud mat and the

11 soil surface. The coefficient of friction assumed,

12 .7, is fairly high, and relies on shear failure of the

13 soil.

14 To ensure that the soil friction shear,

15 that's when the coefficient and then the mud mat was

16 introduced. So that the, really the soil will shear

17 before there is a tendency to slip at the interface.

18 That was the basis for the coefficient.

19 And al so, we are pouring foundation

20 concrete about the base mud mat, and this -- all

21 concrete and new concrete, what is the coefficient of

22 friction to assume between that? According to CIT-49,

23 it says it could go maximum .6 coefficient of friction

24 when you pour new concrete on old concrete.

25 But this coefficient of friction can go as

1 high as one, if the surface of the interface is
2 intentionally roughened. What is meant by
3 intentionally roughened is you roughen so that there
4 is at least quarter inch of depth of the roughening.
5 If you can ensure that, you can go to as high as one
6 as the coefficient of friction.
7 So we have gone for intentional roughening
8 and used .7 coefficient of friction.
9 CHAIRMAN CORRADINI: Thank you.
10 MEMBER KRESS: Educate me a little. I'm
11 not an expert in this area. It seems to me like all
12 the seismic forces are transferred from the soil to
13 the structures.
14 MR. CHAKRABARTI: Yes.
15 MEMBER KRESS: Now it's the structures
16 that you worry about, so if you want to lessen the
17 effect of th e seismic event on the structures, you
18 would like to have as much as sliding as you can --
19 (Simultaneous discussion.)
20 MEMBER KRESS: What you're doing is
21 increasing the forces?
22 MR. CHAKRABARTI: Yes, that's right. But
23 we have not performed our analysis --
24 (Simultaneous discussion.)
25 CHAIRMAN CORRADINI: My sense of it is

1 that's an innovative way that a conservative engineer
2 will not touch with a ten-foot pole.
3 MEMBER KRESS: Oh, you want to be? You
4 remember the Moten, I mean the liquid metal, the
5 breeder reactor --
6 CHAIRMAN CORRADINI: Yes, yes. The Clinch
7 River. Clinch River did that.
8 MEMBER KRESS: They did that. They did
9 that, yes.
10 MR. CHAKRABARTI: That's a new state of
11 the art thing that is coming up.
12 MEMBER KRESS: Yes.
13 MR. CHAKRABARTI: And base isolation is
14 being introduced in the design. But these are
15 conventional nuclear power plants.
16 MEMBER KRESS: This is the way -- so
17 you're being conservative by increasing the effects of
18 the --
19 MR. CHAKRABARTI: I understand. If it
20 slips, it cannot transfer the --
21 DR. WALLIS: Did you lubricate the molten
22 lead by putting water on it?
23 CHAIRMAN CORRADINI: They haven't had
24 Graham review it. They haven't.
25 (Simultaneous discussion.)

1 MR. BRAVERMAN: Excuse me, excuse me. I
2 just realized there was another consideration that may
3 answer your question about a dry soil or saturated
4 conditions, because really GE could have identified
5 any fee factor which determines the coefficient of
6 shear fail in the soil.
7 The reason for that is there's in Table 1,
8 Table 5, a requirement that at the site, the COLA has
9 to demonstrate that they satisfy this fee, equal, I
10 think, 30 or 35 degrees, which gives you a .7 value.
11 So that could be confirmed later on at the
12 site, to make sure the soil conditions, whatever it
13 is, saturated, dry, satisfies that minimum coefficient
14 of friction. So that's another check that can be done
15 down the road.
16 MR. CHAKRABARTI: Yes, and like during the
17 process of review, there have been many enhancements
18 to the DCD from the way it was originally submitted.
19 The status of the review. All issues
20 identified during the review have been resolved. The
21 PCCS, we still haven't had any issue with PCCS, but
22 this is being addressed in Section 6.2.2.
23 DR. WALLIS: It's actually in the SCR, is
24 that?
25 MR. CHAKRABARTI: In the SCR? No, we had

1 started discussing about the PCCS because it --
2 DR. WALLIS: But it disappeared. I
3 couldn't find it, a discussion later on.
4 MR. CHAKRABARTI: I think at the end of
5 RAI 3.8-117, we had introduced discussion of the PCCS.
6 But then we have referred it to Section 6.2.
7 DR. WALLIS: It seemed to be referred to
8 early on, and then it never appeared later on in
9 detail. But maybe I -- it was such a long document.
10 MR. CHAKRABARTI: I know. At the end of
11 RAI 117, we had discussed the issue of PCCS, because
12 we were reviewing at that time. But then we decided
13 it is better to address the issue under 6.2 and close
14 it.
15 DR. WALLIS: Oh, I see. Okay.
16 MR. CHAKRABARTI: So we moved it to 6.2.
17 DR. WALLIS: Oh, that's where you put it.
18 Okay, okay.
19 MR. CHAKRABARTI: Yes. The way I have
20 planned the presentation like, you know, last ACRS
21 presentation we had talked about a few issues relative
22 to various RAIs, and GEH, I think, did a good job in
23 talking about the same RAIs in this more bigger scope
24 of what the RAI was about.
25 All of these RAIs really started with many

1 questions, but I'll go over the issue that was open or
2 that were open during the last ACRS meeting, and
3 address those.
4 In 3.8-107, the issue that we had open on
5 this one during the last meeting was significant non-
6 linear behavior of the containment structure due to
7 thermal loading.
8 What we have noticed, that the thermal
9 stresses had caused significant cracking in the
10 concrete sections, and we had a notion that we are
11 using this cracked section analysis results and
12 superimposing them with the elastically computed
13 stressors from other mechanical loads.
14 Was it practical to do it, because all
15 those loads will be acting together and due to thermal
16 load cracking and the forces and moments we've
17 computed elastically, they'll be redistributed and
18 it's still okay.
19 GEH performed an analysis where they
20 considered in a sample case the mechanical loading,
21 also considered the non -linear behavior with cracked
22 sections, and they demonstrated that in the main
23 critical areas or in the majority of the areas, the
24 elastic analysis superimposition was still okay.
25 There were certain areas where the

1 resultant stresses were exceeded because of
2 redistribution, but those areas were located in areas
3 where stresses are not critical. Based on that, we
4 accepted the method of superimposing elastic analysis
5 results for mechanical loads with the non -linear
6 thermal results, and -- results.
7 In RAI 3.8-79, this was about the Seismic
8 Category 2 or non-seismic structure GEH described.
9 They're all designed to Category 1. During the last
10 ACRS meeting when we had, this was not involved at
11 that time because GEH was planning to design them to
12 meet the seismic criteria. But finally, we agreed
13 that to demonstrate there will not be any unacceptable
14 interaction.
15 DR. WALLIS: What kind of unacceptable
16 seismic interaction are you thinking about?
17 MR. CHAKRABARTI: If these Category 2
18 structures are not designed u sing the SSC or the
19 seismic forces, there are a few things. First of all,
20 the seismic input motion. If we do not follow the
21 Category 1 design, the seismic input motion can be
22 derived using other codes that may not be prevalent.
23 In the design approach, the Category 2
24 structures don't need to design, need to be designed
25 to remain stable or anything. As long as it does not

1 hit the other structure. By the seismic interaction,
2 we mean like if you have a non-Category 1 structure,
3 during a seismic event it collapses and hits the
4 Category 1 building.
5 DR. WALLIS: Okay.
6 MR. CHAKRABARTI: So if it his the
7 Category 1 building, it might be still okay. But we
8 have to --
9 DR. WALLIS: There's an impact --
10 MR. CHAKRABARTI: Impact, yes. We have to
11 take into consideration impact. It is more difficult
12 to analyze those for with an impact than are easier to
13 make sure they don't impact. That's what by
14 following, by following the design methodology in
15 which Category 2 structures will be designed, using
16 the same criteria used for Category 1 structures.
17 DR. WALLIS: So that they won't collapse.
18 MR. CHAKRABARTI: They won't collapse.
19 DR. WALLIS: You start thinking about what
20 happens if they actually collapse. That gets pretty
21 difficult.
22 MR. CHAKRABARTI: It gets pretty
23 difficult.
24 MEMBER KRESS: That raises another
25 question. These are all done for say a shut -down

1 earthquake.

2 MR. CHAKRABARTI: Yes.

3 MEMBER KRESS: Now if you're going to do a

4 PRA, you would look at earthquakes greater than that.

5 Did you look at what sort of earthquake might cause

6 one of these problems to collapse and give you an

7 issue? Did you look at the frequency of those?

8 MR. CHAKRABARTI: I'm not -- I did not

9 really go into the --

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

11 MR. CHAKRABARTI: Yes.

12 MEMBER STETKAR: They didn't do a seismic

13 PRA. They only did a seismic margins analysis, so

14 they don't' know.

15 MEMBER KRESS: So you wouldn't know that.

16 Okay. Thank you.

17 MR. CHAKRABARTI: So that's how we

18 resolved this. Then RAI 3.8 -94. There were many

19 issues in the original RAI that GEH went through, but

20 the issue that we had open with us in the last few

21 days, the bearing pressure demands concluded by GEH

22 appeared to be very high, and we had questions.

23 How are these high bearing pressure

24 demands going to be met? Like for medium soil, the

25 bearing pressure demand was calculated to almost 150

1 gifs (ph) per square feet, and we did not think that
2 it would have soil that could take that kind of
3 bearing pressure.
4 So we wanted t o see what was the reason
5 for this and how are you going to account for it, and
6 during our review, it was found that if bearing
7 pressure demands calculated by GEH were done very
8 conservatively, and in fact while we had accounted the
9 vertical loading multi ple times, and that's what
10 really led to that high bearing pressure.
11 Subsequently, GEH revised the analysis.
12 They used the SASSI result, results in computing the
13 bearing pressure, and the bearing pressures came down
14 significantly, like the value that wa s 150 gifs per
15 square feet were in the 50 gifs per square feet,
16 almost one-third, and those were the results.
17 In RAI 3.8 -96, this is all the sliding
18 evaluation and GEH was really having difficulty
19 demonstrating sliding stability. The basic reason for
20 this was the amendment of the structure, which really
21 was not considered, and it was attempted to
22 demonstrate sliding stability was in friction only.
23 That didn't work.
24 Then the amendment was considered and the
25 passive resistance of the soil was used for sliding

1 stability, but the embedded walls were not quite
2 designed for the passive resistance. Also, there are
3 many issues like at one time the correlation was
4 considered to resist sliding.
5 So we went over this, through many
6 iterations, and finally the method that GEH just
7 described, that is what we found and we were able to
8 demonstrate.
9 CHAIRMAN CORRADINI: So adding the wiggle
10 -- adding the corrugation and the key, the shear key -
11 -
12 MR. CHAKRABARTI: The shear keys were
13 going --
14 CHAIRMAN CORRADINI: Satisfied or gave you
15 confidence?
16 MR. CHAKRABARTI: In addition, we took the
17 passive resistance of the wall. Not full passive
18 resistance, but to the extent that it is needed to
19 demonstrate 1.1 factor of safety against sliding.
20 So with all these and considering friction
21 on the side walls, GEH was able to demonstrate sliding
22 stability. All of the calculation was done using the
23 time history, like the sliding stability was
24 calculated for each time stake. I mean you could not
25 qualify it.

1 MEMBER ARMI JO: You say that the
2 foundation walls weren't designed for full passive
3 soil pressure. To resolve this problem, were the
4 foundation walls thicker or --
5 MR. CHAKRABARTI: Yes. Reinforcement had
6 to be increased.
7 MEMBER ARMIJO: Okay.
8 MR. CHAKRABARTI: Yes. I don't think we
9 meant the walls taken out.
10 (Simultaneous discussion.)
11 MEMBER ARMIJO: Can I hear that from GEH?
12 MR. CHAKRABARTI: Yes.
13 MR. NIOGI: Thickness of the wall was not
14 changed. We increased the reinforcement.
15 MR. CHAKRABARTI: Yes.
16 MEMBER ARMIJO: Okay.
17 DR. WALLIS: What kind of analysis did
18 they do to show that it is acceptable? Was it
19 computer analysis of some sort? How do all these
20 wiggles and roughnesses and you can use whatever you
21 called them? What sort of analysi s was done? Was
22 this some kind of a computer that analyzes how the
23 soil responds?
24 MR. CHAKRABARTI: I do not believe it was
25 done, based on practically, but Sujit may be able to

1 explain on that.

2 MR. NIOGI: Well, we didn't do any

3 calculation that is a practical application, and for

4 roughening the surface of the concrete, it's bar code

5 SCR Code 249, which will allow you to do that. But

6 roughening of that would be -- introducing the trough

7 in the soil is more like practicing --. We didn't do

8 that. The re's no calculation. There is no

9 calculation.

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

11

12 MR. NIOGI: No.

13 DR. WALLIS: I just wondered how you

14 figure out that it works?

15 MR. CHAKRABARTI: I don't know if you have

16 established the details of that one.

17 MR. NIOGI: We have not done that.

18 MR. CHAKRABARTI: Well, that can be done

19 really. What can be done, like you design the trough

20 spacing so that if you push against the passive

21 resistance of each segment, and also calculate the

22 shear failure for that portion --

23 DR. WALLIS: Determine how it fails?

24 MR. CHAKRABARTI: I mean how it fails. So

25 the feet can be decided.

1 DR. WALLIS: And then this is a hand
2 calculation?
3 MR. CHAKRABARTI: By hand calculation you
4 can do it, yes.
5 DR. WALLIS: And you've reviewed all that?
6 MR. CHAKRABARTI: The details of the
7 trough has not been established.
8 MR. BRAVERMAN: Samir, this is Joe
9 Braverman. To a large extent, I think we relied,
10 though, on the shear keys around the periphery of the
11 foundation, because if the shear keys are low enough,
12 that will lock in the section of soil underneath the
13 base mats.
14 So the effectiveness of that roughening is
15 really kind of secondary. All that ensures the
16 roughening of the shear keys is that failure plane
17 will, if it d oes occur, will occur below the shear
18 keys.
19 DR. WALLIS: So you consider that the keys
20 just move the whole soil with them?
21 MR. BRAVERMAN: Exactly.
22 DR. WALLIS: And then the shear that fails
23 is below that level?
24 MR. BRAVERMAN: Exactly.
25 DR. WALLIS: And that's just a simple hand

1 calculation?

2 MR. BRAVERMAN: Yes, because one can

3 calculate the resistant force achievable from the

4 shear failure of the soil. As mentioned before,

5 that's tan of fee (ph), where fee, you know, will be

6 verified by the COLA to achieve a .7 value.

7 MR. CHAKRABARTI: I think it can be done.

8 CHAIRMAN CORRADINI: You can go ahead, if

9 you'd like.

10 MR. CHAKRABARTI: Okay. Next is 3.8 -120.

11 The only issue we had open on this, I mean we talked

12 about 120, the use of that ma terial in the FSC wall

13 and everything.

14 At the time of the last meeting, we had

15 resolved all that, but only open issue was it was also

16 used in containment liner, and it was not an approved

17 material for ASME code. But since then, ASME has

18 approved it, and the issue was closed.

19 MEMBER ARMIJO: What was their main reason

20 for using a higher strength material for the liner?

21 MR. CHAKRABARTI: For the liner, you

22 probably --

23 MEMBER ARMIJO: A-709.

24 MR. CHAKRABARTI: Yes, it was -- as I

25 remember, it was used for attachment of the structural

1 beams and stuff.

2 MR. NIOGI: Right. This is Sujit Niogi

3 again. Those structural beams are attached to this

4 thick plate, and that's transferring the forces and

5 moments to the wall. So we have to use a thicker

6 plate as an embedment, and then on the top of that, we

7 have the buttering, which is stainless steel liner on

8 the -- surface.

9 So we need to have this higher strength

10 code, and also weldability. 207 is weldability. We

11 don't need to do any pre-heat treatment, you know. So

12 we, that is the best material we found. It certainly

13 will --

14 MR. CHAKRABARTI: And on the liner on 1380

15 --

16 MR. NIOGI: Only the inside the areas

17 where --

18 MR. CHAKRABARTI: Where there are

19 attachments?

20 MR. NIOGI: Exactly, where you h ave the

21 attachments, yes.

22 MR. CHAKRABARTI: And then 3.8 -125. I

23 think we already went over these, and basically where

24 we were trying to look at, because what we got from

25 the analysis is the fuel racks were anchored, and the

1 design was changed to a free-standing. So we wanted
2 to see how it affects this design. GEH demonstrated
3 that from the analysis of the spent fuel racks, the
4 dispersements and all --
5 DR. WALLIS: They're free -standing? That
6 means they just sit there? They aren't attached?
7 MR. CHAKRABARTI: Yes.
8 DR. WALLIS: So they're very free to move
9 around.
10 MR. CHAKRABARTI: Very free to move
11 around, and they ran the analysis of the fuel racks,
12 and determined the maximum dispersements that it can
13 have. Accordingly, we made sure the base plates on
14 which these legs are standing, they're big enough so
15 that it will not roll over into the containment liner
16 area, and also it does not hit the spent fuel pool
17 wall. So that was our main concern --
18 DR. WALLIS: Would you remember the actual
19 numbers for the displacement?
20 MR. CHAKRABARTI: I remember for the base
21 plates, we had at least one inch margin beyond the
22 maximum sliding, and I can't vouch, but I think for
23 the side walls also we had similar margin, whatever is
24 the maximum calculated, a bolt in each wall. Misty
25 will confirm. I think GEH has an action to get back

1 to you with those numbers.

2 MR. BRAVERMAN: I'd like to address a

3 little, because a question arose a number of times

4 about sliding. It's not as if the racks are in air,

5 where they would likely slide a lot. They're in

6 water, and if you have a very deep glass, the bottom

7 portion of the water's not going to allow the racks to

8 move too much, because it would have to push and

9 displace the water a lot.

10 DR. WALLIS: This is the add ed mass

11 effect?

12 MR. BRAVERMAN: Yes.

13 DR. WALLIS: The concern I had with the

14 PCCS was I didn't see a correct treatment of the added

15 mass as being a relative motion between the structure

16 and the water. They just seemed to add some mass to

17 the structure, which is not the way to do it.

18 MR. BRAVERMAN: We were involved to some

19 extent a while back regarding the PCCS analysis, and

20 my recollection, I believe, they made a finite element

21 model at that time. It's an older analysis, and they

22 added water as added mass to the finite element model,

23 the PCCS, and that is an industry-accepted methodology

24 to estimate the --

25 (Simultaneous discussion.)

1 DR. WALLIS: --just add mass to the solid.
2 As you were saying, the water actually helps to
3 restrain. It's a re lative motion between the
4 structure and the water that matters.
5 MR. BRAVERMAN: Yes, but the difference is
6 in the fuel racks, it's free to move, so you get the
7 structure-fluid interaction.
8 DR. WALLIS: Right.
9 MR. BRAVERMAN: In the case of the PCCS
10 that's anchored. It's restrained.
11 DR. WALLIS: Right, but it still wiggles.
12 MR. BRAVERMAN: Well, that's where the
13 added mass --- there have been tests done that when
14 you have a rod vibrating in air, versus a rod
15 vibrating in water, they would vibrate an equivalent
16 amount if you add this much mass to it.
17 DR. WALLIS: It's in an infinite pool.
18 But if you have walls and stuff, it gets more
19 complicated, because the waters restrain.
20 MR. BRAVERMAN: Yes.
21 DR. WALLIS: So anyway.
22 MEMBER ABDEL-KHALIK: Is this statement
23 correct, that the spent fuel pool concrete floor is 5-
24 1/2 meters thick?
25 MR. NIOGI: Yes.

1 MEMBER ABDEL-KHALIK: It is?

2 MR. DEAVER: This is Jerry Deaver with

3 GEH. I have the dimensional information on the gaps,

4 if you would like to get that.

5 CHAIRMAN CORRADINI: Yes. This is a good

6 time for it.

7 MR. DEAVER: Okay. We have the two

8 directions. One direction we have -- in the north -

9 south direction, we have full racks all the way

10 across, and the gap between the rack to the wall is 92

11 millimeters initially, as a minimum. And then after

12 seismic and thermal expansion, which aren't likely to

13 occur at the same time, we have a minimum gap of 47.5

14 millimeters.

15 DR. WALLIS: Is it bigger?

16 MR. DEAVER: Pardon me?

17 DR. WALLIS: Bigger than it was before?

18 MR. DEAVER: No. It started with 92.

19 CHAIRMAN CORRADINI: 92 to 47.

20 DR. WALLIS: Oh, I'm sorry. I misheard

21 you. Thank you.

22 MR. DEAVER: Okay, and then in the east-

23 west direction, where we have latitude deceptive

24 dimension, because we have a lot of empty space in the

25 other end of the rack or the pool, the initial gap is

1 60 millimeters and the minimum gap is 8.4 millimeters.
2 That's with seismic and thermal.
3 DR. WALLIS: That's the closer one, yes.
4 MR. DEAVER: Pardon me?
5 DR. WALLIS: That's the closer one.
6 MR. DEAVER: That's the closer one, but
7 remember, for a different meeting where we were here,
8 they have total freedom to put that anywhere they
9 want, because that's the reason where they've got the
10 open area. Remember the open area, FLUENT calculation
11 from a couple of meetings ago?
12 DR. WALLIS: I guess yes. There's a big
13 open area.
14 MR. DEAVER: There's a big open area.
15 DR. WALLIS: And a strange FLUENT
16 calculation, I must say, yes.
17 MR. DEAVER: Not strange, just not as
18 well- described as one would like. That's my
19 characterization.
20 MEMBER ARMIJO: That's not much left to
21 the six millimeters or nine millimeters. It's not
22 much --
23 MR. DEAVER: 8.4, but --
24 MEMBER ARMIJO: Sounds like this --
25 MR. DEAVER: --without the thermal

1 expansions, it's 12 millimeters, so we could set that
2 as larger, based on as-builts when we actually --
3 MEMBER ARMIJO: So that's your worse case?
4 MR. DEAVER: Right. This is worse case,
5 minimum dimensions.
6 MR. CHAKRABARTI: Okay. So that's how we
7 have closed all our open issues, and if there are any
8 other questions for us?
9 CHAIRMAN CORRADINI: None?
10 (No response.)
11 CHAIRMAN CORRADINI: Okay. Thank you very
12 much. I think we want to continue now with Section
13 3.9, and no w GEH is going to come back up to talk
14 about 3.9, is that correct?
15 (Off mic discussions.)
16 Chapter 3 - Section 3.9 RAIs/GEH
17 MR. DEAVER: Okay. I will continue with
18 Section 3.9, Mr. Jerry Deaver, GE -Hitachi. I'd like
19 to go to the next slide. There were several open
20 items, open issues in this section, but we're going to
21 cover five of the more significant items that were
22 resolved.
23 So going to the next slide, 3.9-75. There
24 was an open issue related to the reactor internal
25 classification with respect to Reg Guide 1.20, and

1 there was some confusion about prototype versus non-
2 prototype.
3 We initially were classifying ESBWR as a
4 non-prototype, because there were a lot of
5 similarities with the ABWR plant, although we
6 recognized that the chimney and the st and-by liquid
7 control line were new components.
8 So we were kind of mixing up the situation
9 by classifying them as prototypes, but the others, all
10 the other traditional components we were saying were
11 non-prototype. That was very confusing to the staff,
12 and so we ultimately agreed that it would be best to
13 classify the initial reactor, ESBWR reactor internals
14 as prototype, and then the subsequent reactor vessels
15 and internals would be classified as non-prototype.
16 So we had clarified that in the DCD and in
17 the LTR that we have on reactor internals. So, okay.
18 Going to the next issue, 3.9 -96, this
19 question had a lot of different aspects to it. This
20 was asked at a time when we were still talking about
21 prototype and non -prototypes, and we were relying on
22 ABWR data in some areas, particularly the bottom head
23 area, as to why we didn't need to have
24 instrumentation.
25 But ultimately, we agreed to the prototype

1 classification, and we provided in our response a
2 complete description of the reactor internal vibration
3 program, and identified the number and location of
4 sensors that would be used.
5 We have 46 separate sensors in the
6 program. Many of them are related to the steam dryer.
7 But we also have sensors that are on the steam
8 separators, the chimney, the shroud and on the stand-
9 by liquid control line. So we have a comprehensive
10 program that includes accelerometers, pressure
11 transducers and strain gauges to -- in key positions,
12 to obtain the vibration data.
13 DR. WALLIS: This is a kind of full-scale
14 experiment really?
15 MR. DEAVER: Well largely what we're doing
16 is a confirmatory thing. We've analyzed all the --
17 MEMBER ARMIJO: For your first of a kind
18 start-up?
19 MR. DEAVER: This is typical for Reg Guide
20 120. It's a confirmatory --
21 DR. WALLIS: But you have certainly
22 analyses.
23 MR. DEAVER: Yes, and we have to meet the
24 criteria when we take the data --
25 CHAIRMAN CORRADINI: I think, if you

1 remember, this was the analysis where we were asking
2 questions relative to the difference in the structure,
3 and then they agreed to do this to their --
4 MR. DEAVER: Okay, and we've described the
5 methodology, you know, once we get the data, how we're
6 going to process that data and evaluate it against the
7 limits that have been established, and we've justified
8 the components that will need instrumentation.
9 Some of it's confirmatory. We really
10 established the program based on risk base, you know,
11 where we've had problems before. But also for new
12 components that we haven't had experience with, then
13 we need new data to substantiate that they're going to
14 be acceptable.
15 So we've completed our description of the
16 program, and NRC has a good understanding of what that
17 is now.
18 Okay. Going on to 3.9 -81, this question
19 relates to the postulated break in the steam line and
20 feed water lines, and is there any dynamic
21 amplification of loads in the reactor internal core
22 structure components, core support structures?
23 The components that are -- the core
24 structure components that hold the fuel are the CRD
25 housings and the control rod guide tubes in the

1 vertical direction, and these are modeled as axial
2 beam elements, and they represent the assembly of the
3 control rod housing and the guide tube in the vertical
4 direction in this primary structural model.
5 From that model, we find that in the
6 vertical direction, there's no frequencies,
7 fundamental frequencies below 105.4 hertz, and the
8 associated loads from a main steam line and feed water
9 break do not provide any extra type excitation on
10 those components.
11 So we -- so that actually demonstrated
12 that no amplification would occur on these vertical --
13 DR. WALLIS: How do you predict the
14 unsteady pressures in the break, when a break flow
15 comes out? I mean we talked about this. You're going
16 to do a fluid analysis of the jets that impinge on
17 things --
18 MR. DEAVER: That's external, yes.
19 DR. WALLIS: And they had fluctuating
20 pressures in them, don't they, which presumably would
21 be available to excite what you're talking about here,
22 by working back through the system. Or would they
23 not?
24 MR. DEAVER: Well, the actual blowdown
25 phenomena, which I think Wayne understands a bit

1 better than me.

2 (Simultaneous discussion.)

3 DR. WALLIS: Which they can't transfer

4 back, because the mark number is bigger that one?

5 MR. MARQUINO: It's chok ed, right. It's

6 choked at the nozzle and the fluctuating pressure is

7 due to the vortices, I believe --

8 DR. WALLIS: Outside. They're all

9 outside.

10 MR. MARQUINO: --in the discharge side.

11 DR. WALLIS: There's no way they can

12 transfer back to the interior?

13 MEMBER KRESS: So the interior effect is

14 just the increased flow?

15 MR. DEAVER: Right. You're going to have

16 the initial flow and then it's going to gradually

17 decay down. So it's going to be a more stable

18 blowdown phenomena inside the vessel, because of the

19 large volume that's in there.

20 Okay. So we revised the DCD to address

21 this issue, and so we're confident that we've handled

22 the loads properly.

23 Okay, moving on to 3.9 -177, at one point

24 we had a COL item listed in 3.9, which required that

25 the ASME code design specs and design reports be made

1 available for the NRC staff to audit.

2 Actually, the ASME code requires that

3 these documents be made available at the site, that

4 when the ship the components to the site, that these

5 documents are required to be on site and available.

6 But we felt like with the ITAAC

7 requirements that we were putting in Tier 1, that it

8 was not necessary to have the COL item as a separate

9 commitment by the applicant, because we already had it

10 covered by an ITAAC in T ier 1, which, like I

11 mentioned, ASME requires that reports be made

12 available anyway.

13 The second part to it that gave the staff

14 confidence that we were capable of preparing design

15 specs, they had an audit where we prepared design

16 specifications for the ma jor reactor internals, the

17 vessel, other ASME components including valves, and

18 the RTNSS -type or items that were considered risk -

19 significant.

20 So we had five binders' worth of

21 documentation that we prepared, and so they came and

22 audited those documents. There, we demonstrated that

23 we covered all the requirements that would be required

24 in a design spec. So we demonstrated our capability

25 and largely have most of the design specs that are

1 required for ASME components.

2 Okay. The last issue is 3.9 -254, an d

3 related was 255. These dealt with the qualification

4 of piping programs for piping analysis. We have the

5 PISYS and ANSI -7 programs that are the computer

6 programs that we use, and there was some confusion

7 over Reg Guide 192, Rev. 1 versus Rev. 2.

8 When we benchmarked the programs, we used

9 Reg Guide 192 Rev. 1, because it -- associated with

10 the Reg Guide is a NUREG 6049, which is has the cases

11 that we've benchmarked previously to, and so we found

12 it more convenient to use that benchmark case.

13 If we were to use the Reg Guide 192 Rev.

14 2, we would have had to benchmark against alternate

15 pipe cases that we hadn't established previously.

16 So we found it more convenient to work the

17 Rev. 1, and in fact Reg Guide 192 Rev. 2 actually

18 allows you to use Rev. 1 , and the way we're using the

19 Reg Guide 192 Rev. 1 fully complies with the --

20 what's, you know, stipulated by Rev. 2.

21 So in the process, we have an

22 understanding now that the qualification that we ran

23 is acceptable. We also included environmental effects

24 caused by or on fatigue, as stipulated by Reg. Guide

25 1.207. These were fully incorporated into ANSI-7.

1 We had an audit of both of these programs,
2 and during the audit, there was one comment made
3 regarding the methodology of how to establish the
4 temperature coefficient, which we subsequently
5 resolved. So the final audit of the computer programs
6 have now been completed.
7 Also what was required by the NRC was we
8 had to accomplish a Level 2 status on the programs.
9 Previous to this, we had Level 2, but it was the prior
10 versions that, you know, were not applicable for
11 ESBWR.
12 So the Level 2 now makes it possible for
13 us to run the analysis without doing alternate
14 calculations and so forth. So those have been fully
15 demonstrated, fully documented at this t ime, so we're
16 ready tod o analysis.
17 So in summary, we've demonstrated that we
18 have a comprehensive vibration program for the reactor
19 internals, and fully defined for the first prototype
20 plan. And then we've also been able to demonstrate
21 our capability t o prepare and do ASME code
22 documentation and define requirements.
23 So that's all I have today. If you have
24 any questions.
25 CHAIRMAN CORRADINI: So the only committee

1 I have on the left side, so go ahead.

2 MEMBER STETKAR: Yes. In August, when we

3 were talking about tech specs, I asked about

4 functional testing of the squib valves, and I was

5 instructed to wait until we talked about Chapter 3.

6 So I waited. So now I'm going to ask about functional

7 testing of the squib valves.

8 MS. CUBBAGE: Excuse me, John. The staff

9 can't hear you.

10 MEMBER STETKAR: Oh, okay. Sorry.

11 CHAIRMAN CORRADINI: What did you say Amy?

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

13 back.

14 MEMBER STETKAR: Let me repeat. In

15 August, when we talked about technical specifications,

16 I asked about functional testing of squib valves. At

17 that time I was instructed to wait until we talked

18 about Chapter 3.

19 So I have patiently waited, and now we're

20 talking about Chapter 3. So now I'm going to ask

21 about functional testing of squib valves . in Table

22 3.9-8 of DCD Rev. 7, just to make sure we're on the

23 right revision, the technical specifications

24 explicitly state that the squib valves need not be

25 fired as part of the surveillance requirements.

1 The bases for the tech specs say that
2 "Operability of the squib valves is verified by
3 continuity tests and the in -service test program for
4 squib-actuated valves. The in -service testing
5 requirements in Table 3.9 -8 say that squib valves for
6 the SLC injection, GDCS injection, GDCS equalizing and
7 GDCS deluge squib valves, and the ICPCCS full crosstie
8 valves are fired and replaced per paragraph ISTC-
9 5260." Please tell me what that functional testing
10 does, and how frequently it's performed?
11 MR. DEAVER: Okay.
12 MEMBER STETKAR: I'm specifically
13 concerned also, because in the final draft, the draft
14 final SER, there was a staff concern about possible
15 external missile injection from -- ejection from squib
16 valves when they're fired, and in response to an RAI,
17 I think it was RAI, I don't have the number here.
18 I think it was 3.5 -6, but I'm not sure
19 about that, the staff's conclusion was "The staff
20 finds that these squib valves are actuated by the
21 booster assembly that causes an explosion inside the
22 valve assembly, and the explosive pressure is just
23 adequate to push the piston that opens the valve
24 outlet."
25 Now if the pressure is "just adequate," I

1 want to make sure that it's adequate. In order to
2 have the pressure adequate, I need to functionally
3 test those valves with design differential pressures
4 across those valves, and make sure they work.
5 MR. DEAVER: Yes.
6 MEMBER STETKAR: So that's another reason
7 for my question about how will they be functionally
8 tested and how frequently.
9 MR. DEAVER: Well, let me describe first
10 of all that squib valves are l argely a commodity that
11 isn't off the shelf at this point and has to be
12 developed. So we recognize that -- up front hat for
13 these different valves of different sizes and
14 different kind of arrangements, that we've got to
15 individual qualify, have our suppli ers qualify these
16 valves.
17 And not only the igniter, but the plunger
18 part that shears the cap, that then opens the valve
19 up. So --
20 MEMBER STETKAR: I understand the
21 qualification. It's the same thing we do with
22 qualifying motor -operated valves and air-operated
23 valves and pumps and pieces of pipe in hangars and all
24 that kind of stuff. But we also functionally test
25 motor-operated valves and air-operated valves and

1 pumps to make sure they operate under as-built, as-
2 installed, as-maintained, as-aged conditions.
3 MR. DEAVER: Right.
4 MEMBER STETKAR: So I'm asking about the
5 latter, not the former.
6 MR. DEAVER: Right. Well, what we're
7 planning to do, the igniters is the commodity that is
8 subject to shelf life and degradation over time. So
9 we have a program that every outage we go in and we
10 take out the igniter and replace it and test it.
11 MEMBER STETKAR: This would be like
12 removing the motor from a motor-operated valve and
13 putting it on a bench and make sure the motor works?
14 MR. DEAVER: It's really just the igniter
15 part.
16 MEMBER STETKAR: No, but I mean it's
17 logically equivalent to removing the motor from a
18 motor-operated valve, to make sure the motor works on
19 the bench, but you never know whether it will operate
20 the valves.
21 MR. DEAVER: So the plan is, on a
22 rotational basis, every outage, to remove certain
23 igniters, take them out --
24 MEMBER STETKAR: I understand that. I'm
25 asking about how and how frequently will you actually

1 explode a squib-operated valve under actual installed
2 differential pressure conditions, to have some
3 confidence that indeed the igniter will ignite, the
4 explosive will fire, the pin will shear and indeed the
5 valve will open? That's what I'm asking about.
6 MR. DEAVER: Okay. Well, our plan right
7 now is not to destructively test a valve.
8 MEMBER STETKAR: Ahh. That's the answer I
9 was hoping not to hear, but expecting to hear.
10 MR. DEAVER: Okay.
11 MEMBER ARMIJO: I think that's what --
12 MR. DEAVER: Can I ask --
13 MEMBER STETKAR: Because actually in this
14 table, I'm led to believe that it says "fired and" --
15 read the quote in the note here, so that I'm not
16 misquoting something.
17 MEMBER ARMIJO: It says "fired and
18 replaced."
19 MEMBER STETKAR: It says "fired and
20 replaced." It doesn't say igniter bench-tested. It
21 says the valve, "it applies to explosively-actuated
22 valves." It's Note X in the table, parenthesis
23 "(paragraph ISTC-5260)," and the frequency is Note E-
24 2. It says "fired and replaced" per paragraph ISTC-
25 5260.

1 Now I don't know what ISTC -5260 is, so
2 that's why I was curious what it tells me to do.
3 MR. DEAVER: I'm not familiar with that
4 code.
5 MEMBER STETKAR: Okay. Well since it's in
6 the table in DCD Rev. 7, and referenced as the only
7 reference that might pertain to any type of functional
8 testing, I'd be really curious what it is.
9 MR. SCARBROUGH: This is Tom Scarbrough
10 with the NRC staff. I heard your question, and you're
11 exactly right. ICC for squib valves in the ASME code
12 only deals with those initiators.
13 MEMBER STETKAR: Oh, is that right?
14 MR. SCARBROUGH: Yes. No effort to take
15 the valve out, and the reason is historically, squib
16 valves are these little things that we use in SLC
17 systems, S -L-C, and they have very little safety
18 significance. In the new plants, the new reactors,
19 it's much different.
20 MEMBER STETKAR: EPV valves are 13 inches,
21 I think, in diameters.
22 MR. SCARBROUGH: Yes. They're very large
23 and have very large diameters.
24 MEMBER STETKAR: GDCS valves are eight
25 inch, I think.

1 MR. DEAVER: Six inch.

2 MEMBER STETKAR: Six inch?

3 MR. DEAVER: But the throat part of BPVs

4 is about eight.

5 MEMBER STETKAR: Oh, about eight? Okay.

6 MR. SCARBROUGH: So one of the things that

7 we've been working with, because in this area the AP-

8 1000 reactor design is ahead of ESBWR, and we're

9 working with Westinghouse on their design. Because of

10 the increase in size, they've had to change the design

11 significantly for these things.

12 They've had a lot of challenges regarding

13 that. One of the areas that we've been dealing with

14 is how are you goi ng to monitor these now very

15 important valves during surveillance? So the ASME

16 code, we've already talked to ASME about the OM code

17 is inadequate in this area.

18 So what we've done is we recognize that

19 because of the early design phase, and when we audited

20 GEH, we did talk to them about their squib valves, and

21 they indicated the design is still on the table. They

22 really haven't decided what design they're going to go

23 with yet.

24 CHAIRMAN CORRADINI: What does that mean,

25 just so I understand what you mean by "on the table"?

1 You mean they have various possibilities?

2 MR. SCARBROUGH: Yes. They've talked

3 about the various ones. They're sort of monitoring

4 what AP 1000 is doing, and there's a lot of work going

5 on in that area. So they're sort of following that

6 process and seeing where that leads. Because there's

7 a couple of different designs being used by AP 1000.

8 So what we did in the SER for the ESBWR is

9 we indicated that the fact that this, the AS -OM code

10 only really focuses on the initiators, and it's the CO

11 applicant will need to be -- will be responsible for

12 establishing appropriate surveillance activities for

13 the squib valves.

14 MEMBER STETKAR: Yes. I noted that. It

15 says "appropriate surveillance activities." It

16 doesn't say "functional testing," though. So --

17 MR. SCARBROUGH: Yes, because we're not

18 quite sure, to take these large valves out and fire

19 them, it would be very difficult. There's a lot of

20 possibilities going on for much more specific detailed

21 in-service monitoring, where you monitor the internals

22 of the piston rod and different aspects of the

23 internals of the squib valve, to make sure that it's

24 functionally intact and ready to fire.

25 MEMBER STETKAR: I guess my concern is

1 that they are new valves, and if indeed there is some
2 very careful design, as implied by the pressure as
3 "just adequate" to break the piston loose, given our
4 experience with, you know, 20 years of problems with
5 things like motor-operated valves not being properly
6 sized, designed and maintained for in-service
7 conditions for differential pressures, discoveries
8 that we really needed to completely re-look at not
9 only the design criteria but how we test those valves,
10 to make sure that they're going to work, that's sort
11 of the genesis of my concern here.
12 MR. SCARBROUGH: Yes, and we're following
13 the AP-1000. We're attending their design review
14 meetings. We're watching -- we watched their blowdown
15 test that they just did recently on their prototype.
16 So we're monitoring what they're doing with those, and
17 we recognize exactly where you're coming from, because
18 they're following the QME-1007 approach for these
19 qualifications.
20 They know they have to demonstrate that
21 these valves are very reliable, and then after that,
22 they're also working with the United Kingdom, because
23 that's part of the process there, in terms of making
24 sure that the surveillance process for these is
25 adequate.

1 Until they really finalize the design,
2 they won't really know exactly the right way to be
3 able to monitor them.
4 MEMBER STETKAR: Until they fail.
5 MR. SCARBROUGH: But it definitely is
6 something that is going to be followed very closely by
7 the staff.
8 CHAIRMAN CORRADINI: So can I say it back
9 to you a different way, just so I'm -- because I'm,
10 I'm listening. I was expecting him to ask the
11 question, just not now.
12 (Laughter.)
13 CHAIRMAN CORRADINI: Eventually, this
14 question today, under Chapter 3. So what I hear you
15 say is because these designs are paper designs and
16 small valves have been produced, manufactured, tested,
17 and large valves a re still in the process of being
18 precisely designed and tested, you're leaving it to
19 the COL applicant to demonstrate, besides the firing
20 off-line, as Jerry was explaining to John per the
21 current code, you're expecting the COL applicant at
22 this point to ta ke on the responsibility to prove it
23 for that design under those conditions?
24 MR. SCARBROUGH: Yes sir, because really
25 the operating program is the COL applicant's

1 responsibility. The design certification applicant,
2 they include a lot of information that the CO
3 applicant incorporates by reference in their FSAR.
4 But the responsibility lies with the CO applicant.
5 CHAIRMAN CORRADINI: Okay, right. So
6 that's Clarification 1. Clarification 2 is to me,
7 let's say that the COL applicant decides to want to do
8 what he calls functional testing on site. Is there a
9 valve line that one can do that with this design?
10 MR. SCARBROUGH: If I understand it, your
11 question was okay, I have a COL applicant. They're a
12 relatively conservative bunch. They want to do it
13 every once in a while on site, in location, and then
14 replace all the --
15 CHAIRMAN CORRADINI: --guts of it, once
16 they successfully do it. Is that possible, by the
17 design as we have it?
18 MR. BEARD: Alan Beard with GE -Hitachi,
19 and Jerry, correct me if I get this wrong. But we do
20 include provisions in the design of the pipes that
21 house these valves, such that we could establish the
22 necessary differential pressure across them using test
23 type of set-up. We could fire those and we could go
24 in and replace th e internals to that valve with the
25 parts that have been --

1 CHAIRMAN CORRADINI: Okay, and then re -
2 establish it online. Okay.
3 MR. BEARD: I don't remember. I think
4 there is. There are tabs when you get differences in
5 pressures.
6 MEMBER STETKAR: Th ere are test
7 connections, there are isolation valves that you can
8 close, that you can --
9 CHAIRMAN CORRADINI: Okay. I just didn't
10 know, because I think -- I mean my point is that this
11 is a generic question that has popped up here. I
12 haven't looked bac k in AP -1000. I'm sure those
13 previous members of ACRS that were excellently asking
14 questions at the time asked the same sort of
15 questions, because I would expect this is a generic
16 thing with all of these plants.
17 And now it just -- this is since we have
18 GE folks here that might remember the ABWR, aren't
19 there large DPVs in the ABWR design also?
20 MR. MARQUINO: No. The answer to that is
21 no, there are no DPVs in the ABWR.
22 (Simultaneous discussion.)
23 MEMBER STETKAR: One other observation I
24 want to make is --
25 MEMBER ARMIJO: But smaller.

1 MR. DEAVER: In the SLC, yes.

2 MEMBER ARMIJO: Only in the SLC?

3 CHAIRMAN CORRADINI: They're more of the

4 standard SLC squib valve.

5 MEMBER STETKAR: Well, that's what I was

6 trying to understand.

7 MR. DEAVER: Right. One thing I wanted to

8 clarify is that we did qualify or test the DPV valve

9 in the early 90's. We had a test program where we

10 actually built the valve and tested it. So we have

11 that.

12 MEMBER STETKAR: No that I understood, and

13 the DPV valve design hasn't changed?

14 MR. DEAVER: No.

15 MEMBER STETKAR: The squib valves, we used

16 to have drawings of the squib valves in an earlier

17 version from GE.

18 CHAIRMAN CORRADINI: I was waiting for you

19 to say this.

20 MEMBER STETKAR: --and we don't have those

21 anymore. So the squib valves are right at the moment

22 basically unknown.

23 MS. CUBBAGE: What do you mean by "the

24 squib valves"?

25 MEMBER ARMIJO: Is it a design requirement

1 for these valves, that they testable and repairable?
2 I guess replace the internal s, or is this just
3 impractical?
4 MR. DEAVER: Well, I mean they could be
5 physically removed and taken into a test assembly or,
6 you know, and tested or I guess my perspective is that
7 the plunger, the piston that comes in and shears, all
8 of that is all mechanical, you know. It's related to
9 material properties, degradation.
10 MEMBER STETKAR: It happened in an
11 accident this summer.
12 MR. DEAVER: Really, we're going to use
13 corrosion-resistant materials. So largely it's a
14 mechanical function that, you know, if we share it and
15 says "yes, it broke." But that's fine. We know that
16 one broke, but what about the new one coming out?
17 MEMBER ARMIJO: So your argument is that
18 just testing the detonators or whatever these things
19 are called, the charges would be sufficient to ensure
20 that these things will work, in addition to the
21 qualification --
22 MR. DEAVER: I guess the point I'm trying
23 to make is that if you get, establish a load from the
24 igniter, then the mechanical parts are going to
25 function properly.

1 CHAIRMAN CORRADINI: But I think where
2 we're coming, where he's coming from, it's his issue,
3 but I sense where he's coming from is when you put
4 this sort of thing into play, there are examples in
5 analogous industries where these things didn't work.
6 MR. DEAVER: Well, they were a little more
7 complicated, the motor-operated valves.
8 CHAIRMAN CORRADINI: Granted, but I guess
9 my only point is under actual pressure conditions, I
10 think, is that where he's coming from.
11 MEMBER STETKAR: I mean we've had problems
12 with simple solenoid -operated valves that haven't
13 worked, you know. Plungers, you know, are -- they can
14 get minor corrosion, they can get minor deposits,
15 they can get, you know. You don't know what's going
16 to happen.
17 MEMBER KRESS: A little philosophy here.
18 To me, to test one of these valves say in place, or to
19 even take it out and test it in little bits, is a
20 useless test, because the replacement --
21 CHAIRMAN CORRADINI: Useless or useful?
22 MEMBER KRESS: Useless. The replacement,
23 you don't know wheth er it's going to work or not,
24 because that one doesn't tell you anything. What is
25 needed --

1 (Simultaneous discussion.)

2 MEMBER KRESS: In my mind, excuse me, what

3 is needed is a bunch of tests offline and under the

4 right conditions, to give you some re liability for a

5 fleet of these, and use that reliability to make a

6 judgment on how good they're going to work.

7 CHAIRMAN CORRADINI: So your argument,

8 though, would be that would be the qualification test

9 program, once they pick a design. That's your point?

10 MEMBER KRESS: That's right. That's my

11 point, exactly. Whereas to test them online is just -

12 - other than the igniters, I think that's worthwhile

13 and but I think it's a useless test otherwise, to

14 actually test the whole valve.

15 MEMBER ARMIJO: I th ink his issue is

16 really on aging effects. A new valve is likely to

17 work, but you know, if they've been in-service for a

18 long time, is there other things that might happen --

19 MEMBER KRESS: You might be able to spec

20 for aging effects. I don't know.

21 MEMBER ARMIJO: Yes. Other things that

22 happen that will make the valve jam, you know. The

23 powder blows, the thing breaks, but some --

24 MEMBER KRESS: Well, you might be able to

25 make that part of your offline qualification test.

1 MEMBER ARMIJO: Yes. That's where I would
2 do it.
3 MEMBER STETKAR: The only problem about
4 qualification testing for data is the predicted
5 reliability of these things --
6 MEMBER KRESS: You have to have a lot of
7 data.
8 MEMBER STETKAR: You have to destroy so
9 many valves that --
10 MEMBER KRESS: You have to have a lot to
11 do that. Yes, that's -- that is the --
12 MEMBER STETKAR: The first ones are going
13 to cost you an awful lot of money.
14 MEMBER KRESS: I agree with that.
15 MEMBER STETKAR: That's the problem. The
16 *in situ* testing or the not necessarily *in situ* if you
17 take it out and have an appropriate test bed.
18 Absolutely doesn't tell you anything about
19 the valve, the new valve being installed. However, it
20 does at least give you some level of confidence about
21 if it works, i t doesn't tell you anything. But it
22 gives you a bit of confidence.
23 If it doesn't work --
24 MEMBER KRESS: This year.
25 MEMBER STETKAR: It gives you a lot of

1 information.

2 DR. WALLIS: Well, isn't one way to ensure

3 that it's more likely to work to have a margin in this

4 pressure, so that --

5 MEMBER STETKAR: Well, that's -- and I

6 don't know. I think this is probably a staff

7 paraphrase, because they're trying to justify the fact

8 that there's no concern for external missiles. But it

9 tells me that apparent ly it's some, you know,

10 obviously it's some sort of design charge.

11 Looking at the design of, I think it's the

12 DPV valves, that you basically blow something that

13 shears something --

14 (Simultaneous discussion.)

15 MEMBER STETKAR: Well then it flops over,

16 kind of like a check valve, and most of the time check

17 valves work, and sometimes they don't. Sometimes they

18 bind up because the flopper thing kind of binds up.

19 MR. DEAVER: Yes, it's mainly the shearing

20 effect that's going to make it work or not. The flop-

21 over part is not that --

22 MEMBER STETKAR: The earlier design of the

23 GDCS valves was a very different valve, because they

24 had a more -- it was a piston driven down into a

25 little well or something like that.

1 MR. DEAVER: Yes. That's a case where the
2 pressure is from one side but the flow has got to come
3 in a different direction. We recognize that that's a
4 different-type valve.
5 MEMBER STETKAR: So I think staff at least
6 answered -- you know, I understand the current
7 situation, which is what I didn 't understand in
8 August. So --
9 MR. DEAVER: Okay.
10 CHAIRMAN CORRADINI: Questions.
11 Additional questions for Jerry?
12 MEMBER ARMIJO: Just one last thing. Is
13 GEH going to pursue the development of these valves
14 with some suppliers?
15 MR. DEAVER: Oh yes.
16 MEMBER ARMIJO: It's not the COL?
17 MR. DEAVER: No, no. We will supply this
18 equipment and we'll fully --
19 MEMBER ARMIJO: And you'll work with your
20 valve suppliers to qualify and do all the testing?
21 MR. DEAVER: Right, right.
22 MEMBER ARMIJO: Bu t it's your current
23 intent not to do destructive testing online on the --?
24 MR. DEAVER: That's true, right. Yes, we
25 have there suppliers that we're currently working with

1 or discussing test programs and such. Okay.

2 CHAIRMAN CORRADINI: Other questions for

3 Jerry?

4 (No response.)

5 CHAIRMAN CORRADINI: Okay, thank you.

6 Right. So at this point we're going to take a break

7 until 10:30.

8 (Whereupon, a short recess was taken.)

9 CHAIRMAN CORRADINI: All right. Let's get

10 started. David, you're up.

11 Chapter 3 - Section 3.9 RAIs/Staff

12 MR. MISENHIMER: Okay. I'll have my

13 presenters get up here. My name's Dave Misenhimer.

14 Again, I'm the Chapter PM for Chapter 3. We have two

15 folks that are going to do the presentations this

16 morning on Section 3.9, Yuke n Wong and Tuan Le, and

17 Yuken will start out.

18 MR. WONG: My name is Yuken Wong from NRO

19 Division of Engineering, Engineering Mechanics Branch

20 II. I'm going to talk about the review of open items

21 in Section 392, dynamic system analysis and testing of

22 system component structures.

23 For Section 392.4, pre -operational flow

24 induced vibration testing of reactor internals, the

25 regulations and regulatory guidance are GDC -104,

1 Regulatory Guide 1.20 and SRP Section 392 and 392.
2 Reg Guide 1.20 is related to the re actor internals
3 comprehensive vibration assessment program.
4 In RAI 3.9 -75, the staff asked the
5 applicant to clarify the use of both terms "prototype"
6 and "non-prototype" for reactor internals components
7 in the DCD and in topical report NEDE -33259, reactor
8 internals comprehensive assessment program report.
9 In the response, GEH clarified that
10 prototype applies to the components that are different
11 from the ABWR reactor internals, such as the chimney
12 and stand-by liquid control structures. The ESBWR
13 reactor internals as a whole are classified as non-
14 prototype Category 2.
15 Separately, the staff questioned the
16 classification of the ESBWR reactor internals as non-
17 prototype Category 2, considering there's substantial
18 differences between the ESBWR and ABWR reactor
19 internals, and GEH agrees with the staff's finding and
20 later reclassified the ESBWR reactor internals as
21 prototype and supplement the response to RAI 3.9-75.
22 This resolved the issue.
23 In RAI 3.9 -96, the staff request the
24 applicant to explain the basis for selecting the
25 reactor internals components for testing for the first

1 ESBWR plant. In the response, GEH provided an item
2 by item discussion of why each component is selected
3 for analysis and testing, or why was it was
4 considered adequate without fu rther analysis testing
5 in the topical report, NEDE-33259.
6 The staff finds their response acceptable,
7 and meets the acceptance criteria in Reg Guide 1.20,
8 and this resolved the issue.
9 In Section 392.5, dynamic system analysis
10 of reactor internals in the forward conditions, the
11 regulations and regulatory guidance are GDC 214, NCFR
12 Part 50, Appendix S, SRP Section 392 and 395, and ASME
13 Code Section 3, subsection NG.
14 In RAI 3.9 -81, the staff asked the
15 applicant to demonstrate there's no significant
16 dynamic amplification of the loads on the reactor
17 internals, as a result of the main steam line and feed
18 waters of line breaks.
19 In the response, GEH compared the
20 frequency of the blowdown loads to the natural
21 frequency of the core support structures, and the
22 spatial description of the blowdown loads to the core
23 support structures, and concluded that there's no
24 dynamic amplification of the blowdown loads.
25 DR. WALLIS: So when do they -- how do

1 they get the periods of the loads from the blowdown?
2 I mean blowdown, there's a -- I think there's a quasi-
3 study process, or is there a process? How do you get
4 that, periods of the loads from a blowdown?
5 MR. WONG: In the response, GE did not get
6 into details as to how those --
7 DR. WALLIS: Well, I noticed that they
8 looked at the natural period of the structures. They
9 looked to see if there was a resonance. But I'm
10 interested in the exciting. What's the exciting
11 mechanism from the blowdown?
12 MR. WONG: In the response, GE did not get
13 into details on how those --
14 DR. WALLIS: How did you satisfy yourself
15 it was okay, if they didn't get into the details?
16 MR. WONG: I would defer the reviewer, the
17 contractors for this section.
18 DR. WALLIS: There's a contractor who
19 reviewed this?
20 MR. WONG: Yes. I mean I to ok over this
21 section recently, so I mean this review has been going
22 on for several years, so I would --
23 DR. WALLIS: I can't remember. I know
24 we've seen something before, but I can't remember.
25 MR. WONG: Yes, they -- Vic and Tom, are

1 you on the line?

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

3 --

4 CHAIRMAN CORRADINI: Can you identify

5 yourself please?

6 MR. SAH: This is Vic Sah (ph) at the

7 Argonne National Lab. I think in the -- this

8 particular section, that is, what is 3.9.2.4. I think

9 partly we were supported by the, some of the NRC

10 staff, and what we understand that the update

11 components in the lower part of --, it goes much

12 higher than 100 hertz. That was the reason that there

13 will not be any dynamic amplification because of the

14 blowdown.

15 DR. WALLIS: That was the conclusion. I

16 remember that, but how do you know what the period of

17 the loads is, the imposed loads. In order to see

18 whether 100 hertz is okay, you have to know it was a

19 driving force at 100 hertz or not.

20 MR. WONG: That is true. Well, what it

21 implies that the driving force was much lower than 100

22 hertz.

23 DR. WALLIS: How do you determine that

24 driving force?

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

1 you recall, I think we worked with Jay Rodgen (ph)
2 from NRC. He reviewed these.
3 CHAIRMAN CORRADINI: Yes, I remember.
4 MR. WONG: We had a discussion on that. I
5 think what we were talking about it, the contractors.
6 Vic Shaw on the phone now. We did not review this
7 subsection of 392.
8 DR. WALLIS: So if GE states something,
9 it's okay without review that it has a proper basis?
10 MS. CUBBAGE: I think what we're saying
11 there was another staff member. Maybe we could get
12 Jay?
13 CHAIRMAN CORRADINI: I'm sorry. Is it a
14 staffer, is it Argonne? Is it your contractor that
15 assisted you?
16 MR. WONG: The contractor, Vic, we just
17 mentioned. He did not review this subsection, 392.5
18 of the SSE, and this subsection was reviewed by a
19 member of the staff who is no longer --
20 DR. WALLIS: Well, how do you determine
21 the driving force from the blowdown.
22 MR. WONG: He was responsible for this
23 section. I mean we find it acceptable, based on the
24 evidence presented. The natural frequency of the
25 loads and the core support structure do not coincide.

1 I mean I --

2 DR. WALLIS: I understand that , but

3 there's a --

4 MR. WONG: There's a question. Why did we

5 solve, I mean --

6 DR. WALLIS: There's a break in the steam

7 line up here somewhere, and it sent some loads into

8 the vessel, and it shakes things at the bottom. But

9 you have to somehow, in or der to know how this load

10 comes in and shakes things at the bottom, you have to

11 know what the driving force here is up at the top here

12 presumably.

13 MR. WONG: Yes. I think that level of the

14 analysis, from my understanding in reading the SC, it

15 was not audited. It's not reviewed in that detail.

16 DR. WALLIS: So it's a mystery how they --

17 it's a mystery to me at this point how they determined

18 the driving force?

19 MS. CUBBAGE: Okay. Unless GE has

20 anything to offer at this time, I'd like to take this

21 issue back and try to get you an answer.

22 CHAIRMAN CORRADINI: GEH, do you guys have

23 something to say relative to the forcing function that

24 was used?

25 MR. MARQUINO: This is Wayne Marquino.

1 We'd like to take that offline and get back to you at
2 the break.
3 DR. WALLIS: Thank you.
4 CHAIRMAN CORRADINI: Okay. Why don't we
5 keep on going?
6 MR. WONG: Okay.
7 DR. WALLIS: I remember some discussion on
8 this, but I can't --
9 MR. WONG: Based on the sustainment in the
10 GR IR response, because the periods, the fr equency of
11 the loads and the frequency of the core support
12 structure do not coincide, and the spatial dispersion
13 of the blowdown loads and the motion of the core
14 structures are not compatible, therefore, you know,
15 there's no potential for amplification of dynamic
16 loads. This is basis for resolving this RAI. And we
17 will take this question back and get back. This
18 concludes my presentation.
19 CHAIRMAN CORRADINI: So just to be clear,
20 what I'm writing down that we're going to get from
21 staff and from GEH is the basis of the forcing
22 function and what staff did to convince themselves
23 that it was acceptable relative to the response, okay?
24 Other questions for Mr. Wong? Other questions for
25 Mr. Wong before they move on?

1 (No response.)

2 CHAIRMAN CORRADINI: Okay. Why don't you

3 go ahead?

4 DR. WALLIS: Well, that's all this slide's

5 about really isn't it?

6 CHAIRMAN CORRADINI: They're moving on to

7 another RAI, but the question was -- go ahead.

8 MR. LE: Good morning. My name is Tuan

9 Le. I'm the reviewer of Section 393, which is an SME,

10 S-1, 2, 3 component, component support for support

11 structure.

12 Today, I would like to present the RAI

13 3.9-177, which is request, the staff request the

14 applicant to restate the COL information item

15 regarding the availability of the estimate design

16 report, and the design specification. Originally

17 listed in the DCD Section 393 and Section 399, or the

18 applicant address the information in Item 2 of the

19 ITAAC.

20 As a result of the staff question for this

21 RAI, the applicant respond, and the applicant

22 committed to develop an ITAAC for review of the design

23 report prior to the fuel load, and a commitment of the

24 completion of design specification for this

25 significant component prior to the certification.

1 On that, the staff in July 20, 2009, staff
2 subsequently did the design specification audit at the
3 GE site, and during this audit, the staff find a
4 number of items, follow-up items to be respond for the
5 staff, regarding the finding.
6 After that, the finding was resolved and
7 the GE have respond to all the follow-up items. Based
8 on the information review, the staff found that the
9 design document review components reflect the
10 methodology and the criteria contained in the DCD, and
11 met the requirement of the ASME Code Section 3,
12 Article in SE-3000.
13 Therefore, this issue was closed after
14 resolve all the follow-up items of the audit report.
15 This concludes my presentation for the RAI 3.9 -177.
16 I'll be open to any questions. Any questions?
17 CHAIRMAN CORRADINI: Questions from the
18 Committee?
19 MR. MISENHIMER: That's it for this
20 section. I should mention that 3.9 -254, 255, we
21 didn't talk about that yet. We will have a presenter
22 talk about when we get to 3.12.
23 CHAIRMAN CORRADINI: Okay. Wayne, did you
24 want to clarify or give us some information?
25 MR. MARQUINO: Yes. This is Wayne

1 Marquino of GE with Jerry Deaver, and my understanding
2 is the question was about high frequency loads on
3 structures like the guide tubes in the lower plenum.
4 The phenomena that's causing the loads is
5 the depressurization of the vessel, caused by a pipe
6 break. So we have phenomena like voiding formed in
7 the lower plenum, water moving up because of that --
8 liquid moving up because of that voiding, and to
9 define the differential pressure, we do calculations
10 with the TRAC -G code, to determine the differential
11 pressure on different parts of the internal structure.
12 But those phenomena develop over the
13 course of seconds, not 100 hertz. So the phenomena
14 that's producing the loading, its character is a lower
15 frequency than the --
16 DR. WALLIS: It's way off scale. I mean
17 it's the order of several hertz, one hertz or less or
18 something, rather than 100. I just wondered why you
19 were even worried about 100 hertz?
20 MR. MARQUINO: I think it's because it's
21 the natural frequency.
22 DR. WALLIS: That's its natural frequency,
23 but I couldn't see any mechanism that would drive that
24 sort of frequency anyway.
25 MR. DEAVER: Right. I think -- this is

1 Jerry Deaver with GEH. I think, you know, the
2 simplistic argument is that it has such a high natural
3 frequency that you could never excite it, and the
4 phenomena --
5 DR. WALLIS: If you would explain that the
6 driving forces are of the order of one hertz or less.
7 MR. DEAVER: Yes.
8 DR. WALLIS: That would perhaps have
9 helped to explain where they came from, because I
10 thought you were thinking of this pipe up here that's
11 break, sort of producing a sonic kind of noise, that
12 goes down and excites stuff down below, and that's not
13 what you're thinking about.
14 MR. DEAVER: No. This is just a mass
15 energy release phenomena.
16 DR. WALLIS: Yes, okay.
17 MR. DEAVER: So I don't see how that
18 frequency could -- any kind of high frequency context
19 could enter into the vessel.
20 DR. WALLIS: So it's the voiding and the
21 motion of the liquid?
22 MR. DEAVER: Right. It's the water level
23 changing and BP changes that are really slow in
24 nature.
25 DR. WALLIS: But that's lower than 100

1 hertz, isn't it?

2 MR. DEAVER: Pardon?

3 DR. WALLIS: Okay, thank you.

4 CHAIRMAN CORRADINI: Okay, thank you.

5 John, I'm sorry.

6 MEMBER STETKAR: I wanted to ask the staff

7 one thing, John, still tracking the squib valve. What

8 assurances do I have that the COL applicant or the COL

9 holder knows that they need to develop some type of

10 enhanced surveillance program for th ese squib valves,

11 other than firing the igniters? You know, we had the

12 discussion. It's my understanding that right now the

13 only requirements are that they fired the igniters.

14 If I read the SER, there's a paragraph in

15 here, and I don't want to quote the whole paragraph.

16 But the paragraph basically reiterates the concerns

17 that we've heard this morning, that indeed they're

18 large valves, they're very, very important to safety,

19 and that the design hasn't been finalized.

20 The COL applicant -- it says "CO L

21 applicants referencing the SBWR design will be

22 responsible for establishing appropriate surveillance

23 activities for squib valves." Yet in other places, it

24 says that the general descriptions of the IST

25 activities are acceptable, which leads me to kind of a

1 gap.

2 How do I know? If we certify the design,

3 we're certifying -- in the design, we're certifying

4 the testing program that's specified in the design,

5 which is only firing the igniters.

6 MR. SCARBROUGH: This is Tom Scarbrough

7 with the staff.

8 MEMBER STETKAR: Hi Tom.

9 MR. SCARBROUGH: Yes. This is sort of the

10 extension between the signed certification review and

11 the CO applicant review. We actually don't approve

12 the IST program --

13 MEMBER STETKAR: Until --

14 MR. SCARBROUGH: As part of the design

15 certification.

16 MEMBER STETKAR: So there's no -- what I'm

17 asking for is there's no need for specificity in an

18 ITAAC related to the testing program at the design

19 certification stage, to the hook dysfunctional

20 requirement.

21 MR. SCARBROUGH: Well, a long time ago it

22 was decided by the agency that we would not have ITAAC

23 for operational programs. This IC is one.

24 MEMBER STETKAR: Okay, thank you.

25 MR. SCARBROUGH: So we deal with it

1 through the CO applicant, and they know that they need
2 to do this and --
3 MEMBER STETKAR: I mean there's a flag in
4 the TAC text here, you know. If people don't read the
5 DCD 2, you know, Level 2 --
6 (Simultaneous discussion.)
7 MR. SCARBROUGH: It's there, right. For
8 the CO applicant to know, and we've already started
9 interactions definitely with -- for the AP-1000 with
10 the CO applicant, and here, we'll be interacting with
11 the CO applicant for the SP to bear as well, that they
12 need to -- this is something that's very significant.
13 Because of the uncertainty in the design
14 of the squib valves, they're going to need to decide
15 exactly the debate that's going on. Do they set it up
16 to be able to fire these valves in place, which
17 they're designed to do multiple times, or do they have
18 a very detailed surveillance, internal surveillance
19 program, so they can verify the integrity, no
20 degradation, you know, no, you know, type of oxidation
21 or something that might cause a problem.
22 So all of that debate is something that's
23 underway.
24 MEMBER STETKAR: Yes. That I understand.
25 For current purposes, my only question was do I need

1 some sort of additional assurance at the DCD stage in
2 the form of ITAAC, that would, you know, more
3 explicitly express those concerns. The answer that
4 I've heard is no, because that's considered an
5 operational program.
6 MS. CUBBAGE: Right, and the rule will
7 specifically exclude operational programs from
8 finality. To the extent they may have been described
9 in the DCD, they still don't have finality.
10 MEMBER STETKAR: Yes, yes.
11 MS. CUBBAGE: So that there's no -- the CO
12 applicant can't say they have finality.
13 MEMBER STETKAR: Yes, okay. I understand
14 that. Thanks.
15 DR. WALLIS: But until you test a full
16 valve, you don't really know the modes of failure, do
17 you, the way in which things can go wrong? You sort
18 of assume that by keeping it clean and all that and
19 watching for corrosion, you can assure yourself that
20 it won't go wrong. But you don't really know what can
21 go wrong until you test it.
22 MR. SCARBROUGH: Yes sir. During the
23 initial phase of th e testing for the AP -1000, we're
24 learning a lot about the valve and how things can go
25 right and go wrong, yes sir.

1 DR. WALLIS: Now doesn't the explosive
2 deteriorate with time? There's chemical effects that
3 go on in there.
4 MR. SCARBROUGH: Well, that's what they're
5 going to --
6 MEMBER ARMIJO: That's what they're going
7 to test.
8 MEMBER STETKAR: Firing the igniters will
9 do that.
10 (Simultaneous discussion.)
11 MEMBER STETKAR: The mechanical part, the
12 *in situ* or the DP across whatever type of intern al
13 valve design they have, with an actual DP, having had
14 the valve sit, you know, in whatever environment it
15 sits.
16 DR. WALLIS: If it's leaking explosive or
17 something, which is --
18 MEMBER STETKAR: Well, or minor leakages
19 of, you know, water or, you know, impurities.
20 DR. WALLIS: But there other ways --
21 MEMBER STETKAR: Corrosion or you don't
22 know.
23 DR. WALLIS: There are other things like
24 mechanical binding and so on.
25 MEMBER STETKAR: And depending on the

1 valve design, they may be more or less su sceptible to
2 that.
3 CHAIRMAN CORRADINI: Okay, thanks. So now
4 we're going to have GEH come up and we're going to
5 talk about Section 3.12; is that correct?
6 (Off mic discussions.)
7 Chapter 3 - Section 3.12 RAIs/GEH
8 MS. CUBBAGE: While we're switching, w e
9 just wanted to follow up from the previous section.
10 Sounded like no additional on the squib valve issue.
11 Was there additional action on the other topics, or
12 did GE's response address that?
13 CHAIRMAN CORRADINI: We're talking about
14 the vibration?
15 MS. CUBBAGE: Yeah.
16 CHAIRMAN CORRADINI: No, I don't think --
17 I think we're fine.
18 MS. CUBBAGE: Okay, thank you.
19 MEMBER STETKAR: Actually Amy, I can't
20 speak for everyone else. I'm not sure at the DCD
21 stage now that there is additional action on the squib
22 valves. I mean, you know, I personally certainly have
23 a concern about them, but all I'm hearing is that it's
24 delayed to the COL.
25 MS. CUBBAGE: I meant additional action

1 for me.

2 MEMBER STETKAR: Well no.

3 MS. CUBBAGE: To satisfy --

4 CHAIRMAN COR RADINI: Go ahead. Finish

5 what you were saying.

6 MEMBER STETKAR: Yes. I was going to say

7 I'm uneasy, but I don't think that there's anything

8 else at the DCD stage, for this particular activity

9 that we're involved in here, that there's any more

10 benefit from doing anymore.

11 MS. CUBBAGE: Okay.

12 MEMBER STETKAR: I understand the problem,

13 and I understand that it's basically pushed off the

14 COL, and that, you know, we'll telegraph it. We'll

15 certainly be interested in it at the COL stage, but

16 that's later.

17 MS. CUBBAGE: Okay, thank you.

18 MR. DEAVER: Okay. This is Jerry Deaver

19 with GEH again. I'm going to cover the open issues

20 associated with 3.12. Actually, we don't have a 3.12

21 in our DCD, but topics relating to piping, pipe

22 supports and the compute r programs were covered in

23 this series of questions.

24 We have three RAIs that I'll cover. The

25 3.9-254 and 255 are really related to the topics in

1 this section, but I've already covered those.

2 The first issue is 3.12 -3. In the NUREG

3 1061, it's very prescriptive in the use of the ISM

4 method. It says that the absolute sum shall be used,

5 and historically for ABWR, we had, we were allowed to

6 use SRSS. But in looking for the records and the

7 justification we couldn't find it.

8 So we were challenged by the staff to

9 basically prepare justification if we were wanting to

10 use the SRSS method. So what we did is we prepared

11 analysis related to the main steam and feed water

12 piping, which we were already calculating for the

13 benchmark purposes, and what we actua lly did was we

14 compared time history response methods against the

15 response spectrum method using SRSS.

16 So the objective was to show that using

17 the SRSS method, that the amplifications and stresses

18 associated with that would be higher than the time

19 history case. What we found was that virtually all

20 cases were above the time history case, but there were

21 six separate locations in the feed water system that

22 did go below the time history results, and the maximum

23 ratio was 1.08.

24 So in discussions with the staff on this,

25 it was agreed that because of this potential of

1 selected areas being worse than -- we agreed to a ten
2 percent adder when we used this analysis. For
3 independent support motion analysis, and this only
4 applies to piping in containment.
5 So it's typically piping that goes from
6 the RPD to the containment, and where we're using the
7 ISM method. We would do the analysis and then add a
8 ten percent stress onto it as a conservative margin
9 factor.
10 DR. WALLIS: You have a problem with
11 English here, that I mean you have to say in all
12 cases, the deviations above the predictions were below
13 ten percent or something, because "in all cases were
14 below ten percent" doesn't mean anything.
15 MR. DEAVER: Some of the wording in here
16 is not correct.
17 DR. WALLIS: Is incomplete.
18 MR. DEAVER: Yes, yes.
19 DR. WALLIS: But what you're saying is
20 that in the worst case, your prediction was above the
21 data. Was below the data. The data was above the
22 prediction by eight percent in the worst case.
23 MR. DEAVER: Right. We had the deviation
24 of eight percent.
25 DR. WALLIS: You didn't bound it quite,

1 because some of them escaped through the limit by
2 eight percent?
3 MR. DEAVER: That's correct.
4 DR. WALLIS: And so you agreed to a ten
5 percent correction.
6 MR. DEAVER: Added to bound any potential
7 case.
8 DR. WALLIS: Yes.
9 MR. DEAVER: So in doing the ISM analysis,
10 we also had discussion about how many groups of, you
11 know, for different supports, and it was determined
12 that we were only going to be allowed to use two
13 support groups. One either associated with the vessel
14 or associated with the containment, and within that
15 structure, and we would use the limiting of response
16 vector for the groups.
17 So with that, we added words to the DCD
18 and this item has been resolved.
19 MEMBER ARMIJO: I guess I don't
20 understand. If you did the analysis both ways, why
21 don't you just use the absolute sum and --
22 MR. DEAVER: Well, the time history
23 approach is more labor -intensive. We don't always
24 have the data for every support point. So that's just
25 a more labor-intensive way to do analysis.

1 MEMBER ARMIJO: So you're just saying you
2 picked a more efficient way and you just accepted a
3 ten percent adder because --
4 MR. DEAVER: Right, and we always have the
5 recourse to go back. I f we have real issues, we can
6 always go back.
7 MEMBER KRESS: And you know that ten
8 percent is good enough for every location that you
9 worry about?
10 MR. DEAVER: Yes. That's what we --
11 MEMBER KRESS: You know why it was eight
12 percent above your simpl ified analysis? You know the
13 reasons for --
14 MR. DEAVER: I don't think we totally
15 understand the reasons. The other significant point
16 is that those happen to be locations that were
17 typically low stress. So you wouldn't normally be
18 concerned about them anyway.
19 MEMBER KRESS: I'm not too concerned about
20 them.
21 MR. DEAVER: I mean we didn't have the
22 combination of high stress --
23 MEMBER ARMIJO: And a high deviation.
24 MR. DEAVER: Right.
25 MEMBER ARMIJO: Okay.

1 DR. WALLIS: But it's not data you're
2 talking about. You're talking about SRSS predictions,
3 right? Because data to me implies you measured
4 something physically.
5 MR. DEAVER: No, no.
6 DR. WALLIS: It's actually comparing two
7 predictions.
8 MR. DEAVER: These are all calculations,
9 yes. Okay.
10 DR. WALLIS: Correct these slides when
11 they become part of the record.
12 MR. DEAVER: We certainly could polish it
13 up.
14 DR. WALLIS: We probably could, to make it
15 clearer.
16 MR. DEAVER: Okay.
17 DR. WALLIS: I don't know if you're
18 allowed to do that. We're not allowed to correct our
19 verbal records that he's recording over there.
20 (Laughter.)
21 DR. WALLIS: That's mistaken in some way,
22 then we're stuck with it.
23 MR. DEAVER: I'm okay with correcting,
24 improving it if it's allowed. Okay. We'll s end that
25 to you. Okay.

1 The next issue is 3.12-17. This topic is
2 on the general use of SRSS for dynamic loading, and
3 within ESBWR. There's a non-exceedance probability
4 requirement of 84 percent that's required in NUREG
5 0484, and typically what we found is that through the
6 course of BWR development that basically all
7 structures, the vessels, the buildings and such, all
8 have relative same response characteristics.
9 And we responded to this question in two
10 ways. One was basically a qualitative justification
11 that load events aren't likely to combine at the same
12 time. The peaks, you know, as such would not occur at
13 the same time.
14 Then the randomness of the amplitudes and
15 phasing of responses, and then just the rapid
16 variation of plus and minus variatio n and short
17 durations of peaks, such as seismic responses and so
18 forth, and other containment loca-type responses.
19 So that was the qualitative, but then we,
20 for Mark II, we did a detailed study. We had 291
21 dynamic load cases that were evaluated with all the
22 combinations of dynamic loads, and we demonstrated
23 that there was an 84 percent non-exceedance.
24 So we met the criteria and we demonstrated
25 for ESBWR that this prior work was applicable to

1 ESBWR. So in conclusion, we're in compliance with the
2 reg, the NUREG 0484.
3 The last issue deals with the responses.
4 In this case, we're talking about the uniform support
5 method of analysis, and in the SRP 3.9.2, Section 22-
6 g, it talks about using the absolute sum method or the
7 USM method. In our DCD, we were not clear in the
8 methodology that we were going to use for that. The
9 simple solution in this case was that we would simply
10 commit to the absolute sum method when we're using the
11 USM method for analysis of piping.
12 So we have changed the DCD to clearly
13 state that, and now we've demonstrated compliance with
14 the SRP 392. So in summary, we've -- through I think
15 there were like 38 RAIs in Section 3.12. Throughout
16 the response to those and through the audits, we feel
17 that, you know, our analysis methods and -- for both
18 piping and supports, are consistent with the SRP
19 requirements.
20 That's been demonstrated, and we've
21 provided the analytical cases and such, you know,
22 justifying the use of SRSS when it's appropriate, or
23 the combinations.
24 DR. WALLIS: I'm try ing to understand.
25 Maybe I'm stupid or something here. You've got just

1 in 3.12-17, you are asked to justify using SRSS. I
2 don't understand what GE EBWR Mark II is.
3 MR. DEAVER: That's referring to our
4 containment design. That's --
5 DR. WALLIS: But that's not for the ESBWR,
6 is it?
7 MR. DEAVER: They're similar.
8 DR. WALLIS: Because it's similar.
9 MR. DEAVER: It's very similar.
10 DR. WALLIS: You're arguing that it's
11 similar, and it worked for this -- for the BWR Mark
12 II. Therefore, it should be applied to ESBWR.
13 MR. DEAVER: Yes, it could be.
14 DR. WALLIS: That's what you're arguing.
15 MR. DEAVER: Yes.
16 DR. WALLIS: Close enough. I'm just a bit
17 surprised that you could use BWR Mark II as an
18 argument for justifying something about ESBWR, which
19 is not the same thing.
20 MR. DEAVER: Well, in previous work, even
21 the Mark I containments, which are quite different, at
22 least as far as the suppression pool and such, even
23 those were demonstrated to be generally similar. So
24 that's --
25 DR. WALLIS: Are you arguing that the

1 method has been qualified as being used for other
2 systems?
3 MR. DEAVER: Right.
4 DR. WALLIS: And there's nothing peculiar
5 about ESBWR, which would mean that it would no longer
6 apply?
7 MR. DEAVER: Right. It's not a drastic
8 deviation or variation of what we've done in the past.
9 DR. WALLIS: Okay.
10 CHAIRMAN CORRADINI: Other questions
11 please, for Jerry?
12 (No response.)
13 CHAIRMAN CORRADINI: Okay. Thank you,
14 Jerry.
15 MR. DEAVER: Thank you.
16 CHAIRMAN CORRADINI: So we'll have staff
17 join us for 3.12.
18 Chapter 3 - Section 3.12 RAIs/Staff
19 MR. MISENHIMER: My name again is Dave
20 Misenhimer. I'm the project manager for Section 3.
21 We're going to talk about Section 3.12. Kaihwa Hsu
22 will be presenting this section. Go ahead.
23 MR. HSU: I'm Kaihwa Hsu, okay. I'm the
24 lead reviewer for the Section 3.12, okay. I'm
25 discussing all those existing open item. The first

1 open item is related to the independent support motion
2 measure response special method, and in the SRP 3.12
3 recommend the acceptance criteria that's listed in the
4 NUREG 1061, Volume 4.
5 In the original, GEH opposed. They used
6 the SRSS method for that, for those support group
7 combination. However, in the 1061, which is very
8 clearly stated if, unless this support grou p are from
9 the different structures, otherwise if they are in the
10 same structure, they can be shown as the phase
11 uncorrelated, then they are allowed to use the SRSS.
12 However, according to all those seismic
13 response, we understand if in the same structure it's
14 always phase correlated, and based on this phase
15 correlated, so staff asked the question, and the GEH,
16 okay, proposed the study. The staff reviewed that
17 study. The staff find they do have the phase
18 correlation, and so staff limited that, based on that
19 phase correlation, and based on their study.
20 If they only use two group of their study,
21 they're allowed to use the SRSS with extra ten percent
22 margin to cover their design. As far as the rest of
23 the combination areas, combination structure
24 locations, they have to follow the 1061.
25 GEH proposed they are following that. So

1 GEH's final position, which means their acceptance
2 criteria, and they're listing the NUREG 1061, Volume
3 4.
4 So if nobody have a question, I'm going to
5 go to the next one, which is talking about 3.12 -17,
6 which is talking about SRSS method using the low
7 combination of the dynamic loading, just like GEH just
8 proposed the acceptance criteria which list in the
9 NUREG 0464, Revision 1 for using the SRSS combination
10 method.
11 GEH, okay, provide their justification, in
12 their study, which means that the provisions of the
13 NUREG 0464, Revision 1. So on that basis, open item
14 was resolved.
15 DR. WALLIS: So what are these acceptance
16 criteria?
17 MR. HSU: Those are non -exceedance
18 probability of 84 percent of two independent, I mean
19 two independent -- in time-dependent, okay, input.
20 DR. WALLIS: That's the only criteria?
21 MR. HSU: Yes. Okay, for the next IR we
22 did n't talk about 3.47. This is load combination for
23 seismic inertia response vector, and this one is SRP,
24 okay, talking about you want to use the APS method.
25 So GEH revised it from the SRSS to the APS. On the

1 basis of it, this is a new staff recommendation of the
2 SRP 392. So these open items are also resolved. No
3 questions?
4 So I'm going to to the 3.92 -254 and 255.
5 3.92-254 and 255 deals with the piping stress analysis
6 computer code. So one computer code is called the
7 PISYS, and PISYS, which performs all the static and
8 dynamic analysis for the piping analysis, and staff
9 asks this question, is because when the staff reviews
10 the basic document, okay, staff finds that there's an
11 inconsistency with the DCD, because in the PISYS, in
12 the DCD they're talking about they use 1.92 Rev. 2.
13 But however, they are benchmarked against
14 NUREG CR 6049, NUREG CR 6049, which is for the
15 benchmark of the Reg Guide 192 Rev. 1, and Reg Guide
16 1.92 Rev. 2 benchmark supposed to benchmark to the
17 basic document for the 1.92 Rev. 2 Reg Guide NUREG,
18 which I think is the NUREG CR 6557 or something.
19 So staf f asked that question, and they
20 identified. Actually, the computer codes are
21 developed based on the NUREG, Reg Guide 1.91 Rev. 1.
22 So we asked them to reflect that in their DCD. And
23 also, the software document and QA status for computer
24 codes were not completed.
25 So staff identified those problems and

1 performed the audit, and they revised that
2 documentation, and they revised the package, and so
3 staff accept the PISYS 08, and otherwise NC-7 is the
4 post-possessor of the PISYS 08. And also NC -7
5 incorporated environmental assess fatigue evaluation
6 into their code.
7 Staff had reviewed their V&V package, and
8 the staff noted that their computer code temperature
9 used in the calculation for the fatigue environmental
10 factor, FEF, which is not consistent with the
11 procedure stated in the NUREG CR 6909.
12 So staff identified all this, and they
13 revised all those computer codes, and staff performed
14 the final review of their documentation and evaluation
15 package, and find that their code is completed.
16 The software -- their completed their
17 software design document address all the staff
18 concerns. Therefore, this issue was closed.
19 MEMBER ARMIJO: Was that temperature non-
20 conservative, or just a simple error?
21 MR. HSU: Just a simple error, because
22 NUREG, okay, 6909 talking about when you have -- when
23 you calculate it, you see the fatigue is talking about
24 range. So the whole range, you're supposed to use the
25 average temperature. But they're only talking about

1 they used the temperature, okay, for the down -
2 trenching, and not consider about up-trenching, yes.
3 So that's not consistent with the
4 definition of the NUREG CR 6909. On the basis, they
5 are committed to follow the Reg Guide 1.207 and follow
6 the 6909. So we identified all those issues.
7 DR. WALLIS: This PI SYS code, is that a
8 GEH code?
9 MR. HSU: Both PISYS code is GEH
10 proprietary.
11 DR. WALLIS: It's a GEH proprietary code.
12 MR. HSU: That's not a commercial code.
13 DR. WALLIS: Okay. I just wondered about
14 that.
15 MEMBER ARMIJO: So now those have gone
16 through the GEH Level 2 process there and verified and
17 you're happy with it?
18 MR. HSU: Yes.
19 MEMBER ARMIJO: Okay.
20 DR. WALLIS: It's interesting that the
21 code is there before the design documents are written
22 and completed?
23 MR. HSU: Because --
24 DR. WALLIS: It often seems to be the case
25 that you've got the code, and then someone figures out

1 we'd better have a design document, so you write it.
2 It seems backwards to me, but that's --
3 MR. HSU: Because this is a -- this code
4 is like a little bit conf used, okay. They have a
5 PISYS 05, PISYS 06, PISYS 07, PISYS 08.
6 DR. WALLIS: An evolving thing.
7 MR. HSU: Yeah, and then when we look at
8 that, okay, like ANSI 714, they say you have to use
9 the PISYS 08 as the input. You're not taking the
10 PISYS 07 as the input. So previously -- so that's the
11 reason, okay, they clarify for us which version they
12 have to be used for us.
13 DR. WALLIS: Like these documents I get
14 from the government, which are always in some updated
15 computer code that I can't read on my machine.
16 CHAIRMAN CORRADINI: Questions?
17 (No response.)
18 CHAIRMAN CORRADINI: Okay, thank you.
19 What we're going to do is we're going to continue and
20 take a topic from this afternoon, Chapter 4, and
21 discuss it now. So --
22 MS. CUBBAGE: And it should be quick and
23 uneventful.
24 CHAIRMAN CORRADINI: Well, let's not -- we
25 don't want to make any --

1 MS. CUBBAGE: Right. We don't have the
2 technical staff here. We're going to just do -- it's
3 a high level presentation. If there are any questions
4 on Chapt er 4, we'll have the staff here at one
5 o'clock, if need be. But we'll go ahead and do that
6 real quick and --
7 CHAIRMAN CORRADINI: Just to remind
8 everybody. Most of the -- most, I thought, we think,
9 I thought all of the issues on Chapter 4 we dealt with
10 back in May, when we went through all the topical
11 reports again and the new issuance of them.
12 So what we're going to do is review, at a
13 relatively high level, Chapter 4 discussion. But I
14 hope you all have, you know, totally in your minds,
15 the joys of May 17th and 18th that we see. Bruce?
16 MEMBER ARMIJO: Yes, I remember this
17 stuff.
18 (Off mic discussions.)
19 CHAIRMAN CORRADINI: All set.
20 MR. BAVOL: Yep.
21 CHAIRMAN CORRADINI: Go ahead.
22 Chapter 4 - Reactor/Staff
23 MR. BAVOL: Okay. My name is Bruce Bavol.
24 I'm the project manager for the Chapter 4 review, and
25 everybody's had an opportunity to take a look at the

1 safety evaluation for Chapter 4. Like Amy had
2 mentioned, this is going to be very brief, high level.
3 A number of the significant RAIs a nd the
4 issues that were a part of the Chapter 4 review were
5 contained and discussed in previous Subcommittee
6 meetings listed here on this slide here. Fuel
7 assembly, fuel rod, control blade, mechanical design,
8 nuclear design, gamma thermometer and back in October,
9 critical power correlation and critical power testing.
10 Out of the approximately 258 technical
11 RAIs that were closed for Chapter 4, and they're
12 related to the appropriate sections here. The staff
13 found no outstanding issues, and ACRS had no
14 outstanding issues for us from the previous briefings.
15 So in conclusion, the staff finds that the
16 ESBWR fuel assembly and control blade designs are
17 acceptable, meets regulatory requirements, including
18 applicable GDCs, and the analysis and testing has
19 demonstrated conservative design. Like I said, this
20 is very short, very sweet. Are there any questions
21 for us or the staff that we can take away?
22 CHAIRMAN CORRADINI: Anything?
23 (No response.)
24 CHAIRMAN CORRADINI: Okay. John, I'm
25 sorry. I didn't mean to -- do you have anything?

1 MEMBER STETKAR: No.

2 CHAIRMAN CORRADINI: Okay. So with that,

3 why don't we break for lunch and be back here at

4 12:30. Is that allowable? I'm assuming it's

5 allowable. Amy?

6 MS. CUBBAGE: To what?

7 CHAIRMAN CORRADINI: Start at 12:30?

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

9 CHAIRMAN CORRADINI: Okay, good. We're

10 breaking for lunch. Back at 12:30.

11 (Whereupon, at 11:23 a.m., a luncheon

12 recess was taken.)

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

2 12:31 p.m.

3 Chapter 9/GEH

4 CHAIRMAN CORRADINI: Okay. We'll come back

5 in session, and we'll start off with Chapter 9 and GEH

6 presentation for auxiliary systems.

7 MR. DEAVER: Okay. We'd like to -- this is

8 Jerry Deaver with GEH. I'd like to kick off the

9 Chapter 9 discussion . The agenda will cover several

10 topics. The first one will be related to spent fuel

11 pool to K heat, and associated analysis with racks.

12 Then we'll cover spent fuel uncovery. Then

13 we'll cover gas accumulation in the FAPCS system. At

14 this point I'll turn it over to Mike Arcaro to cover

15 auxiliary system RTNSS functions, plant service water,

16 RCCW, chill water system and instrument error and

17 service error.

18 CHAIRMAN CORRADINI: I believe it was in one

19 of the prior meetings where we -- there was some

20 discussion about the heat load in the spent fuel

21 pools, and I think there was an inconsistency that

22 you were going to check on and get back to us, if I

23 remember correctly.

24 MR. DEAVER: Well, what we found is, you

25 know, there was this discussion about the 3 0, you

1 know, using a heat load that was at the 30 day point
2 after a restart of an outage. That comes directly out
3 of SRP 9.1.3 Rev. 1. It talks about doing the
4 calculation at that specific time frame.
5 So I guess at that time, we were in fact
6 consistent with the NUREG requirements, although what
7 we found is, and I think the implication in that SRP
8 is that that's the limiting case. We, in our
9 subsequent analysis, found that that is not
10 necessarily the limiting case.
11 So as a result of that, we've now reanalyzed
12 using the maximum loads for a full pour-off load and
13 with the prior loads that have been discharged. So
14 we're using the latest decay heat methodology.
15 So this is the most accurate means of
16 calculating decay heat, in accordance with the ANSI
17 Standard 5.1, 1994 edition. It includes all the
18 actinide issues and the activation product issues that
19 have been, you know, previously required for analysis
20 purposes.
21 DR. WALLIS: So the requirement is these two
22 together, the one full core vector and one refueling
23 load is equal to both together.
24 MR. DEAVER: Well see that's -- that's not
25 even very conservative, assuming you have multiple

1 loads of fuel coming out.

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

3 MR. DEAVER: Right. So there is a more

4 recent SRP, which was issued in March of 2007, which

5 you know, wasn't in effect when we docketed. But

6 really I think in effect we're working to the latest

7 SRP now as far as this issue is concerned, as far as

8 doing the current methods analysis.

9 Because associated with that Rev. 1, there

10 was a branch technical position, ASB 9-2, which

11 provided a methodology. But it was not as rigorous as

12 what we're doing today. So the next slide actually

13 shows, as a --

14 MEMBER ABDEL-KHALIK: So this actually

15 includes more than one discharge?

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

17 analysis.

18 MEMBER ABDEL-KHALIK: In the current

19 analysis. So it corresponds to essentially late in

20 the life of this facility, where you have a lot of

21 spent fuel accumulated in the core, and then you have

22 a complete core offload after 36 days or something

23 like that, plus one refueling load ignot?

24 MR. MARQUINO: Yes. It's ten years of

25 operation, two year cycles, so five batches of spent

1 fuel in the core offload.

2 MEMBER ABDEL-KHALIK: Okay.

3 DR. WALLIS: The thing that interested me is

4 it depends how quickly you offload, doesn't it?

5 MR. DEAVER: Of course, yes.

6 DR. WALLIS: If you offload instantaneously,

7 you've got 200 megawatts or something like that.

8 MEMBER ARMIJO: Fortunately, you can't do

9 that. I don't think you can do that.

10 DR. WALLIS: But you have to take your time;

11 otherwise, you're stuck with 50 megawatts or something

12 like that, which you can't handle. So you take days

13 to do it.

14 MR. DEAVER: Yes. That's the other part

15 that's interesting here, is that the SRP talked in

16 terms of 150 hours.

17 DR. WALLIS: That's right.

18 MR. DEAVER: Which is six and a quarter

19 days. But we've always been analyzing to five days,

20 you know, which was still a conservative early time

21 frame to start looking at heat load.

22 DR. WALLIS: So how long does it really

23 take?

24 MR. DEAVER: To get to the point where

25 you're discharging --

1 DR. WALLIS: To offload this whole core.

2 MEMBER ARMIJO: To offload. Listen, you've

3 got a lot of bundles in this.

4 MR. DEAVER: Well, to do a full core

5 offload, that's 1,132 bundles, and you know, we're not

6 going to be at a point where we're fully disassembled,

7 you know, take the containment head off, vessel head,

8 internals, cool down to the point where we can get

9 1,132 bundles out in five days. That's not going to

10 happen.

11 DR. WALLIS: When do you start to take them

12 out when you've taken off the head and cooled down?

13 When do you actually start to offload?

14 MR. DEAVER: As soon as the -- in our case,

15 we'll be removing the partitions, chimney partitions.

16 So that's after the dryer separator and chimney

17 partitions.

18 DR. WALLIS: So you'll be -- how long after

19 shutdown will you start to offload, actually offload

20 fuel?

21 MR. DEAVER: Do you recall, Allen --

22 MR. BEARD: I was going to say, the best

23 case we would look at is about 42 hours before we

24 actually start to remove fuel from the RPD itself.

25 DR. WALLIS: Forty-two hours. The choice,

1 the 42 hour, you put it in. You put it in and it's
2 decaying as you put it in. S o you've got to sort of
3 integrate this whole thing really, if you've got a
4 proper answer.
5 MR. DEAVER: Right. The next slide gives
6 you a little perspective of -- well actually, it's the
7 next one after. But this slide gives you the
8 perspective of what the actual heat rate is in a given
9 point in time in a cycle. So you can see that in the
10 start of this curve, the blue line is approximately
11 the 36 days. That represents the core offload.
12 DR. WALLIS: This is the same curve you give
13 us for the PCCS heat removal.
14 (Laughter.)
15 DR. WALLIS: It's the same curve.
16 (Simultaneous discussion.)
17 MR. DEAVER: --I guess. But you can see
18 that the heat load, core offload, the heat associated
19 with the core offload increases in time, and the decay
20 heat on the bot tom curve from the old batches is
21 declining. So when you add the two together, you get
22 the total and you can see that at about a year, you're
23 not really changing the amount of total heat that
24 could potentially be, you know, available for the
25 cooling.

1 DR. WALLIS: This is the heat when you've
2 just finished the offload, so the maximum --
3 MR. DEAVER: This is at five days. This
4 would be the heat load at five days.
5 DR. WALLIS: It's the maximum when you
6 actually finish the offload, or some time during t he
7 offload, because this stuff's aging as you go along?
8 CHAIRMAN CORRADINI: I think, I mean he
9 keeps trying to ask you the same question and you're
10 not answering it. Are you assuming once you hit five
11 days it instantaneously appears in the spent fuel
12 pool?
13 MR. MARQUINO: Yes.
14 DR. WALLIS: It doesn't. You're offloading
15 it step by step.
16 CHAIRMAN CORRADINI: Yes, but if they did
17 that, you'd ask them what's the assumption on the
18 offload rate. So they're just saying at five days, it
19 goes from point --
20 DR. WALLIS: They don't know that, because
21 as you put it in, the early stuff is hotter, and then
22 the decays --
23 CHAIRMAN CORRADINI: But it's only one -one
24 thousandths of a full core. So what do I care?
25 DR. WALLIS: No, but it may be that half a

1 core aged -- half a core aged three days is worse than
2 the whole core at five days. I don't know.
3 CHAIRMAN CORRADINI: No, no.
4 DR. WALLIS: Have you broken it down?
5 CHAIRMAN CORRADINI: Not at that point.
6 DR. WALLIS: You've actually done the
7 integral of all this over time?
8 CHAIRMAN CORRADINI: Well, it goes as the
9 minus .2 power of time after about a minute.
10 DR. WALLIS: Yes, that's right.
11 MR. DEAVER: Let's go to the next slide.
12 This gives you perspective of the decay.
13 MEMBER ABDEL-KHALIK: But before we -- how
14 much difference has this correction made?
15 MR. DEAVER: Well, previously we were using
16 17.3 megawatts, and now we're at, rounded up, it's
17 18.1. So we're .8 megawatts higher in our
18 calculations now. What we've actually done in our
19 spent fuel pool, boil off and our rack calculations,
20 we've actually added margin on top of that, because we
21 didn't want to be right at the limits.
22 CHAIRMAN CORRADINI: So the difference from
23 what we heard previously and what we had now is .8
24 megawatts?
25 MR. DEAVER: Yes.

1 CHAIRMAN CORRADINI: Okay, uh-huh.

2 MR. DEAVER: Right, okay.

3 DR. WALLIS: That takes kind of all the

4 stuff that's in the fuel pool already?

5 MR. DEAVER: Yes.

6 DR. WALLIS: Which is fuel -- is at the

7 bottom there. Okay.

8 (Simultaneous discussion.)

9 MR. DEAVER: Okay. Now going to the next

10 slide, this shows you that the K rate after shutdown,

11 and the green line, which is the bottom line, was the

12 prior analysis at the 36 day case.

13 DR. WALLIS: So why are the old batches

14 decaying so fast? I mean they're old batches, aren't

15 they? Why are they decaying so fast? I would think

16 they'd be pretty constant by then.

17 MEMBER ABDEL-KHALIK: Well, this is the core

18 that was just offloaded.

19 DR. WALLIS: It was just offloaded? That's

20 the old stuff that's within that core?

21 (Simultaneous discussion.)

22 DR. WALLIS: The spent fuel that was taken

23 in the fuel pool.

24 MEMBER ABDEL-KHALIK: In the immediate prior

25 cycle.

1 DR. WALLIS: It's not the stuff that's
2 already in the fuel pool?
3 MR. DEAVER: This is the total heat.
4 CHAIRMAN CORRADINI: It's the sum of all of
5 them.
6 DR. WALLIS: Including what's already in the
7 fuel pool?
8 MR. DEAVER: Yes.
9 DR. WALLIS: Where is that on here?
10 MEMBER ARMIJO: On this case, it's a 20-year
11 case. So there's several lines that contribute to
12 this composite line.
13 CHAIRMAN CORRADINI: I think that's the
14 point, Graham. That bottom line is the sum of maybe
15 five batches, and most recent batch is probably
16 dominating the other four, and that's falling off over
17 time.
18 DR. WALLIS: How recent is it, though? It's
19 years old, isn't it? It's been in there for some
20 time.
21 (Simultaneous discussion.)
22 MEMBER ARMIJO: Two years.
23 DR. WALLIS: So it can't be decaying at this
24 rate. This rate is far too rapid for any batch that's
25 been in there for a while.

1 MR. MARQUINO: So this is the accounting of
2 different batches' contribution.
3 DR. WALLIS: So batch number --
4 MR. MARQUINO: You see the oldest batch is a
5 small fraction of the most recent batch, and also here
6 you can see the contribution of the spent fuel batches
7 versus the full core discharge.
8 MEMBER ARMIJO: You can see the contribution
9 just dropping off.
10 MEMBER STETKAR: I'm a little confused.
11 This isn't decaying. I don't know anything about
12 decay heat. I just know about counting years. This
13 seems to indicate you did the analysis with ten years
14 and five previous cycles, plus the offload, which is
15 what you said orally.
16 The curves and the text in the DCD claim
17 that it's done with 20 ye ars' worth of fuel, ten
18 cycles.
19 MR. DEAVER: Well, let me explain.
20 MEMBER ARMIJO: That's why it took 20.
21 MEMBER STETKAR: Well, this only counts up
22 to five cycles --
23 CHAIRMAN CORRADINI: Let Jerry try to
24 illuminate us.
25 MR. DEAVER: What we've done, and I think

1 I've explained it before, but I'll go over it again,
2 as far as the number of fuel cells that we're actually
3 providing in this licensing submittal, it's ten years'
4 worth. But we have a pool that will accommodate 20
5 years.
6 So from a desi gn perspective, we're
7 designing our systems, the FAPCS system and our
8 buildings and structures, to handle the full 20 years'
9 worth of fuel. So when we're talking about a systems
10 situation like boil -off and such, we're using 20
11 years. But when we're talki ng about racks and the
12 rack certification, then we're talking ten years.
13 And so it makes it a little confusing, but
14 the numbers are not that much different. The
15 contribution of the ten to twenty year is only .68
16 megawatts. So it's not that much different. But what
17 you're seeing on here is the ten-year batches.
18 MEMBER STETKAR: But on the slide that we
19 jumped to this one from, your Slide No. 5 --
20 MR. DEAVER: Right. That's a 20-year.
21 MEMBER STETKAR: That's a 20-year?
22 MR. DEAVER: Yes, because this is associated
23 with the full boil -off calculation. This is what
24 we're using --
25 MEMBER STETKAR: For full boil-off?

1 MR. DEAVER: For full boil-off, from a FAPCS
2 system perspective.
3 MEMBER STETKAR: Okay.
4 MR. DEAVER: Okay, and what just -- why
5 don't we go back to that curve, Wayne? Okay. So what
6 you see on this curve is the green line is the prior
7 one, which was basically done at the 17.3 megawatts.
8 The blue line represents the new calculated
9 value, and the red line is the bounding number that
10 we're actually working to in our calculations. So
11 we've got margin in our calculations at this point.
12 CHAIRMAN CORRADINI: The bounding number
13 that you're working to. Can you say that again? I'm
14 sorry, I don't remember what that means.
15 MEMBER ARMIJO: Is the designing capacity,
16 you know?
17 MR. DEAVER: Well --
18 MR. MARQUINO: That's a number that has some
19 conservatism over the EOC case.
20 MR. DEAVER: Well, it includes the 102
21 percent power level, and so far it's got all the
22 adders associated with it.
23 MEMBER ARMIJO: But your spent fuel pool
24 cooling capability is at 20 megawatts or 22 or --
25 MR. DEAVER: Well, at -- we have to talk

1 about normal case and abnormal, okay. For the normal
2 case, what we've really just got the ten years of new,
3 you know, we discharged the current cycle and we have
4 the five discharges. That's the normal case, and we
5 have an 8.3 megawatt heat exchanger that can
6 accommodate that load.
7 But when we're considering the abnormal case
8 of a full core offload in addition, then where we're
9 at is we're using two heat exchangers, and we're also
10 allowed to have the pool temperature go up 20 degrees.
11 So now we really have a heat exchanger capability of
12 more like 29 megawatts, up in that range.
13 So it's the capability of our heat exchanger
14 system is increased significantly.
15 MR. MARQUINO: Jerry, they're asking what
16 the number is. It's 19.1 megawatts, is the value on
17 this curve at 150 hours. They're asking what number
18 do you use for the design versus the ANS calculated
19 number.
20 MR. DEAVER: Okay.
21 DR. WALLIS: So this boiling is just subcool
22 point.
23 CHAIRMAN CORRADINI: Well wait. Let him
24 answer this question before you give him another
25 question.

1 MR. DEAVER: Yes. John Burns, I believe, is
2 on the line. What's the actual heat load at the time
3 that you start the boil-off calculation?
4 MR. BURNS: This is John Burns. The actual
5 heat flow at the start of the calculation. Let's see.
6 At the 150 hour point -- hang on, I'm pulling that
7 up. MEMBER ARMIJO: So we can read it off this
8 chart.
9 MR. DEAVER: I know at the five-day point, I
10 believe John, you were at 20.1.
11 MR. BURNS: That's correct.
12 MR. DEAVER: But at the 150 hour point, I'm
13 not sure what you're at. It's something lower.
14 MR. BURNS: I've got some figure s I know
15 here.
16 MEMBER ARMIJO: It's a red curve?
17 CHAIRMAN CORRADINI: The red curve looks 19-
18 ish to me.
19 MEMBER ARMIJO: 18 something, 19 something.
20 CHAIRMAN CORRADINI: Something like that.
21 MEMBER ARMIJO: Close enough.
22 MR. BURNS: Yes. Down around the 18 mark.
23 MR. DEAVER: Okay. Is there another
24 question?
25 CHAIRMAN CORRADINI: Yes, Graham.

1 DR. WALLIS: You say "boiling." Does it
2 actually get -- the whole pool doesn't get up to the
3 boiling point, does it?
4 MR. DEAVER: Well, what we're assuming is
5 that for a 72 hour period, we have no cooling. So
6 when you cut off the FAPCS system --
7 DR. WALLIS: No pumping.
8 MR. DEAVER: Right.
9 DR. WALLIS: Okay. That's what you're
10 assuming?
11 MR. DEAVER: Yes.
12 DR. WALLIS: So it does boil off?
13 MR. DEAVER: It does boil off.
14 MEMBER ABDEL-KHALIK: I guess I have a
15 question about the previous Slide No. 4. I'm looking
16 at the blue line, which corresponds to the decay heat
17 from the core offload, and this graph starts, the
18 first point is at 36 days, and you're plotting this as
19 a function of time into the cycle.
20 Now tell me what this means. This curve is
21 really at points in time at the five day cool-down
22 point? In other words, if I offload the core at 36
23 days, after it had been running for 36 days, and
24 allow, give it five days to offload --
25 MR. DEAVER: Yes.

1 MEMBER ABDEL-KHALIK: Then my decay heat
2 from that offload would have been 14 megawatts?
3 MR. DEAVER: Yes.
4 MEMBER ABDEL-KHALIK: And if I -- if that
5 core had been operating for 180 days instead of 36
6 days.
7 MR. DEAVER: Yes.
8 MEMBER ABDEL-KHALIK: And I offloaded in
9 five days, the decay heat associated with the -- would
10 that full core that had been operating for 180 days
11 would have been 15.8 megawatts. Is that what this
12 means?
13 MR. DEAVER: Yes. That's exactly what it
14 means.
15 MEMBER ABDEL-KHALIK: Okay. So these are
16 really different scales, right?
17 MR. DEAVER: Well --
18 MEMBER ABDEL-KHALIK: Of time into the
19 cycle. Okay. That's fine.
20 MR. DEAVER: It's time into the operating
21 cycle, but it's consistent in that it's at five days'
22 discharge time.
23 MEMBER ABDEL-KHALIK: Right.
24 DR. WALLIS: So this 72 hours after your
25 core offload you're talking about, this 72 hours?

1 MR. DEAVER: Wait. Which one are we talking
2 about now?
3 DR. WALLIS: The thing is boiling off.
4 There's no water supply for 72 hours. That's after
5 you've offloaded?
6 MR. DEAVER: Yes. At the time, 150 hours to
7 222 hours.
8 DR. WALLIS: And there's no water flow?
9 MR. DEAVER: There's no water flow, and
10 we're at the worse case conditions.
11 DR. WALLIS: Your FLUENT calculations seem
12 to show water coming in all the time, the different
13 calculations.
14 MR. DEAVER: That's the rack cooling part.
15 DR. WALLIS: Or something else.
16 MR. DEAVER: Or something else, yes. Now
17 moving forward, now I have a slide that relates to the
18 boil-off analysis that's performed.
19 So again, this is a system calculation, so
20 it's at the 20 year worth of spent fuel. So we have
21 the obligation to look at a cooling or a boil -off for
22 72 hours, and the bounding case we find that the
23 evaporation is 1962 cubic meters of volume of water,
24 and this drops the water level in the pool by 10.26
25 meters.

1 DR. WALLIS: That's a lot of water.

2 PARTICIPANT: That's 30 feet.

3 MEMBER STETKAR: The minimum pool level --

4 well, let me ask you a question. Is there any way

5 that you can drain the water down to the bottom of the

6 slot, so that the -- between the pools? I had a

7 question eons ago about what the height of that?

8 MR. DEAVER: Well, we h ave a weir that said

9 14.35 meters in the pool. So we're always, you know,

10 bringing water into the pool. So it's always

11 overflowing the weir.

12 MEMBER STETKAR: Okay. Is there anyway that

13 you can cut off the water inlet? Is there any way

14 that you can drain water below that level?

15 MR. DEAVER: Well, we have these anti-siphon

16 holes that are in the piping.

17 MEMBER STETKAR: Yes. I understood for the

18 supply water.

19 MR. DEAVER: On the inlet.

20 MEMBER STETKAR: And that's the only

21 connections? I mean t here are no other connections

22 that you can --

23 MR. DEAVER: Right. The pool has no other

24 connections. It has two inlets and two outlets.

25 MEMBER STETKAR: Thanks.

1 MR. DEAVER: That's all there is.
2 MEMBER STETKAR: Thank you.
3 MEMBER ARMIJO: What happens with all that
4 water that boils up? Where does it --
5 MR. DEAVER: It just magically disappears.
6 MEMBER ARMIJO: It's got to go somewhere.
7 MR. DEAVER: We know it's going to condense
8 on walls and ceilings, and it actually ends up back in
9 the pool in some form and so this is a very --
10 MEMBER ARMIJO: That's what I was trying to
11 get at. Do you have some sort of a passive feature
12 that would put that back into the pool --?
13 MR. DEAVER: I mean obviously it's somewhere
14 in the building still, and it's going to condense and
15 it's going to end up back in the pool, you know,
16 because you've got such a large volume of water.
17 That's a lot of water.
18 MR. MARQUINO: And some of it would escape
19 the building also.
20 MEMBER ARMIJO: Can it escape the building?
21 MR. DEAVER: Well, we've had a recent
22 exchange with the NRC staff about venting and
23 preventing the building from pressurizing.
24 DR. WALLIS: You don't want it to condense
25 on some important equipment.

1 MEMBER ARMIJO: Yeah. That's what I was
2 getting at.
3 MEMBER STETKAR: Yes, I was -- I'm going to
4 have another question after we finish boiling water.
5 Is the floor level, you know, whatever you call it,
6 the refueling building floor level, where you can
7 stare into the pool, is that leak -tight from l ower
8 elevations in the building, or can water -- we're
9 talking about water condensing, you know, and where
10 does it go?
11 Can it condense on building surfaces and
12 flow to lower elevations in the building? Stairwells,
13 access? Is there any requirement -- let me ask you
14 this. Is there any requirement that it's leak-tight?
15 MR. DEAVER: No, no, it isn't.
16 MEMBER ARMIJO: Okay.
17 MR. DEAVER: We're at grade. Our floor, you
18 know, our refueling floor or the fuel building floor
19 is at grade.
20 MEMBER ARMIJO: Yes.
21 MR. DEAVER: But the water can seep down.
22 MEMBER ARMIJO: Back down into lower
23 elevations in the buildings.
24 MR. DEAVER: To lower elevations, yes.
25 MR. MARQUINO: And we have a floor drain

1 system in the building. So the -- most of the
2 condensate would flow to the floor drain system and be
3 collected.
4 DR. WALLIS: Does it set off fire alarms and
5 things like that? I expect it would, because it's
6 steam going everywhere and --
7 MEMBER ARMIJO: It's not a smoke detector
8 involved.
9 MR. DEAVER: I don't know. Mike, do you
10 have -- you have that part of the question.
11 MR. ARCARO: Yeah, I would have to look at
12 that. But I think for areas where you have steam,
13 they use a different type of detector.
14 DR. WALLIS: Okay. Well --
15 CC I don't think the temperature is going to
16 set it off, if that's what you're asking.
17 MEMBER STETKAR: You typically use an
18 ionization detector or something like that.
19 MR. ARCARO: Yes, right.
20 MEMBER STETKAR: It would be a heavy
21 humidity situation --
22 MR. DEAVER : I don't think 100 percent
23 humidity would ever set it off.
24 DR. WALLIS: Well, it's an awful lot of
25 water. It's going somewhere.

1 MR. DEAVER: Yes, that's right.
2 DR. WALLIS: That's right.
3 MEMBER ARMIJO: That's why you have some
4 flooding somewhere, that you don't want it to flood?
5 It all goes into these floor drains and in the tanks
6 or other pools?
7 MR. DEAVER: Yes. It would go back into our
8 water systems, and so we wouldn't necessary lose the
9 water.
10 MEMBER ARMIJO: So you don't worry about any
11 kind of flooding that would come from condensation of
12 --
13 CHAIRMAN CORRADINI: I just want to make
14 sure we're not deviating. This is a design basis
15 calculation they're required to do. So I -- if we're
16 going to ask them to be realistic.
17 MR. DEAVER: Yes. In the real case, if
18 we're starting to lose pool water, we're going to
19 start using fire water and other sources to refill the
20 pool.
21 MR. MARQUINO: And also you're talking about
22 investment protection versus safety, because --
23 MEMBER ARMIJO: Oh, I understand. I'm just
24 curious. Right.
25 MR. DEAVER: Okay. So as a result of this,

1 we just recently, based on the new heat calculations,
2 we've updated the DCD sections. We have more boil-off
3 than we had previously, and that affected some of the
4 tech spec requirements. But what we've shown is that
5 even under these severe cases, we still have fuel
6 cover.
7 MR. MARQUINO: 30 feet of water.
8 MR. DEAVER: And, you know, that we never
9 uncover the actual stored fuel. Okay. So that's the
10 boil-off analysi s. Then we get into the rack
11 thermohydraulic analysis.
12 DR. WALLIS: But it's boiling pretty
13 vigorously then, if it's giving off -- I'm trying to
14 figure out what's the sort of state of the pool. But
15 there's quite a velocity of steam coming off that
16 pool, isn't there?
17 I'd have to calculate it. But this huge
18 amount of water, even in three days, it's still a
19 pretty rapid --
20 MR. DEAVER: You're going to have some
21 active boiling going on.
22 DR. WALLIS: It looks like the staff would
23 be interested in what happens to all this great plume
24 of steam and where it goes and what it does. Even
25 though it's a design basis action, you'd be looking

1 for consequences.

2 MR. DEAVER: Right, okay. Okay. As a

3 result of the heat load calc, revised heat load calc,

4 we also had to look at the fuel storage rack

5 thermohydraulic analysis, and we -- in this case, it's

6 the ten years' worth of fuel, and we assumed a heat

7 load of 19 megawatts, which was greater than the 17.3

8 that we previously had in our licensing topical

9 report.

10 But what we've done is we had a prior

11 analysis where we looked at 29 megawatts. That was a

12 very early point in time after shutdown of the

13 reactor, and very conservative. So we have a bounding

14 case, is what it amounts to. So we're modifying the

15 LTR to introduce again the 29 megawatt case, to look

16 at the critical parameters associated with the fuel

17 pool.

18 So we have the exit temperature is an issue,

19 and the amount of temperature that exits the racks.

20 DR. WALLIS: What do you mean by the rack

21 exit temperature? This is the maximum rack exit

22 temperature?

23 MR. DEAVER: This is the maximum exit

24 temperature, and again --

25 DR. WALLIS: There's a distribution of

1 temperature. This is the maximum.

2 MR. DEAVER: Right.

3 DR. WALLIS: Okay, because it just say s

4 "rack exit temperature." It doesn't say "maximum."

5 MR. DEAVER: Well, yes, and we assumed the

6 worst case conditions. We put the hot bundles at the

7 farthest point in the pool, you know, furthest away

8 from the cooling flow. So this is the temperature

9 coming out of the top of the racks.

10 DR. WALLIS: So this is the maximum

11 predicted by FLUENT or something, when you look across

12 the spectrum.

13 MR. DEAVER: The CFT program, right. So the

14 calculated value for the 29 megawatt case was 80.9

15 degrees Centigrade, and the limit is 121. So we have

16 a lot of margin still in this case. The other thing

17 we look at is the fuel cladding temperature. In the

18 29 megawatt case, it was calculated to be 97.12

19 degrees Centigrade.

20 So the real criteria is it has to be belo w

21 100, and but again we'll be -- this is a bounding

22 number.

23 DR. WALLIS: We'll presume it's more than

24 100, because of the depth of water to increase the

25 pressure. So all --

1 MR. DEAVER: Yes. Our real limit is
2 something above 100.
3 DR. WALLIS: That's right.
4 MR. DEAVER: And then the -- then the last
5 bullet is there's no condition within the fuel
6 assembly that causes boiling. Therefore, nuclide
7 boiling is prevented.
8 So as we've gone through this case, with
9 this bounding point on megawatt cas e, we've
10 demonstrated that this fully satisfies all the
11 requirements that we would have at the 19 megawatt
12 case. Okay. Any questions?
13 DR. WALLIS: I was wondering why you did the
14 29 megawatt case, which is so much bigger?
15 MEMBER ARMIJO: They just did.
16 MR. DEAVER: That was actually an earlier
17 point in time, a couple of years ago. So we were
18 being very conservative at that point. Okay. Going
19 to the next slide, last, I believe it was the last
20 meeting or the one before, we had some discussion
21 about the streamline effects.
22 And so when we went back to our, the people
23 who did our analysis, what we found is that the
24 domains in the racks were actually blocked, so that we
25 couldn't see the flow.

1 DR. WALLIS: Well, the very interesting
2 thought was not in the figure at all.
3 CHAIRMAN CORRADINI: It was calculated. It
4 didn't go in the figure.
5 MR. DEAVER: There are three things, I
6 think, that the comments revolved around. One was we
7 had a hard time understanding the figures you gave us.
8 Second was you guys told us there was some blockage
9 factor, and third was the fact what Graham said, is
10 that all the streamlines that were shown were outside
11 of the racks, or patterns, whatever they are.
12 So what we've had them do is just turn on
13 the domain where the inlet flow and one of the hottest
14 racks is shown, as far as the streamline effects. So
15 now you can see the cooling coming in through the
16 bottom of the racks, and then the flow as it goes
17 through the rack itself.
18 DR. WALLIS: There's a big vortex or
19 something above the rack, something that swirls
20 around?
21 MR. DEAVER: Yeah. It's probably just the
22 normal flow of heat that's being discharged off the
23 top of a hot source.
24 MEMBER ARMIJO: There's no cross-flow within
25 these domains or the racks?

1 MR. DEA VER: No, no. The actual racks
2 prevent flow. So these are real silos, you know, or
3 chimneys.
4 MEMBER ARMIJO: Okay.
5 MR. DEAVER: So we think, you know, this is
6 a much better piece of information as regarding how
7 the flow really occurs. So we've inclu ded this
8 already into our LTR revision, and --
9 DR. WALLIS: Now where it goes up to 73
10 degrees, is that what I conclude from this?
11 MR. MARQUINO: Yep.
12 MR. DEAVER: Right.
13 DR. WALLIS: And that's Fahrenheit. No, no.
14 It's C, C.
15 MR. DEAVER: That would be degrees C.
16 DR. WALLIS: Okay, uh-huh.
17 MR. DEAVER: So we think this helps explain
18 the streamline effects, you know, and this is
19 reasonable. Okay. Moving on to one of the RAI
20 topics, this RAI 19.1 -128 SO-1. This dealt with the
21 question of could we uncover fuel or have it drain
22 down in the actual vessel cavity?
23 Our configuration is such that we have a
24 refueling bellows that is a 360 degree structure that
25 goes around the vessel, and it separates the upper

1 cavity from the dry well, and it pr otects people from
2 down below.
3 So that's a design we've had in all of our
4 BWRs going back, at least starting with BWR -2s. So
5 we've had a very good history of operation with that
6 type of bellow seal. It's got a lot of flexibility in
7 it to accommodate vessel expansion and so forth.
8 So in this question, we address the issue
9 of, you know, reliability of this refueling bellows.
10 We discussed issues with plugs that we use for the
11 steam line and IC system and so forth, and address the
12 general issue of inadvertent drain down of valve
13 configurations during outages and the potential for --
14 DR. WALLIS: These are the seals that leaked
15 in some of the Mark I's that --
16 MR. DEAVER: I only know of one plant that
17 had any leakage in the bellows, and it was very minor.
18 But they did have to address it. That happened to be
19 in Spain. So in general, these bellows have been very
20 reliable, and they actually have the ability to block
21 it off. Well, we have a leak detection system that's
22 in operation all the time.
23 DR. WALLIS: You have somewhere that if it
24 does leak, it's directed out into a suitable drain or
25 something?

1 MR. DEAVER: Right. If there's actual
2 leakage in the bellows then yeah, there is a drain
3 line that goes off to a sump. So we think, you know,
4 through the addition of information in the DCS or DCD,
5 and with the response to the questions, we've you
6 know, adequately responded to the potential for drain
7 down.
8 We have nothing really different than prior
9 BWRs, and we haven't had an issue with drain down.
10 DR. WALLIS: What does this "not credible"
11 mean? I mean I'm sure we've had this discussion
12 before, but I'm always puzzled by what is credible.
13 To a scientist, almost everything is credible.
14 Without it, it would violate the second law.
15 CHAIRMAN CORRADINI: What are you looking at
16 Graham? I'm sorry.
17 DR. WALLIS: It says "fuel uncovery is not
18 credible." I'm just saying to a scientist, everything
19 is credible. It's just a question --
20 CHAIRMAN CORRADINI: We're engineers,
21 though.
22 DR. WALLIS: --of how likely it is, and even
23 to engineers. I can conceive of it and it's
24 believable, but I'm just -- it's very unlikely is what
25 you mean, right?

1 MR. DEAVER: Right.

2 DR. WALLIS: Then that calls the question of

3 how unlikely it is.

4 MR. DEAVER: That's why they said credible.

5 DR. WALLIS: That's right, so you don't have

6 to give a probability. There's no experience with it.

7 It hasn't happened before. Therefore, it's very

8 unlikely to happen again. That's what you're saying.

9 MR. DEAVER: Well, I don' t know many years

10 of reactor operation we've had with this

11 configuration, but we've never had an issue with it.

12 DR. WALLIS: That's right.

13 MR. DEAVER: And even if we had some leakage

14 --

15 DR. WALLIS: Well, TMI was incredible until

16 it happened.

17 MEMBER ARMIJO: You'd have to have a massive

18 leak.

19 MR. DEAVER: Yes. I mean you'd have to be

20 asleep while it happened.

21 DR. WALLIS: That's right.

22 MR. DEAVER: Yes. Okay, then moving onto

23 the next RAI is 9.1 -155 SO-1. This dealt with the

24 potential for gas accumulation in the FAPCS system,

25 and you know, and the issues were water hammer, gas

1 binding in pumps and inadvertent leaks --

2 DR. WALLIS: Gas is what kind of gas?

3 MR. DEAVER: Well, that's part of the answer

4 is that it's not reactor non-condensible gas, because

5 it's not connected with the reactor system.

6 DR. WALLIS: So it's air or nitrogen or

7 something?

8 MR. DEAVER: It would have to be that, and

9 the most likely problem would be in servicing, where

10 somehow you didn't fill the system, and you left a

11 volume of air in the system, and then the system would

12 start up.

13 DR. WALLIS: That has nothing to do with the

14 accumulation of other gas from the reactor?

15 MR. DEAVER: No, no. We don't have that

16 issue, and that was our response, is that it's a low

17 pressure system. It doesn't come in, you know. It's

18 not connected to the reactor system's primary coolant

19 boundary, and therefore it has no ability to, you

20 know, to collect these non-condensibles.

21 Then our second bullet is associated with

22 the line slope of vents and drains and such, that with

23 adequate piping of the system, then we minimize the

24 gas accumulation. And then with maintenance

25 procedures, then we take care of any of the --

1 DR. WALLIS: These vents are automatic?
2 They automatically vent, or do they set off an alarm?
3 MR. DEAVER: No. These are all manual
4 vents.
5 DR. WALLIS: So someone has to come and open
6 them up?
7 MR. DEAVER: Right. I mean they're just for
8 servicing purposes.
9 DR. WALLIS: But there is an alarm, isn't
10 there, on the vent? I think there is an alarm on most
11 vents like that.
12 MR. DEAVER: I don't think so. These are
13 just manual valves.
14 DR. WALLIS: They are? You just have to
15 remember to go and check them or something?
16 MR. DEAVER: Well, that's all part of th e
17 maintenance procedures. You've got to be able to
18 validate the valve positions after you, you know, and
19 the fact that the system's been vented.
20 MEMBER ARMIJO: So we've --
21 (Simultaneous discussion.)
22 DR. WALLIS: --talking about the GDCS line
23 and stuff. There were vents there which were actually
24 alarmed. Maybe I'm wrong.
25 MR. MARQUINO: Well, we haven't determined

1 exactly what alarms are going to be set by what
2 conditions. That's part of our HFE commitment. We
3 have a lot of instrumentation and indications in the
4 plant. But in terms of what is important enough to
5 alert the operator, that hasn't been finalized.
6 DR. WALLIS: When you are really concerned
7 about gas, you have an alarm on the vent.
8 MR. DEAVER: Yes. The GDCS is, yes, a
9 different situation. But with air, we mainly -- we
10 have ITAACs now that go in and establish that the
11 proper slopes have been established, and that's not
12 going to change after you've built the plant. So the
13 ITAAC should take care of any future operating
14 conditions.
15 So at any rate, we don't think we have a gas
16 accumulation issue. Okay.
17 MEMBER STETKAR: Before you go to RTNSS,
18 this is a bit off the wall, but that's what your tax
19 dollars pay me to do.
20 (Laughter.)
21 MR. DEAVER: And we appreciate it.
22 MEMBER STETKAR: And at the moment, they're
23 not paying me to be anything, but that's a different
24 issue. I was looking at the FAPCS system, thinking
25 about some other things. The reason I asked things

1 about drainage of water earlier is the nice little
2 drawing, t he one -line drawings of the fuel and
3 auxiliary pool cooling system in the DCD, I think it's
4 Figure 9.1-1, is not an elevational drawing.
5 The tops of the spent fuel pool floor is at
6 great elevation, as I think you said earlier.
7 MR. DEAVER: Yes, uh-huh.
8 MEMBER STETKAR: That's the bottom of the
9 suppression pool is at great elevation; is that right?
10 MR. DEAVER: Yes. I think that's not
11 correct also.
12 MEMBER STETKAR: The bottoms of the GDCS
13 pools are substantially higher than that.
14 MEMBER STETKAR: Now during normal
15 operation, according to the system description, one
16 train of the fuel and auxiliary pool cooling system is
17 normally a line for cooling the, not surprisingly
18 enough, fuel, spent fuel pool.
19 MR. DEAVER: Right.
20 MEMBER STETKAR: It says that the other
21 train can be aligned as necessary for cooling or
22 clean-up of the suppression or, if necessary, the GDCS
23 pools. You can align it anywhere. If I look at the
24 system design, and if I have the system operating with
25 one train circulating the sp ent fuel pool, and I line

1 up the other train to the -- some of the other pools
2 at a higher elevation, if I have one valving error, I
3 can drain the suppression pool or the GDCS pool into
4 the fuel pools, overflow the spent fuel pools, and
5 where does the water go?
6 How fast can I do that? There's no check
7 valve that I can find in the suction line that
8 prevents reverse flow. So I just have a basic gravity
9 drain through the system.
10 MR. DEAVER: But we have cross-tie valves
11 that don't allow you to switch from one system to the
12 other.
13 MEMBER STETKAR: Yes. I said with one valve
14 error. I can drain -- so the question is, and if I do
15 that, because the fuel and auxiliary cooling pumps are
16 at the bottom elevation of the fuel building, if the
17 fuel pools can overflow and flow down into the bottom
18 of the building with a reasonable flow rate, they get
19 flooded and I've lost my system, which has
20 implications for RTNSS and, you know, also building
21 flooding and all of that kind of stuff.
22 So I was curious. I do need either a valve
23 failure or an operator error to do this to me?
24 MR. DEAVER: Yes.
25 MEMBER STETKAR: But I was just curious how

1 fast it can happen and how far can I drain down? I'm
2 a little bit concerned about if it does happen, how
3 far can I drain down either the GDCS pool, if it's
4 aligned that way, or the suppression pool, if it's
5 aligned that way.
6 I don't know where the -- I have no, you
7 know, isometric drawings that show where the suction
8 lines come off those pools.
9 MR. DEAVER: Yes. I'm not sur e that that's
10 a --
11 MEMBER STETKAR: I thought there might be a
12 check valve in the suction line that prevented that
13 reverse flow back up into the fuel pools. But I
14 couldn't find one.
15 MR. DEAVER: Yes. I'm not sure that that's
16 possible when you're swit ching off between systems.
17 What might be a correct check valve in one direction
18 may not be good when you're --
19 MEMBER STETKAR: Well now you'd always want
20 to take suction from that line.
21 MR. DEAVER: Okay.
22 MEMBER STETKAR: You know, it's the drain
23 line out of the, whatever you call them, the skimmer
24 overflow pool or something like that.
25 MR. DEAVER: Right, surge tanks.

1 MEMBER STETKAR: There's a -- yes. There's
2 a drain line that goes down to the suction of the
3 cooling pumps. You'd never want to pump water back up
4 that line for any reason.
5 MR. BEARD: Alan Beard with GEH. At least
6 one point that I'd like to make is that the system
7 that we use for cooling and purifying the GDCS pools
8 is its own dedicated system. It is part of FAPCS that
9 it doesn't share IC stuff that --
10 MEMBER STETKAR: IC-PCC pools, according to
11 the DCD, is it own separate system. I have a separate
12 question about that one. That's the only single --
13 MR. BEARD: Your concern, yes.
14 MEMBER STETKAR: GDCS pool and --
15 MR. BEARD: Yes.
16 MR. DEAVER: Right. The IC system, we
17 wanted to keep it clean.
18 MEMBER STETKAR: I'm going to ask you about
19 that when we get to RTNSS. But I was just curious
20 about it. I don't know the line sizes. I don't know
21 the drainage rates.
22 MR. BEARD: What you're worried about is
23 GDCS draining back through?
24 MEMBER STETKAR: I'm worried about a couple
25 of things. I'm worried about either GDCS or

1 suppression pool draining back through overflow. You
2 know, what would happen is the spent fuel poo ls would
3 just fill up and overflow.
4 CHAIRMAN CORRADINI: So I'm not sure. I
5 understand the GDCS. I'm not understanding that one.
6 That's the one I didn't understand, because I thought
7 they were at the bottom. Both were the same.
8 MEMBER STETKAR: The bottom, I'll use the
9 graphic. The bottom of the GDCS pool is here; the
10 bottom of the suppression pool is here. The top of
11 the fuel pools is here.
12 CHAIRMAN CORRADINI: Oh, I thought the
13 bottom of the fuel pool was there.
14 MEMBER STETKAR: No, no.
15 CHAIRMAN CORRADINI: So what he said is
16 correct?
17 (Simultaneous discussion.)
18 MEMBER STETKAR: I can gravity drain with
19 one valving error. I can gravity drain water from
20 here. But I don't know where the suction lines take
21 off. I'm assuming they're close to the bottom,
22 because I'd like them to be there. But I don't know
23 that to be true.
24 CHAIRMAN CORRADINI: Right, okay. Now I get
25 it. Thank you.

1 MEMBER STETKAR: And it's a question of
2 draining that volume, because that's water that I'd
3 like to have for other purposes, and where does the
4 overflow from the fuel pool go, because my fuel and
5 auxiliary pool cooling system equipment that I'd like
6 to have for other purposes is down in the basement.
7 I mean this is a large line. I mean I know
8 you have floor drains and things, but --
9 MR. DEAVER: Well no, but what --
10 MEMBER STETKAR: A two-inch floor drain
11 might not handle a ten-inch line.
12 MR. DEAVER: No, but what should happen is
13 that any excess flow should go over the weir, and go
14 into the surge tank. So --
15 MEMBER STETKAR: I'm coming up that way,
16 though. That's the water -- the water is flowing out
17 of the surge tank up. That's my water. That's my
18 inlet. That's my source. It's coming back through
19 the suctions of the pumps.
20 I mean if y ou can think of, you know, the
21 cartoon, up that line, flooding back into the skimmer
22 lines and out over the tops of the pools. It's, you
23 know, if you had a make -up on your swimming pool and
24 left it on overnight, it would be what was flooding
25 your swimming pool for you, from the suction of your

1 pumps.

2 MR. DEAVER: Yes. I don't think we have an

3 immediate answer for you on that topic, unless --

4 MEMBER STETKAR: Okay. But I mean the two

5 concerns is how fast, you know, how fast can I drain

6 those, the safety-related pools if you will, the GDCS

7 pool or the suppression pool, because I don't know the

8 line size basically.

9 CHAIRMAN CORRADINI: But you know that.

10 What is the pipe diameter for the FAPCS?

11 MR. DEAVER: They vary throughout the

12 system.

13 MEMBER STETKAR: They vary and I haven't

14 found conclusive numbers, so I'm not quite sure. I

15 think they're fairly large lines, but I'd like to know

16 what they are.

17 And then the question is, the reason I asked

18 earlier when we were talking about the steaming, is if

19 we do overflow the fuel pools through, you know,

20 flooding up over the tops of the skimmer line, where

21 does that water go? Does it just flood over and down

22 into the bottom of the, you know, the basement of the

23 fuel building, in which case you'd flood out --

24 MEMBER ARMIJO: Your pumps.

25 MEMBER STETKAR: Your pumps. It's not a

1 design basis, I will fully admit that.

2 MEMBER ARMIJO: It would be nice to know.

3 MEMBER STETKAR: But it's -- if I can do it

4 with one valving error, I might be able to do it some

5 time. Or there might be a check valve in that suction

6 line from the skimmer, whatever you call them, the

7 surge tanks or something like that. It just doesn't

8 show up on the single one line.

9 MR. DEAVER: We have a relatively new system

10 engineer working on that system.

11 DR. WALLIS: Can you trace the line --

12 MEMBER STETKAR: You might want to, you

13 know, check back with him. I'm glad we talked about

14 this today, because we still have tomorrow.

15 DR. WALLIS: Can you trace the line for us

16 on Figure 36 or something, is that too hard?

17 MEMBER ARMIJO: Your backup slides.

18 MEMBER STETKAR: Oh, the backup slides? Oh.

19 I didn't --

20 (Simultaneous discussion.)

21 MEMBER STETKAR: Yes, okay.

22 MEMBER ARMIJO: You have cooling mode and

23 all sort of the --

24 MEMBER STETKAR: Go to that. I didn't

25 realize there was --

1 DR. WALLIS: The elevations are wrong, but
2 the lines are right.
3 MEMBER STETKAR: The elevations are wrong.
4 I mean the problem is this is similar to the figure in
5 the DCD. You're led to b elieve that the fuel pools
6 are higher in elevation that the GDCS, which isn't
7 true. It's actually reversed. But the flow path
8 would be just line up the suction line from the GDCS
9 pool or the suppression pool, coming out of this --
10 there's two check valve s. There. You have your
11 little hand there, through those two little checks,
12 yes, however that is.
13 Through those two little check valves, out
14 to the suction of the pump, and then just because you
15 can line, align either pump train to either flow path,
16 I need to have one of those normally closed suction
17 valves misaligned.
18 Such that I line up the suppression pool,
19 let's call it suction flow, back through that common
20 suction header now, because they're cross -tied, up
21 through what's highlighted on this figure, the green
22 line, back up -- you see there's no check valve in
23 that line. Back up overflowing the skimmer surge
24 tanks to the skimmer lines, and out into my building.
25 DR. WALLIS: But aren't the check valves

1 that you just showed us that are in between the
2 reactor building and the containment?
3 MEMBER STETKAR: They are. They're designed
4 to work the way I want the water to go.
5 DR. WALLIS: Oh, so they don't help you at
6 all? They work --
7 MEMBER STETKAR: They help me. They don't
8 help this problem. I mean those check valves you want
9 to work that way, because it's -- when I thought about
10 it, if there were a similar check valve in that green
11 suction line, such that it would allow water to flow
12 from the skimmer surge tank to the suction of the fuel
13 and auxiliary pool cooling system, and not allow
14 reverse flow back up into the skimmer surge tank, I
15 wouldn't worry about this.
16 CHAIRMAN CORRADINI: So you're saying,
17 you're saying the -- you're saying the green line
18 coming out of the skimmer surge tank should have a
19 check valve, as does the suppression pool does?
20 MEMBER STETKAR: Exactly.
21 CHAIRMAN CORRADINI: I've got it.
22 MEMBER STETKAR: The suppression pool line,
23 any way you can line up the system to something inside
24 the containment, as a check v alve to prevent reverse
25 flow in that direction.

1 MR. GELS: This is John Gels in Wilmington.
2 I kind of -- I have access to more detailed diagrams
3 for the system, and I can confirm that there actually
4 are check valves on the exit of the surge tank.
5 MEMBER STETKAR: Ahh.
6 MR. GELS: Yes. But additionally, the
7 suction lines from the suppression pool, those lines
8 have valves that are safety -related and normally
9 closed. They only open when we're in the suppression
10 cooling mode, and they will close again if the pumps
11 trip.
12 MEMBER STETKAR: But in this case, the pumps
13 wouldn't trip. I don't know if you were listening to
14 the whole thing. I walked you into this during normal
15 operation.
16 We're not talking about accident conditions
17 or anything. Normal operation, when for some reason,
18 you need to align one of the trains of FAPCS to either
19 cool or clean up or whatever the suppression pool or
20 the GDCS pools.
21 So it's not an accident condition or
22 anything. It's just a normal operational alignment of
23 that system, which can in fact be simultaneously
24 operated in parallel, provided the valves are aligned
25 correctly.

1 But the answer is, though, you confirmed
2 that there are indeed check valves in the suction line
3 from the skimmer surge tanks?
4 MR. GELS: That is correct.
5 MR. DEAVER: Yes. This is a simplified
6 diagram.
7 MEMBER STETKAR: Thank you. That answers my
8 whole question.
9 MR. DEAVER: Okay.
10 MEMBER STETKAR: Thank you very much.
11 MR. DEAVER: Thanks, John.
12 DR. WALLIS: So we learned once again th at
13 the devil's in the details. If the details aren't
14 shown, you don't know them.
15 MEMBER STETKAR: No.
16 MEMBER ARMIJO: That's always the case.
17 MEMBER STETKAR: Thank you.
18 MR. DEAVER: I think that finishes my part.
19 I'll turn it over to Mike to go into RTNSS.
20 MR. ARCARO: Mike Arcaro. I'm the principle
21 engineer for the balance of plant side of ESBWR. What
22 I wanted to do today is just go through some of the
23 auxiliary systems, and key on the RTNSS functions, and
24 then also talk about some of the other design features
25 associated with plant investment protection.

1 The auxiliary systems support RTNSS
2 functions. We had an RAI that talked about providing
3 a description of those functions in Tier 1. So we did
4 that. So in the DCD, you'll find Tier 2 d escriptions
5 of all the RTNSS functions, and corresponding Tier 1
6 ITAAC associated with those functions. Okay, next
7 slide.
8 Going through, this table came out of 19
9 Alpha of the DCD, and it's got an overview of the
10 RTNSS functions. I broke it down into j ust the BOP
11 systems associated with RTNSS. So we'll go through,
12 you know, the first couple of items there have to do
13 with the fire protection system. Fire protection
14 system for ESBWR is supporting the RTNSS-Bravo
15 function, which is a safety function after 72 hours.
16 This is part of the fire protection system
17 that's providing water to the ICPCCS pools post -72
18 hours for make-up. The piping going to the, from the
19 CAT-1 fire protection tanks to the connections at the
20 reactor building are CAT-1 piping in a CAT-1 trench.
21 This part of the system is completely
22 separate from the FAPCS pool cooling system. So it's
23 a separate.
24 MEMBER STETKAR: Quick, before you get into
25 it. I really appreciate this presentation, by the

1 way. Just to make sure I'm oriented ri ght, anything
2 that's RTNSS-B is in a seismic Category 2 building; is
3 that correct?
4 MR. ARCARO: CAT-2 or better.
5 MEMBER STETKAR: Yes, CAT -2 or better. But
6 C is non-seismic, right?
7 MR. ARCARO: C would be --
8 MEMBER STETKAR: Unless it's for other
9 reasons in a CAT-1 or CAT-2.
10 MR. ARCARO: That's true.
11 MEMBER STETKAR: Okay.
12 MR. ARCARO: And then 19 -- there's also a
13 table that tells you the housing for RTNSS.
14 MEMBER STETKAR: But I mean the general
15 principle is if it's written as B, it's got to be CAT-
16 2 or better. If it's written as C, there's no --
17 MEMBER ARMIJO: No requirement.
18 MEMBER STETKAR: There's no requirement,
19 strictly from a RTNSS perspective.
20 MR. ARCARO: Right, that's correct.
21 MEMBER STETKAR: Okay.
22 MR. ARCARO: S o the fire protection system
23 components that we're talking about are in the fire
24 pumping closure area, which is a CAT -1 structure. So
25 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

1 assumptions on temperature of the water in pools, and
2 in particularly obviously I'm interested in --
3 MEMBER ARMIJO: ICPCCS.
4 MEMBER STETKAR: --the ICPCC, the PCC
5 function.
6 MR. DEAVER: I don't know the answer. I
7 think it's more of a functional thing. You don't want
8 water boiling off and having to make up water all the
9 time. You'd like to keep it cool enough so that you
10 don't get that heavy evaporation, is my first guess.
11 MEMBER STETKAR: Well, but I mean your
12 accident analyses must start with some assumed pool
13 water temperature, right?
14 MR. DEAVER: Yes.
15 MEMBER STETKAR: And I guess my question is,
16 is that system relied on to maintain that water at
17 that temperature?
18 MR. DEAVER: Yes.
19 MEMBER STETKAR: So why isn't that system a
20 RTNSS system, or that train or this train?
21 MR. MARQUINO: Because if it didn't work, it
22 would be -- if it didn't work, it would depend on
23 other conditions in the plant, in terms of whether you
24 got to the tech spec LCO, and then if you got to the
25 tech spec LCO, you'd be taking the action through

1 required actions.

2 MEMBER STETKAR: Is there a tech spec LCO on

3 pool temperature?

4 MR. MARQUINO: Yes.

5 MEMBER STETKAR: Is there? Okay, I don't

6 remember.

7 MR. MARQUINO: I'll check on that.

8 MEMBER STETKAR: Check that. I honestly

9 don't remember. I mean I didn't try to dog it that

10 far. I was just trying to think about what function

11 this, that other little train provided, and whether or

12 not it should be -- it certainly shouldn't be safety-

13 related, but at least RTNSS is a support function.

14 MR. DEAVER: John Gels, do you have any

15 comment on that?

16 MR. GELS: I'm sorry. Can you please repeat

17 the question?

18 MR. MARQUINO: Is there a tech spec limiting

19 condition for o peration on the PCC -IC pool

20 temperature?

21 MEMBER STETKAR: Temperature.

22 MR. GELS: I don't know if that is an LCO,

23 but I can check on that.

24 MR. MARQUINO: Would you please, so we can

25 get an answer?

1 MR. GELS: Yes.

2 MS. CUBBAGE: PCCIC, not spent fuel.

3 CHAIRMAN CORRADINI: I'm sorry Amy.

4 MEMBER STETKAR: No, this is PC -- this is

5 ICPCC.

6 MEMBER ARMIJO: Pools.

7 MEMBER STETKAR: Pools. This other little

8 train only cools those pools. Okay, thanks.

9 MR. ARCARO: So we'll find out about that.

10 Let's see, going through the rest of the items on this

11 list, we talked about the fire protection water tanks,

12 their function. Also, all the support systems that

13 provide support, fire protection system for this

14 RTNSS-B Bravo function are in there.

15 So the ventilation system, the diesel supply

16 to the fuel for the diesel fire pump, those are all

17 part of the support for that.

18 MEMBER STETKAR: Mike, in the description of

19 the fire protection system, it talks about -- there's

20 two, I think they're called primary fire water pumps,

21 and two, I don't remember whether they're called

22 secondary or two other pumps. Those other pumps and

23 the piping aren't shown on any of the drawings in the

24 DCD.

25 Do they tie into the primary part of the

1 fire protection system that's shown on the DCD, or if
2 they do, where? And how are they protected? I'm
3 thinking about seismic failures. How are piping
4 breaks in that obviously non-seismically qualified
5 part of the system protected from diverting flow from
6 this function?
7 MR. ARCARO: Okay. So this function here
8 has its own dedicated line coming from the primary
9 fire water storage tanks to the reactor building, to
10 the manual valves for filling these pools. The
11 secondary loop of fire protection is provided by the
12 site.
13 So in the 951 of the DCD, you'll see COLA
14 items that talk about in addition to the primary
15 system, you have to provide a secondary system. It's
16 550,000 gallons of fire water for the secondary loop,
17 and that's in order to support design basis fires for
18 the turbine building and for other buildings
19 throughout the plant.
20 MEMBER STETKAR: And is there a requirement
21 somewhere specified that that will normally remain
22 isolated from this primary side, or do you simply take
23 credit because this is a 72-hour event? I'm thinking
24 about, you know, a seismic event, where you can break
25 the non-seismically qualified section of piping that

1 may or may not be normally connected to the primary
2 side.
3 MR. ARCARO: Right, right.
4 MEMBER STETKAR: And can you drain your
5 primary water stored, you know, your tanks during that
6 interim period, 72-hour period before you need it?
7 MR. ARCARO: Right, right. If you look at
8 Figure 951 of the DCD, it will show you the primary
9 loop and then the secondary loop is from yard piping.
10 And going into th e nuclear island, there's check
11 valves. So the system is designed so that you can
12 feed from the secondary side for a fire, but not, you
13 know, invalidate the primary loop, water provided.
14 MEMBER STETKAR: Yes, got it, got it. Thank
15 you.
16 MR. ARCARO: O kay. I guess the other thing
17 on this slide is the oversight and, you know, how we
18 verify functionality of the system. So for these, all
19 these functions here in the availability control
20 manual, there's actual LCOs that we do to verify that
21 the system can operate the support the function.
22 MEMBER STETKAR: LCOs in your, not tech spec
23 LCOs?
24 MR. ARCARO: Correct, correct.
25 MEMBER STETKAR: Yes.

1 MR. ARCARO: Availability LCOs.

2 MEMBER STETKAR: ALCOs, ACLCOs.

3 MR. ARCARO: So next slide, we're talking
4 about the support systems again, ancillary diesel
5 generators, standby diesel generators. Ancillary is
6 supporting the Bravo function. So it's safety system
7 functions post -72 hours. This is in a CAT -2
8 structure.

9 This, the loads are shown in Chapter 8 of
10 the DCD, but it's supporting the fire pump, the motor-
11 driven fire pump, PCCS fans, control room
12 habitability, recirc air handling units and the
13 cooling unit. Also emergency lighting and Q -DCIS for
14 post-accident monitoring.

15 Standby diesel generators. These are the
16 large diesel generators that are supported by service
17 water, RCCW. These are 15 megawatt generators. The
18 ancillary diesel generator is a 850 to 1,700 kW
19 diesel. So a difference in size there.

20 Standby diesel generators also have
21 availability LCOs to ensure operation. Here we see
22 for the ancillary diesel, the HVAC is supporting the
23 functions, so it's also listed as a RTNSS system.
24 Standby diesel generators are supported by the
25 electric building HVAC. So that's also supported.

1 For the systems that are normally operating,
2 where the availability controls the maintenance role
3 rather than availability of controls LCO.
4 MEMBER STETKAR: The standby diesels are in
5 the electrical building?
6 MR. ARCARO: That's correct. Yes, the have
7 separate bays in the electric building.
8 MEMBER STETKAR: Is the electrical building
9 a non-seismic structure? I don't remember.
10 MR. ARCARO: I believe it's a CAT-2.
11 MEMBER STETKAR: Is it a CAT-2?
12 MR. ARCARO: A CAT-2 structure.
13 MEMBER STETKAR: I remember your seismic.
14 You don't need to consider soil liquefaction under
15 CAT-2 buildings though, right, for your seismic
16 qualifications?
17 MR. MARQUINO: We lost our single structural
18 representation.
19 MEMBER STETKAR: Again, thinking of
20 earthquakes, if I have a liquefaction problem, I think
21 there's a COL item that they have to address
22 liquefaction under CAT-2 buildings.
23 CHAIRMAN CORRADINI: That's a COL item?
24 MEMBER STETKAR: I think so, if I recall.
25 CHAIRMAN CORRADINI: Can we save that for

1 the staff?

2 MEMBER STETKAR: I need to go back and look

3 at my -- yes.

4 CHAIRMAN CORRADINI: Let's save it for the

5 staff.

6 MEMBER STETKAR: You may want to look that

7 up. I have to go back and look at my notes from

8 another chapter, but I think that's true.

9 MR. ARCARO: Okay, next page. Okay. CAT or

10 RTNSS-Charlie functions here. So now we're providing

11 functions supporting the diesel generators, the RCCW,

12 the cooling, that's supporting the FAPCS RTNSS-Charlie

13 functions for suppression for cooling and low pressure

14 injection.

15 So reactor building has functions to cool N-

16 DCIS for a FAPCS system. Turbine building has

17 cooling, local cooling for the FAPCS that in the

18 turbine building, you have the RCCW pumps. RTNSS -

19 Bravo control room habitability air handling units.

20 So for control room habitability, RTNSS-Bravo function

21 that is supported by the recirc air handling units and

22 the auxiliary cooling units.

23 Then also that air handling unit and

24 auxiliary cooler supports the post-accident monitoring

25 heat loads in the Q-DCIS. Next slide.

1 Reactor component cooling water, like we
2 said, supports standby diesel generators, which
3 supports the FAPCS RTNSS -Charlie. Also, nuclear
4 island chill water subsystem is RTNSS, and that's
5 supporting the building, the ventilation systems.
6 Service water is supporting the RCCW for
7 RTNSS, and it's also providing cooling for the turbine
8 building component cooling water heat loads that are
9 plant investment protection, but not RTNSS systems.
10 Okay, so going through the RTNSS cooling
11 systems, the NRC conducted an audit of the cooling
12 systems, specifically wanting to look at the, you
13 know, the aspects of --
14 MEMBER STETKAR: Before you get into the
15 RAIs, because you're going to go off, you know, on
16 those focused things. I think I as ked this before,
17 and I don't recall the answer, and I couldn't find it
18 anywhere. But why didn't the main condensate feed
19 water systems show up as at least a RTNSS-C-type
20 system, you know, from the PRA perspective?
21 MR. ARCARO: I think Chapter 19 talks about
22 that a little bit.
23 MEMBER STETKAR: Does it? Okay.
24 MR. ARCARO: From that I understand, you
25 know, the reliability is such, you know, you have a

1 triple redundant feed water system that pointed it
2 out.
3 MEMBER STETKAR: It just didn't pop up above
4 the screening criteria that you're using.
5 CHAIRMAN CORRADINI: I knew you were going
6 to get to that. I was waiting.
7 MEMBER STETKAR: But those screening
8 criteria are different than most other applicants are
9 using. They're a factor of two to two and a half
10 times higher, in terms of numerical importance, than
11 essentially all the other applicants that are
12 currently in play are using.
13 I mean we've sort of raised this general
14 question before, but I --
15 MS. CUBBAGE: We really don't have anybody
16 here that's --
17 MEMBER STETKAR: Yes. No, I understand
18 that.
19 MS. CUBBAGE: That's not what we --
20 MEMBER STETKAR: I just wanted to make sure
21 that it was -- they were screened out based on PRA
22 considerations. You have no idea how close to the
23 margin they were?
24 CHAIRMAN CORRADINI: We know we have to come
25 back and discuss this.

1 MEMBER STETKAR: I just wanted to -- anyway,
2 it's on the record.
3 CHAIRMAN CORRADINI: Got it.
4 MS. CUBBAGE: The condensate.
5 CHAIRMAN CORRADINI: The feed and condensate
6 system?
7 MEMBER STETKAR: Yes, the condensate and
8 feed water system primarily, and it's -- you know, the
9 basic question is if it was screened out based on the
10 numerical values from the PRA.
11 MS. CUBBAGE: From the perspective of
12 reliability and availabilit y, those are on all the
13 time when the plant's operating. No? Yes? I'm not
14 sure what would happen differently, to ensure
15 availability for a system that's continually
16 operating.
17 MEMBER STETKAR: The FAPCS system is also
18 normally running. So I don't wan t to get into what's
19 normally running and things like that. I'd be
20 interested to see, you know, if it was screened out
21 based on the numerical criteria, how close you were to
22 that margin. I mean, you know, if you're a factor of
23 five below it, I don't care.
24 MR. ARCARO: Okay. Yes, I know in the PRA
25 it was broken up into sections for different systems.

1 So I think we can find those numbers.

2 MEMBER STETKAR: Okay, thanks.

3 MR. ARCARO: Okay. So RAI 9.2-24 was asking

4 a question about RTNSS systems. Th ese systems are

5 relied upon to achieve cold shutdown, and are backing

6 up passive systems. So the issue was we want to make

7 sure that they're highly reliable and capable of

8 achieving cold shutdowns.

9 So in that venue, we had an audit of the

10 cooling water systems, and we spent some time with the

11 NRC, and we went through the calculations and the

12 design basis of the systems, and the few slides is

13 follow up from that, from that audit.

14 Okay. The cooling water systems high level

15 requirements, they perform non -safety functions with

16 defense in -depth requirements. Since during normal

17 operation, they're significant contributors to

18 availability and plant investment protection by

19 design.

20 They're highly reliable and provides

21 features for plant investment and defense in -depth,

22 including seismic ruggedness, redundancy, fire and

23 missile protection and flood protection.

24 The RTNSS -Charlie functions provide post -72

25 hour coolant, but cooling also have requirements

1 associated with redundant trains, separation, seismic
2 requirements and missile and flood protection, okay.
3 The first system is service water. Just big
4 picture, go through some of the features and the
5 functions. The clouded area is conceptual design
6 information. This is our heat removal facility. So
7 the reference plant, we've got a mechanical cooling
8 tower, mechanical draft cooling tower with a basin.
9 That basin is providing the heat removal
10 capability for PRA for RTNSS functions, and that has
11 an interface requirement and an ITAAC for water
12 capacity. As you can see, the service water system is
13 broken up into two trains.
14 So you've got two redundant 100 percent
15 trains, two pumps on each train. You've got three
16 rafter component cooling water, heat exchangers, two
17 turbine component cooling water heat exchangers. Same
18 heat exchanger. They're plate heat exchangers.
19 Also have a bypass line for cold weather
20 operations or for providing flow while you're in
21 minimal heat load operation. That's probably the main
22 features of the system. It's designed as a one
23 percent exceedance system, so the safety -related
24 systems are zero percent exceedance. The service
25 water is designed for one percent exceedance design

1 conditions.

2 Okay, next slide. Okay. Now we're looking

3 at the reactor component cooling water system. Okay.

4 So again, you can see we've got redundancy, we've got

5 separation. The pumps are powered from separate PIP

6 buses, so there's both physical and electrical

7 separation.

8 Normally run the system cross -connected,

9 under a condition where you need to split the trains

10 out. The cross -connect valves will shut. Heat

11 exchangers, you've got three heat exchangers on each

12 train. The heat exchangers are cooling the RCCW and

13 then providing the water, the flow.

14 You can see the diesel generator, the

15 standby diesel generator has its own loop. You also

16 go into the turbine building loads for the NI

17 chillers, and in the reactor building you're

18 supporting loads for RWCU, shutdown cooling, sampling

19 system, FAPCS heat exchangers we've talked about

20 before, CRDM pump heat exchangers. So those are all

21 in either the fuel building or the reactor building.

22 Normal operations, one pump, one heat

23 exchanger per train. It's adjusted so that depending

24 on the heat load, you can run multiple pumps, multiple

25 heat exchangers. Okay, next slide.

1 Okay. Chill water system. Again, the
2 redundancy and separation, you can see that. The top
3 part of that drawing is the nuclear island chill
4 water. The bottom part is the balance of plant chill
5 water. So on the nuclear side, it's sepa rated with
6 manual valves for the balance of plant.
7 The balance of plant chill water system
8 could be used to support the nuclear island heat
9 removal functions, but normally it's not cross-
10 connected and we don't credit it for any scenario.
11 Chillers, again they've got different PIP
12 power. So electrical separation and mechanical
13 separation. The train, redundancy is in the
14 components. So you could see on the supplies, we're
15 going to, you know, control building Alpha or Bravo
16 trains, which supply ventilation systems for redundant
17 trains also.
18 Okay. Some of the design features were
19 service water, the design criteria a single train
20 failure during cool down results in the highest heat
21 load on the service water train, and that's 80.8
22 megawatts. These are in Table 9.2 tables of the DCD.
23 To test that, during a refueling outage we
24 could, during cool down, we could put, you know, that
25 kind of load on a single train to do testing for the

1 heat exchangers. So one of the only things that we
2 learned for servic e water is to provide
3 instrumentation, and design the system so you could
4 test it during refueling, shutdown cooling operations,
5 to simulate the design loads.
6 Lots of margin going into the system
7 designs. One of the points is while it's designed for
8 one percent exceedance, we're making sure the system's
9 capable of operating at zero percent exceedance. So
10 one of the issues from customers was, you know, we
11 want to make sure that there's not going to be any
12 operational perturbations for a couple of days a year
13 during the summer time, which has been an issue with
14 patent systems.
15 So we have the capability of that margin in
16 the components, to make sure we don't trip out
17 chillers and effect the operation of the plant. We
18 also have margin between the heat loa ds of the system
19 and what the cooling towers can do.
20 So in the DCD, we provide a margin above the
21 maximum design heat removal for the system, so that
22 there's margin there and then, you know, the
23 individual plant will provide additional margin on top
24 of that.
25 Okay, next slide. The RCCW system, let's

1 see. The most limiting condition here is loss of
2 power with single train failure. We looked at that,
3 and that's -- that operation still gives us the
4 capacity to bring the plant to cold shutdown in 36
5 hours.
6 MEMBER STETKAR: 36 hours is the time for
7 that?
8 MR. ARCARO: That's correct.
9 MEMBER STETKAR: Thanks.
10 MR. ARCARO: Okay, the heat exchanger
11 design. The limit of the heat exchanger is 59.8
12 megawatts between two, so half of that, and one of the
13 things we use in plate heat exchangers is we also have
14 margin built in if we want to add additional plates.
15 We can give ourselves a couple of degrees margin on
16 the temperature. Again, designed for one percent
17 exceedance, but can operate under zero percent
18 exceedance conditions.
19 Okay, next slide. Nuclear island chill
20 water system. Again, the criteria is 24 hours, either
21 24 or 36 hour cool down conditions. The total heat
22 load of the system is 19,110 kilowatts. The chillers
23 are sized about 1320 tons per chiller, and again we're
24 using common chillers between the balance of plant and
25 the nuclear island site for standardization.

1 Two trains for the nuclear island,
2 redundancy, separation. If you lose power for one
3 train, the other side will pick up the l oads. Again,
4 significant margins both on the chill water side for
5 design, and on the ventilation side. We use the
6 ASHRAE design margins for air flow and for heat load.
7 Okay, next slide. Any questions on coolant
8 systems? I went through that pretty fast. Okay.
9 All right. Instrumental and service error.
10 There were some issues about the ability of the
11 system to support the loads, and you know, the impacts
12 of operating experience on contamination of water, of
13 effects of degradation in the air systems.
14 So some of the points that we have for ESBWR
15 is one, the air system is designed for a three micron
16 particulate rating, right. It's, you've got service
17 air compressors that are oil -free, so oil's not going
18 to be an issue with our air. Stainless stee l
19 components and piping, a three micron limit compared
20 to the standard, which is a 40 micron limit.
21 Also, we have dew point requirements in the
22 dryers, to maintain the dew point over minus 40
23 degrees, to minimize corrosion due to water. Two 100
24 percent trains. So if we lose half of the system, the
25 other system can support the whole load. They are PIP

1 loads. They're coming off the standby diesel.
2 The receivers are sized to give you 10 to 15
3 minutes of operation, based on past experience with
4 plant tr ansience due to lost instrument air.
5 Instrument air and service air is not safety -related,
6 and it's not RTNSS. So components that are required
7 for operation, that are either air-operated or
8 nitrogen-operated in the containment, have safety-
9 related accumu lators or are fail safe. So -- go
10 ahead.
11 MEMBER ARMIJO: I just had a question. Is
12 this the same kind of system for these -- that you've
13 used in the ABWRs, or is this upgraded from that?
14 MR. ARCARO: I'm pretty sure this is
15 upgraded from ABWR.
16 MEMBER ARMIJO: That's my guess.
17 MR. ARCARO: Yes. We've gone through a
18 couple of iterations of this. We started with three
19 compressors; now we have four, four compressors, two -
20 -
21 MEMBER STETKAR: You started with a
22 completely different system design.
23 MR. ARCARO: Yes, right.
24 MEMBER ARMIJO: But I mean as far as the
25 three micron particulate filters, you know. It seems

1 like a lot of improvements over what used to be the
2 old systems.
3 MR. ARCARO: Right, and I think a lot of
4 that is technology, too. You know, that now, you
5 know, the compressors and the dryers and the filters
6 are such that, you know, you can get those levels.
7 MEMBER STETKAR: Mike, were you going to
8 talk about high pressure nitrogen?
9 MR. ARCARO: Probably not, because it's a
10 safety-related system and you're focusing on RTNSS
11 stuff here, or non-RTNSS in this case.
12 MEMBER STETKAR: I noticed in, I think it
13 was DCD Rev. 6, fire revisions listed the MSIVs as a
14 load, if I can call it that, from the high pressure
15 nitrogen system, and DCD Rev. 6 and Rev. 7 has removed
16 the MSIVs from that list.
17 Are they no longer, does the current design
18 no longer have a pneumatic supply to those valves, or
19 can you explain why they were removed?
20 MR. ARCARO: Yes, I'm not -- maybe Jerry can
21 help me out, but they still show up in Table 9.38 of
22 the DCD, with nitrogen demand requirements. So MSIVs,
23 SRVs, ICS isolation valves are in the DCD.
24 MEMBER STETKAR: In Table 9.38. Huh.
25 Because there was a list in Section 9.38 -1 that lists

1 supplies from the high pressure nitrogen system. It's
2 kind of a bulleted list, or I don't remember whether
3 it was a bullet or a paragraph, you know, and they
4 weren't in there.
5 MR. ARCARO: I believe they're still loads
6 on the high pressure nitrogen system.
7 MEMBER STETKAR: Okay, I'll find it.
8 MR. ARCARO: And I'm not sure why we got rid
9 of those --.
10 MEMBER STETKAR: There were notable though,
11 you know, in terms of things inside the containment.
12 They were sort of notable in their absence. But
13 they're in that table, so I'll find it. Thank you.
14 MR. ARCARO: I know we did, in Rev. 7 I
15 think we went through this table and clarified some of
16 the numbers. But this table --
17 MEMBER STETKAR: I didn't even bother
18 looking at the table. We could, I don't know wheth er
19 I looked at it or I missed it. Thanks.
20 MR. ARCARO: So that would be an example of
21 a system that's got an accumulator that's sized to
22 provide the safety function. Okay. There's the
23 instrument air system. You could see four
24 compressors. The interface between instrument air and
25 service air is toward the dryer. You have 100 percent

1 redundancy on the dryer, so first you would take a
2 dryer out. You could provide the functions, the
3 cleaning/drying functions on the other train, and you
4 know, this is a maintenance rule system. So it still
5 has, you know, the requirements for maintaining the
6 system function.
7 Okay in summary, we went through the decay
8 heat calculations and analysis for total decay power
9 curves, talked about the OE experience for ESBWR
10 related to spent fuel uncovering gas accumulation for
11 FAPCS system; talked through RTNSS functions for the
12 balance of plan auxiliary systems; describe the
13 overview for service water, RCCW and the nuclear
14 island chill water system; and talked through some of
15 the design details associated with the instrument air
16 and service air system for ESBWR.
17 CHAIRMAN CORRADINI: Questions for Mike?
18 MEMBER ARMIJO: I don't know if it's a
19 question for Mike or for Jerry, but in your backups,
20 you must be careful never to include backups.
21 CHAIRMAN CORRADINI: A lot of information
22 that you know.
23 (Laughter.)
24 MEMBER ARMIJO: But you didn't talk about
25 it, so I'm going to ask you about Slide No. 34.

1 That's my -- you probably heard from me before on
2 hydrogen water chemistry. So I'm going to go over it
3 now.
4 CHAIRMAN CORRADINI: Oh, Sam, Sam, Sam.
5 MEMBER ARMIJO: You included this in the
6 package for some reason. What was it a backup to?
7 CHAIRMAN CORRADINI: This is Mike's backup.
8 MR. ARCARO: Yes this is --
9 (Laughter.)
10 MEMBER ARMIJO: Big mistake. It was to back
11 up some other point, I guess, or some other chart, and
12 I just wanted to see, you know.
13 MR. ARCARO: Yes. No, I know this was an
14 issue. I was reading through the transcript. So I
15 just wanted to have a talking paper here.
16 MEMBER ARMIJO: Okay. Well you know, I
17 think the issue there is you've already made a
18 decision of what you were going to include in the DCD
19 and the certified design and the staff agreed with
20 you. But I think there are some points here that are
21 -- you do recommend that people use hydrogen water
22 chemistry. That's -- the bulk of the BWRs around the
23 world, with a few exceptions, are using hydrogen water
24 chemistry, and GE recommends it.
25 It seems like a lukewarm recommendation. In

1 your second bullet, you say if utility prefers to
2 begin its operating life without this hydrogen or
3 noble chem, the consequences for the foreseeable
4 future are likely small. I think that's an
5 overstatement. The stress corrosion cracking is a
6 time-dependent thing, and the assumption you're making
7 that it's not likely to occur for some period of time.
8 But nucleation really, nobody knows exactly
9 when it starts, and so that -- I think that's an
10 overstatement. I think there are consequences. And
11 you're r elying on better materials and better
12 processing and fabrication. I don't disagree with
13 that, because I know there are better materials, but
14 they're not immune.
15 My best example is you cite the ABWR
16 operation in Japan. It's been successful but not too
17 much inspection. But there have been the best
18 materials we know how to make, 316 nuclear grade
19 components, that have failed by stress corrosion
20 cracking in Japanese reactors that did not use
21 hydrogen water chemistry, and that's a shroud.
22 And they, and that's really the best
23 material we have for BWR applications. I know they
24 didn't fabricate it the way I would have, but you
25 know, it's the whole idea is to have a belt and

1 suspenders approach, of better materials, better
2 fabrication and the best water chemistry you can have.
3 So I'm still, I guess I'll use the word
4 "disappointed" that GE just doesn't take a stronger
5 position, or the staff doesn't take a stronger
6 position, because I think this should be the reference
7 water for the volume water reactor.
8 I don't think -- I think the old so -called
9 pure water chemistry is -- it should be put on the
10 shelf as a bad experience, and not rely just on better
11 materials. Because I know there are better materials;
12 I helped develop them, but they're not immune, and I
13 know there's better ways to fabricate, but people
14 don't always make things perfect, and you've got some
15 very important components on a long life system that
16 is not protected with the optimum water chemistry for
17 the BWR.
18 So I'll just leave it at that, an d but I'd
19 ask you to downplay your chart here, this thing. I
20 don't think the consequences are small, and I suspect
21 there might be a few people at GE that feel the same
22 way. But --
23 MR. DEAVER: No, we're committed to
24 hydrogen.
25 MEMBER ARMIJO: Well, wh atever the customer

1 you've got, you've got to turn them around. Who wants
2 to make a multi-billion dollar bet?
3 CHAIRMAN CORRADINI: We better have a break.
4 So with that, I think John has a question. But
5 before I allow John to ask just the one little
6 question, the staff found the LCO on the water pool
7 temperature. Amy, can you just --
8 MS. CUBBAGE: 110, yes. It's Surveillance
9 Requirement 3714, verify average water temperature
10 available, in available ICPC pools is less or equal to
11 110 degrees Fahrenheit every 24 hours.
12 MEMBER STETKAR: That's a surveillance
13 requirement. Is there a LCO?
14 MS. CUBBAGE: For the LCO that it feeds into
15 would be operability of the PCC-IC pools.
16 MEMBER STETKAR: Okay, and what was the
17 reference Amy?
18 MS. CUBBAGE: It' s tech spec surveillance
19 requirement 3.7.1.4.
20 MEMBER STETKAR: 3.7.1.4.
21 MS. CUBBAGE: Yes.
22 MEMBER STETKAR: Thank you.
23 CHAIRMAN CORRADINI: John, you're up.
24 MS. CUBBAGE: Okay, wait.
25 MEMBER STETKAR: Wait, wait. Amy?

1 MS. CUBBAGE: Mark Caruso's here to be able
2 to try to answer some additional questions you may
3 have on RTNSS, and Samir Chakrabarti is either back or
4 going to come back to help talk about liquefaction.
5 There was a question on that. So if you'd like to
6 repeat your question to Mark.
7 MEMBER STETKAR: Liquefaction cap B.
8 MS. CUBBAGE: No, the feed water.
9 MEMBER STETKAR: The feed water? Oh, the
10 question was -- the way I led into it is why isn't
11 feed water listed as a RTNSS -Category C system, you
12 know, condensate feed water from the PRA perspective,
13 and the response was well, it was screened out as
14 being, you know, not risk-significant according to the
15 criteria.
16 The observation is that the ESBWR screening
17 criteria for risk significance, if I look at plessel
18 vesseling (ph) importance as a factor of two higher
19 than any of the other current applicants for design
20 certification are using, and for risk achievement
21 worth is a factor of 2-1/2 times higher, they're using
22 plessel vesseling importance greater than .1, and risk
23 achievement worth greater than five, whereas other
24 current in play applicants are using plessel vesseling
25 importance greater than .005, and risk achievement

1 worth greater than two.

2 So the question is, my question was well,

3 what is the inventory of SSCs that were screened out

4 because they, essentially they lie in the difference

5 between those numerical screening criteria to this

6 plant? In other words, if something was screened out

7 because it had a plessel vesseling importance of .009,

8 let's say.

9 MR. CARUSO: Yes.

10 MEMBER STETKAR: I don't know what inventory

11 might be.

12 MR. CARUSO: Well, plessel vesseling in raw

13 values were not, are not screening criteria for RTNSS.

14 There's the original --

15 MEMBER STETKAR: Okay, not for RTNSS, but --

16 MR. CARUSO: But I can address feed water

17 specifically. The staff didn't agree. There's a

18 statement, applicant made the statement that it wasn't

19 risk-significant. If you look, feed water was

20 considered in C under the, you know, if the non-safety

21 system contributes to an initiating event, you need to

22 look at three particular criteria. One, is it -- does

23 failure of the event affect initiating event?

24 MEMBER STETKAR: But something like

25 initiating events. Does it make you vulnerable to

1 greater than some core damage criteria?

2 MR. CARUSO: Does that failure of those

3 initiating events, does it contribute significantly to

4 CVF and WRF (ph), and I think, you know, we -- this

5 woman was on the line. It was on the line in the

6 sense of the last criteria. But we felt that -- we

7 looked at the arguments about why you really didn't

8 need to have it in RTNSS, and in the end, in the end

9 there's two, there's several arguments which are good

10 ones, I think.

11 One is that we gave them credit for the

12 fault-tolerant design of the feed water controller,

13 you know. They're triple fault, you know, triple

14 redundant, fault-tolerant. They're going -- they have

15 a commitment to maintain a mean time of failure of

16 2,000 hours, and we factored that into their -- they

17 have a lower initiating event frequency because of

18 that.

19 So the initiators that take out feed water,

20 that are most important, are losses of power, and the

21 losses of power are in RTNSS. The diesels are in

22 RTNSS. So we gave them credit for that. In addition,

23 we said well, what are you going to do? Are you going

24 to put availability controls on it? Feed water is

25 always running.

1 Plus, you know, one of the big drivers of
2 the maintenance rule was all the balance of plant
3 failures you would get from feed water that would give
4 you transience. Feed water is in the maintenance rule
5 program.
6 MEMBER STETKAR: It is.
7 MR. CARUSO: Which is a big part of what the
8 treatment is for RTNSS. So when all is said and done,
9 I think you have a fair statement about, you know, hey
10 why is -- this is important to risk, you know. I mean
11 losses of feed water. But I think in the end --
12 MEMBER STETKAR: On this -- okay. On this
13 plant, you probably have hit on it already. I just
14 want to make sure I understand. Is the RTNSS list,
15 and there are rules for what is RTNSS and what is not
16 RTNSS, and then there's a reliability assurance
17 program, which has a different set of partially
18 related but slightly different criteria.
19 The reliability assurance program is also
20 non-safety related equipment, but you're required to
21 basically invoke the maintenance rule on it.
22 MR. CARUSO: Yes.
23 MEMBER STETKAR: Is the feed water system,
24 condensate feed water system on this plant in their,
25 the D-RAP list, for example? Or do they have the D-

1 RAP list yet? I don't know. Honestly, I get
2 confused among the different designs, and I didn't
3 have a chance to go back and check it.
4 MR. CARUSO: Well, yes. I would be -- I
5 can't, I don't know off the top of my head, but I
6 would be surprised if it's not. I mean it's scoped
7 under the maintenance rule by the fact that it causes
8 trips.
9 MEMBER STETKAR: Okay. So it's going to be
10 controlled under that anyway.
11 MR. CARUSO: So you know, and you know,
12 reliability assurance program really is basically --
13 it's implemented with all th e regular operational
14 programs. It's connected with, you know, ISI and IST
15 and maintenance rule and all these things, so --
16 MEMBER STETKAR: It's just those lists tend
17 to be populated through the DCD and COL stages. So
18 what's on that reliability assura nce program list
19 tends to get handed over.
20 MR. CARUSO: To me, you know, availability
21 is covered by the fact that feed water, you've got to
22 have feed water to run the plant, and (b),
23 reliability, you know, to me it's the maintenance
24 rule. That's what it's there for. That's the main
25 driver. So I don't know. I mean I felt like feed

1 water's covered.

2 And we had a lot -- we did have a lot of

3 discussion and arguing about this, you know.

4 Shouldn't it get just, you know, technically,

5 shouldn't it get thr own in, you know, according to

6 that last, third criteria about its significance.

7 MEMBER STETKAR: Okay, thanks. That's good.

8 CHAIRMAN CORRADINI: Did you have another

9 question?

10 MEMBER STETKAR: I don't --

11 MS. CUBBAGE: I think Samir is here to

12 discuss liquefaction.

13 MEMBER STETKAR: Yes. I mean, yeah. I mean

14 as long as we're answering those questions. I still

15 have a question for GEH, but not on these topics.

16 MS. CUBBAGE: So could you maybe restate the

17 question? Samir wasn't here.

18 MEMBER STETKAR: Yes. It was my

19 understanding, and unfortunately my notes are over in

20 my office on the liquefaction stuff, but it was my

21 understanding that liquefaction must be considered for

22 Seismic Category 1 structures, but not for Seismic

23 Category 2 structures. Is that true?

24 MR. CHAKRABARTI: No. What we have in DCD

25 2, Table 2.0 -1, we have addressed liquefaction

1 potential on the Seismic Category 1 structures. It
2 says "none." Under footprint of Seismic Category 1
3 structures, it's something from the SSE.
4 MEMBER STETKAR: Right.
5 MR. CHAKRABARTI: And then it says "Other
6 than Seismic Category 1 structures, see Note 14."
7 MEMBER STETKAR: Yes.
8 MR. CHAKRABARTI: And Note 14 says
9 "Localized liquefaction potential and other than
10 Seismic Category 1 structures is addressed by SRP 254
11 in Table 2.0-2."
12 MEMBER STETKAR: But that's by the COL
13 applicant, right?
14 MR. CHAKRABARTI: Well, liquefaction
15 potential is a COL issue.
16 MEMBER STETKAR: So as far as the DCD is
17 concerned --
18 MR. CHAKRABARTI: It assumes there is no
19 liquefaction.
20 MEMBER STETKAR: Pardon?
21 MR. CHAKRABARTI: It assumes there is no
22 liquefaction.
23 MEMBER STETKAR: It assumes there is none?
24 MR. CHAKRABARTI: Yes.
25 MEMBER STETKAR: But it doesn't require that

1 there is none. Under Seis mic Category 1 buildings,
2 the DCD essentially requires that there's no
3 liquefaction. Is that -- that's the way I interpreted
4 that table.
5 MR. CHAKRABARTI: Yes. For Seismic Category
6 1 structures, it assumes there is no liquefaction
7 potential.
8 MEMBER S TETKAR: And effectively requires
9 that the COL applicant must prove that there is no
10 liquefaction under --
11 MR. CHAKRABARTI: Category 1 structures.
12 MEMBER STETKAR: Category 1 structures.
13 MR. CHAKRABARTI: And for Category 2
14 structures, it states tha t the liquefaction potential
15 is requirement is stated in Table 2.0-2. There it
16 says "COL applicant to provide site -specific
17 information in accordance with the SRP 254 to address
18 localized liquefaction potential under other than
19 Seismic Category 1 structures."
20 MEMBER ARMIJO: What does that mean?
21 MEMBER STETKAR: Well, that says the DCD
22 allows liquefaction under Seismic Category 2
23 structures; is that correct?
24 MR. CHAKRABARTI: I don't read it that way.
25 What I read --

1 MEMBER STETKAR: I read it that way, so
2 that's why I was asking the question.
3 MR. CHAKRABARTI: The COL applicant will
4 address. It may not be the same standards, but will
5 address the liquefaction potential, localized
6 liquefaction potential other than Seismic Category 1
7 structures.
8 MEMBER STETKAR: But I'm now going to try to
9 become an attorney.
10 CHAIRMAN CORRADINI: Now?
11 MEMBER STETKAR: Yes. Just because the
12 table in the DCD, if I'm now a COL applicant, to
13 satisfy the DCD, I must prove that I have no
14 liquefaction under Seismic Category 1 structures.
15 MR. CHAKRABARTI: That is very, very clear,
16 yes.
17 MEMBER STETKAR: Okay. If I have a Seismic
18 Category 2 structure, for example, my electrical
19 building, I am not required to prove that I have no
20 liquefaction. I am required --
21 MR. CHAKRABARTI: Address the issue.
22 MEMBER STETKAR: Address it.
23 MR. CHAKRABARTI: Yes.
24 MEMBER STETKAR: Which means I have to -- if
25 I have liquefaction, I guess I need to do some

1 analysis or something, right?

2 MR. CHAKRABARTI: I have not really read the

3 requirements in SRP 254. It's a different section.

4 But that's how I read it. Yes, it will be addressed.

5 MEMBER STETKAR: But essentially any -- I'm

6 thinking about seismic events that now fail the

7 electrical building, because it's a Category 2

8 structure, because of -- it's not going to fail it

9 structurally because it's a Seismic Category 2, except

10 for possible localized liquefaction at the site.

11 Any Category 1 structures are essentially

12 protected by that through the design certification,

13 the specs and the design certification that says

14 "There will not be any liquefaction under Category 1

15 structures."

16 MR. CHAKRABARTI: That is correct.

17 MEMBER STETKAR: The design certification is

18 essentially silent on liquefaction under any other

19 buildings, in the sense that it says it needs to be

20 addressed, but it doesn't say what you need to do

21 about it.

22 CHAIRMAN CORRADINI: You guys are going back

23 and forth. I want to clean this up. I'm trying to

24 understand very quickly, it's your interpretation that

25 it's got to be addressed, but by the COL applicant?

1 MR. CHAKRABARTI: That is correct.
2 CHAIRMAN CORRADINI: But as you read the
3 same sort of thing, it's unclear to you?
4 MEMBER STETKAR: No, no, no. I just want to
5 make sure that I understand that it' s a COL applicant
6 responsibility, and that --
7 CHAIRMAN CORRADINI: Okay.
8 MEMBER STETKAR: --this is the way it's left
9 at the design certification stage.
10 CHAIRMAN CORRADINI: But that's how I
11 understand staff's interpretation of it.
12 MEMBER STETKAR: That is our interpretation.
13 CHAIRMAN CORRADINI: Okay, okay.
14 MEMBER STETKAR: Thanks.
15 MR. CHAKRABARTI: It is a site -specific
16 issues.
17 CHAIRMAN CORRADINI: And then you had
18 something for these gentlemen.
19 MEMBER STETKAR: Yes, on something
20 completely different.
21 CHAIRMAN CORRADINI: Thank you.
22 MEMBER STETKAR: Heavy load lifts. You can
23 take it away and come back to your heavy load lift
24 people if you want. I had a question on why --
25 there's a discussion in Chapter 9 on various locations

1 in the plant, where you do an evaluation of heavy load
2 lifts and rocks, and there's a final concluding
3 statement.
4 One of the notable areas in the plant where
5 I have a really big crane that can lift heavy loads is
6 the turbine building. The turbine building is not
7 mentioned.
8 It's simply a statement that says "Outside
9 of the containment, the main steam tunnel or the
10 refueling floor, there are no safety -related
11 components of one division train routed over any other
12 portion of safety-related" yadda yadda yadda . That's
13 yadda yadda yadda for the record.
14 "Therefore, inadvertent load drops cannot
15 cause a release of radioactivity, a criticality
16 accident, the inability to cool fuel within the
17 reactor vessel spent fuel pool, or prevent safe
18 shutdown of the reactor."
19 I'm concerned about why heavy load drops
20 from the turbine building crane and a boiling water
21 reactor cannot cause a release of radioactivity, if
22 those are the criteria that you need to meet.
23 CHAIRMAN CORRADINI: We're talking in the
24 refueling building?
25 MEMBER STETKAR: No, we're talking in the

1 turbine building.

2 CHAIRMAN CORRADINI: Turbine building, I'm

3 sorry.

4 MEMBER STETKAR: Has steam lines and

5 turbines and things that have, you know, if you've

6 ever been in a boiling water reactor, shielding is

7 pervasive. So if those are one of the criteria for

8 evaluating the potential consequences from heavy load

9 drops, I don't, you know, any release of

10 radioactivity. The other ones I'll grant you.

11 MR. DEAVER: Well, the traditional cases are

12 where we're lifting components over fuel.

13 MEMBER STETKAR: Traditional --

14 MR. DEAVER: Over the core.

15 MEMBER STETKAR: Yes.

16 MR. DEAVER: And so those are readily

17 addressed. But I'm not sure what circumstances you're

18 thinking of in the turbine building that could

19 actually --

20 CHAIRMAN CORRADINI: Are you asking the

21 question is there going to be a crane movement wire at

22 full power over the turbines themselves? Isn't that

23 the point at hand?

24 MEMBER STETKAR: That's the point at hand,

25 or steam lines or something that can, you know, go

1 down. I don't know what the actual turbine building
2 configuration is. We managed to drop something at a
3 plant I operated at, that went down through a hatch
4 and actually hit one of the main feed water pumps, for
5 example.
6 Luckily, it wasn't something that broke the
7 main feed water pump, but it actually tripped the main
8 feed water pump. So I, you know, during plant
9 operation. So indeed people move the turbine building
10 crane for staging for outages and for, you know, just
11 moving equipment around during plant operation. It's
12 not parked like refueling cranes or things like that.
13 So the basic question is if the concern is
14 any release of radioactivity, why isn't the turbine
15 building crane addressed as a potential source of
16 heavy load drops?
17 MR. DEAVER: Well, I just don't know of any
18 events that, you know, if we fail a piece of equipment
19 or guillotine break a steam line, then we're into a
20 local scenario where we're going to isolate the
21 containment and so forth.
22 CHAIRMAN CORRADINI: I think what John is
23 asking, I think you want to take this one away. But
24 what John, I think, is asking is I would have a
25 release of the activity that's in the line.

1 MEMBER STETKAR: For example, you address
2 things in the main steam tunnel, because app arently
3 there's some, I don't even know what it looks like,
4 some crane in the main steam tunnel. It's at least
5 mentioned in this analysis.
6 CHAIRMAN CORRADINI: Without maintenance.
7 MEMBER STETKAR: But yeah. But in the main
8 steam tunnel, a lot of your arguments about if I broke
9 a steam line or a feed line or containment isolation
10 valves, that would limit the amount of release.
11 MR. DEAVER: A failure in the turbine
12 building, you have a steam leak, you have a release,
13 and why isn't that treated?
14 MEMBER STETKAR: Why isn't that at least
15 addressed?
16 CHAIRMAN CORRADINI: Right. That's the
17 point.
18 MR. MARQUINO: I think we want to get the
19 exact section that you're referring us to?
20 MEMBER STETKAR: Yes. It is section, it's a
21 long section. I think it's 9.1.5.6, and it's --
22 that's the -- the title is "Other Overhead Load
23 Handling Systems," and it's the last subsection in
24 that. It's not a numbered. It's just a paragraph.
25 CHAIRMAN CORRADINI: And they've got to come

1 back to us. Yes?

2 MR. MARQUINO: Yes.

3 CHAIRMAN CORRADINI: Okay. Other questions

4 John?

5 MEMBER STETKAR: Nope.

6 CHAIRMAN CORRADINI: Other members of the

7 committee?

8 (No response.)

9 CHAIRMAN CORRADINI: Hearing none, I declare

10 a break. We'll come back at twenty of. We're still

11 ahead of the game, because we're going to go into

12 Chapter 6 this afternoon, just so we're clear, and

13 staff will be back with their views of Chapter 9.

14 MEMBER ARMIJO: We're jumping ahead to

15 tomorrow.

16 CHAIRMAN CORRADINI: We're going to six.

17 We're go ing to control room habitability this

18 afternoon. That's my plan.

19 (Whereupon, a short recess was taken.)

20 CHAIRMAN CORRADINI: Are you okay? All

21 right. Let's get started. So Dennis will lead us off

22 on Chapter --

23 MR. GALVIN: Nine.

24 CHAIRMAN CORRADINI: Nine.

25 MR. GALVIN: But we were going answer

1 Graham's question, but Graham's not here.

2 CHAIRMAN CORRADINI: Sure.

3 MR. GALVIN: Well, I guess we can start up

4 with the other stuff.

5 CHAIRMAN CORRADINI: Hang on one second

6 please. You guys go out side and have your conference

7 call, or not.

8 MR. GALVIN: We only thought this would take

9 five minutes, and we have some research. But I guess

10 we can go back and just --

11 MEMBER STETKAR: Yes. Did you find Graham?

12 CHAIRMAN CORRADINI: Yes. Give us a minute.

13 We don't want to leave out Professor Wallace. He'll

14 feel left out.

15 (Off mic discussion.)

16 CHAIRMAN CORRADINI: This is for the fuel

17 racks?

18 MR. GALVIN: What we're doing today is we're

19 presenting Chapter 9.

20 CHAIRMAN CORRADINI: Right.

21 Chapter 9/Staff

22 MR. GALVIN: Related to Chapter 9, we picked

23 three sets of topics. One is essentially 9 -1, which

24 is FAPCS and the spent fuel pool. The other, the

25 second set of topics -- and the water systems. We've

1 also selected the instrument air system, because there
2 a specific item on that in your letter to the
3 Commission.
4 And we've also, we'd like to briefly talk
5 about -- there was a question in the August 16th
6 meeting about thermohydraulic analysis. So we're
7 going to do that first, because we h ave assistance
8 here from Research, Christopher Boyd.
9 CHAIRMAN CORRADINI: Okay.
10 MR. GALVIN: And it's just -- it should be a
11 short presentation. So Jim Gilmer from DSRA is going
12 to lead this discussion.
13 CHAIRMAN CORRADINI: And Graham, this is for
14 you.
15 DR. WALLIS: This is for me?
16 MR. GILMER: So we're skipping to page 30
17 now of the --
18 DR. WALLIS: It's not for Sam?
19 CHAIRMAN CORRADINI: It's for you.
20 MR. GILMER: Yes, and actually you talked
21 about it earlier with Mr. Deaver, about the new figure
22 that's in backup Slide No. 31, and that shows the
23 streamlines with the --
24 DR. WALLIS: I thought you sorted out the
25 fuel pool, so maybe you should do it.

1 CHAIRMAN CORRADINI: They want to unsort it.
2 DR. WALLIS: They want to unsort it. They
3 want to confuse it.
4 MR. GILMER: Since we have Dr. Boyd
5 available, we wanted to --
6 DR. WALLIS: I saw him back there. I
7 wondered about that.
8 MR. GALVIN: He's a new member to the team.
9 DR. WALLIS: I thought we'd already sorted
10 that out. But anyway.
11 CHAIRMAN CORRADINI: This is for you.
12 DR. WALLIS: Okay. It's for me, so I'll
13 listen very carefully.
14 MR. GILMER: Well, one thing I would add to
15 Mr. Deaver's presentation is this figure will be added
16 to the topical report --
17 DR. WALLIS: That's what they said in their
18 presentation.
19 MR. GILMER: We just received it this week -
20 -
21 DR. WALLIS: It makes a lot more sense than
22 the other figures.
23 MR. GILMER: Yes, and we'll provide it to
24 staff and ACRS.
25 DR. WALLIS: Right, thank you.

1 MR. GALVIN: So I guess there's no need for
2 me to walk through all the bullets. Do you have any
3 specific questions?
4 MR. GALVIN: Jim, why don't we go to Slide
5 31?
6 MR. GILMER: 31. Okay. Just as a
7 refresher, we didn't talk specifically about the way
8 the COP c ode was modeled. The entire region of the
9 racks was treated as so-called porous medium, with the
10 heat load applied. That's the reason why we saw the
11 streamlines, which appeared to be on the --
12 DR. WALLIS: The streamlines that were
13 originally presented in the report seemed to go all
14 over the place. I mean they came in and they wandered
15 all over the place many, many times before they went
16 up.
17 MR. GILMER: Right. I have that as a backup
18 slide, because it didn't make it onto the --
19 DR. WALLIS: And t his is because of a big
20 vortex in there or something? I was a bit confused
21 why a few streamlines came in and wandered all over
22 the place before they went out.
23 MR. BOYD: This is Chris Boyd from Research.
24 On that particular issue, I think GE mentioned what
25 happened there, and we spoke with a teleconference

1 with GE. It would appear that what they did is turned
2 off the streamlines in the rack, to make the figure
3 clearer. They said if we turned on the streamlines in
4 all 21 domains.
5 But by turning them off in the rack and not
6 explaining that, it was a very confusing picture.
7 DR. WALLIS: But then the ones that didn't
8 go through the rack seemed to go around an awful lot
9 of times before they went out, which was a little
10 strange. Did you have any commen t on that? I mean
11 two or three came in, and then the whole thing is full
12 of blue lines and two or three go out?
13 MR. BOYD: Right, and you don't know --
14 those were very low velocity. So what I would say is
15 that this is -- when you're injecting in the bo ttom,
16 you are going to set up just a slow circulation
17 pattern in the pull. These streamlines are something
18 that are just going to follow out through these slow
19 velocity patterns.
20 DR. WALLIS: So it's the big -- it's the
21 buoyancy that sets up the swirly flow?
22 MR. BOYD: The buoyancy would help set up
23 that rotation with the steam rising and the -- but
24 even the jets coming in from the bottom would kick the
25 flow into a little bit of a recirculation pattern.

1 MR. GILMER: Okay. Then we also looked at
2 the pressure drop assumed through the racks. It was
3 based on the operating BWR spec. So that's what we
4 were really talking about. That's a troubling model.
5 MEMBER KRESS: How did you arrive at the
6 friction factor for the median, the appropriate
7 friction factor?
8 MR. GILMER: That was based on the operating
9 BWR.
10 MEMBER KRESS: Oh, you have data.
11 MR. GILMER: You have data for that.
12 DR. WALLIS: Do you have a figure then?
13 MEMBER KRESS: And it's actually
14 conservative for the ESBWR because it was based on the
15 -- numbers.
16 MEMBER ARMIJO: Rather than the --
17 MEMBER KRESS: Rather than the 10 foot.
18 DR. WALLIS: It looks like a very
19 straightforward location of CFX.
20 MR. GILMER: That's right. We did not
21 verify the calculation in a formal way, but we've done
22 very similar calculations with data in the cask areas,
23 and we found that these codes can do a very good job
24 modeling fuel and predicting temperature rise through
25 the fuel, with this porous medium approach.

1 DR. WALLIS: It's interesting. If you look
2 at the figure which is supplied this time, the
3 streamlines seem to come out of the rack and then they
4 all go into the wall, which looks a little peculiar.
5 Maybe that's because only selected
6 streamlines are shown, or it looks as if you've got
7 all the streamlines going through the rack, and then
8 they go right over to the wall. It's peculiar. You
9 think they go straight up as a plume. That must be
10 because of the strong vorticity. The strong vortex in
11 there pushes them to the wall.
12 MEMBER STETKAR : That must be what's
13 happening.
14 DR. WALLIS: Do you see what I mean Chris?
15 MR. BOYD: Yeah, I've seen things like this
16 before. There could be, you know, some entrainment of
17 the flow behind the -- between the plume and the wall,
18 and then there's real ly no flow replacing that
19 entrainment.
20 So that kind of tends to move the plume over
21 towards the wall. I don't think it's a real -- I get
22 the impression it's not a really strong vortex. I get
23 the impression nothing's really strong going on --
24 DR. WA LLIS: But something really pushes
25 that flow over to the wall, isn't it?

1 MR. BOYD: It does appear that there is flow
2 across the tops of the racks that would go on there.
3 We'd have to look at more of their velocity in
4 profiles.
5 MR. GALVIN: Jerry, it looks like you just
6 have one domain turned on, as far as the streamline,
7 right?
8 MEMBER KRESS: Yes. This is probably just
9 through one rack.
10 MR. GALVIN: I think it's just through one
11 rack. That's what's driving that.
12 MEMBER KRESS: If you tried to show all of
13 them, you'd have another mess.
14 MR. GALVIN: Right.
15 MEMBER KRESS: Yes. So that's --
16 MR. DEAVER: This is Jerry Deaver with GEH.
17 This is strictly one rack, and so it's probably
18 showing the flow associated with one rack.
19 CHAIRMAN CORRADINI: But I would guess it's
20 also the limiting rack, given the temperatures?
21 MR. DEAVER: It's one of the limiting ones.
22 It's got a full supply of fresh fuel that's come out
23 of the reactor.
24 MEMBER ARMIJO: How many assemblies in that
25 rack? How many fuel assemblies?

1 MR. DEAVER: There's 180.

2 MEMBER ARMIJO: In that.

3 MR. DEAVER: Right.

4 DR. WALLIS: By one rack, you mean one of

5 these boxes shown here?

6 MR. DEAVER: Yes.

7 DR. WALLIS: So all the flow through that

8 box goes over to the wall pr etty well, rises up the

9 wall?

10 MEMBER KRESS: That's because there's flow

11 coming out of the other racks to keep it open there, I

12 think.

13 DR. WALLIS: So the flow from the other

14 racks pushes it over there?

15 MEMBER KRESS: Yeah, I think so.

16 MEMBER ARMIJO: No, there's nothing coming

17 out of the other racks.

18 DR. WALLIS: There's nothing coming out of

19 the other racks.

20 MEMBER ARMIJO: Just because they just

21 didn't show it.

22 CHAIRMAN CORRADINI: They're not just

23 showing it. They're just simply turning on -- they're

24 simply turning on one grouping of assemblies, to show

25 you what's going on in one grouping.

1 DR. WALLIS: Right.

2 MEMBER KRESS: Now I'm intrigued by this use
3 of porous medium. Do you have a different friction
4 factor that's vertical compare d to horizontal, or is
5 it the same friction factor the whole way?

6 MR. GILMER: My recollection is it was only
7 the upflow. I could be wrong on that.

8 CHAIRMAN CORRADINI: No, but I think the --
9 well, they should answer the question. You
10 understand?

11 MR. BOYD: I think GEH would have to answer
12 this. I forget the details, but typically what you
13 either do is you put in infinitely thin walls, or you
14 put in loss coefficients in the lateral directions
15 that are maybe a factor of 1,000 or 10,000 higher, to
16 keep the flow aligned. I'm not sure which approach
17 GEH used here.

18 DR. WALLIS: Yes. I think that we've got
19 one figure. I tend to believe CFX and all that. As
20 soon as you have one figure like this, then you begin
21 to raise questions, and you've got no answers, because
22 you've only got one figure.

23 So it would be good in the future to have
24 several figures, that sort of anticipate questions
25 about what's going on. So there's just one figure

1 like that. But I'm prepared to accept it, since it's
2 a straightforward standard calculation.
3 MEMBER ABDEL -KHALIK: Let me ask the
4 question about the porous medium formulation. Is this
5 an isotropic porous medium formulation?
6 MEMBER KRESS: Yes, that was my question.
7 MR. BOYD: No. They're not isotropic in the
8 code --
9 (Simultaneous discussion.)
10 CHAIRMAN CORRADINI: Well, let's find out
11 from GE.
12 MR. BOYD: Yeah. We would need to ask GEH
13 how they applied it.
14 MR. DEAVER: One of our people on the phone
15 would have to answer that.
16 CHAIRMAN CORRADINI: Okay.
17 MR. DEAVER: Dave Davenport, do you have the
18 answer to that?
19 MR. DAVENPORT: I'm looking, but not
20 immediately.
21 MR. DEAVER: Okay. You can get back to us
22 with that. Thank you.
23 CHAIRMAN CORRADINI: So now that's one of
24 three topics, right?
25 MR. GALVIN: Okay. So we are done with the,

1 I guess, the conclusions? We had the same conclusions
2 about the natural circulation. We were just trying to
3 explain it, why we thought the model was reasonable.
4 So we'll go back to our first presentation here.
5 So we're going to start with a discussion of
6 the potential storage and fuel and auxiliary full
7 COIN systems, and our presenter is Larry Wheeler.
8 MR. WHEELER: Could I have the next slide?
9 Regulatory guidance is found in the SRP 9.1.2, 9.1.3,
10 which includes the relevant requirements of the GDCs,
11 which include 245.61 and .63.
12 Next slide. In this guidance, regulatory
13 treatment of non-safety systems is found in SECY 94-84
14 and 95-132, and the summary of those documents is
15 RTNSS systems, to be highly reliable, within ES design
16 qualities and reliability.
17 Next slide. The staff's review summary, the
18 key open items. Rackability (ph), buffer pool on the
19 spent fuel pool, decay heat and pool draining down.
20 A follow-up to the RAIs. The staff previously found
21 that the following was acceptable:
22 The potential drain pass that can drain the
23 buffer pool or the spent fuel volume. The spent fuel
24 pool transfer gates and buffer pools are safety-
25 related, Seismic Category 1. Anti-siphon holes on

1 submerged piping are no lower than 9.2 meters above
2 the top of stored fuel assemblies.
3 Maximum bounding of the spent fuel pool heat
4 loads. This was previously discussed with GE, excuse
5 me, GEH. Bounding water make-up for the spent fuel
6 pool is 200 gallons per minute.
7 Next slide. Pool level, the -- measures,
8 collapsed water level. No false readings due to
9 seeing vapor above the actual water level. The high
10 level are key points to this summary. The buffer pool
11 will remain --
12 DR. WALLIS: It's simply a pressure drop
13 measurement, isn't it? The pool level measurement is
14 simply pressure gauges, pressure sensors?
15 MR. WHEELER: I believe that's true.
16 DR. WALLIS: Right.
17 MR. WHEELER: The key points of the staff's
18 summary is the buffer pool will remain 7.3 meters
19 above the stored fuel assemblies during the loss of
20 FAPCS for the 72 hours. The stored fuel in the spent
21 fuel remains covered during the loss of FAPCS for 72
22 hours.
23 MEMBER ABDEL-KHALIK: What is the area
24 footprint of the spent fuel pool roughly?
25 MR. WHEELER: I do not know that answer.

1 Maybe GE could answer that.

2 DR. WALLIS: So it's -- sorry.

3 MR. DEAVER: Go ahead. Dave might know

4 that.

5 MR. GELS: We can look it up. It will just

6 take one minute.

7 CHAIRMAN CORRADINI: I estimate about 100

8 square meters.

9 MR. DEAVER: Okay.

10 MEMBER ARMIJO: Is that 7.3 meters a staff

11 calculation, or is that --

12 MR. WHEELER: It's a GE calculation.

13 MEMBER ARMIJO: And did you verify it by

14 some independent calculation?

15 MR. WHEELER: There is an audit t eam from

16 the NRC that did look at the methodology into those

17 calculations.

18 DR. WALLIS: It's fallen about ten meters,

19 according to GEH.

20 MEMBER ARMIJO: Yes. I'm a little confused.

21 In the GEH presentation, they use minimum coverage

22 height of 10.26 meters.

23 MR. WHEELER: What I wanted to do here is

24 say that this is what the staff previously approved,

25 and my next slide will go ahead and explain to you

1 that there's been changes.

2 DR. WALLIS: It's changed. Okay. That

3 explains it.

4 MR. WHEELER: N ext slide. So we're on

5 number six. August 16th of this year, ACRS

6 Subcommittee noted the issues related to the NEDO

7 33373, basis for the heat loads using the spent fuel

8 thermohydraulics. GEH calculated, calculations for

9 the decay heat were determined to be non-conservative.

10 The spent fuel heat loads for the fuel core offload

11 and discharge fuel decay used the 36th day into the

12 fuel cycle.

13 The updated spent fuel heat loads for the

14 fuel core offload and discharge fuel decay used the

15 end of fuel cycle, an d was determined to be more

16 conservative. Presently, the staff is looking at the

17 new proposed tech spec for the spent fuel pool water

18 level. So that effort is ongoing.

19 We got that information earlier this week,

20 and the staff has not had enough time to draw a

21 conclusion to the new numbers.

22 DR. WALLIS: Oh.

23 MR. GELS: This is John Gels from GEH. The

24 dimensions of the spent fuel pool are 12.86 meters by

25 14.86 meters, which comes to about 191.2 square

1 meters.

2 DR. WALLIS: Thank you.

3 CHAIRMAN CORRAD INI: A reasonably -sized

4 house.

5 DR. WALLIS: But GE did present some numbers

6 in their presentation, GEH, and they -- I thought

7 that they said that the pool level dropped by ten

8 meters?

9 MR. DEAVER: Yes, that's --

10 DR. WALLIS: And you still need ten meters

11 above this. Don't they have about 20 meters when they

12 start? That's an awful lot.

13 MR. WHEELER: Well, we looked at the audit

14 and concluded that the boil-off was around 9.2 meters.

15 With the new heat load, the new proposed number, it

16 is closer to ten meters, and that's on their

17 evaluation.

18 MR. DEAVER: Jerry Deaver with GEH. We used

19 the same methodology. So the resulting number that we

20 came up with was 10.35, as far as the total drop in

21 water level now.

22 DR. WALLIS: And that meets your mi nimum

23 coverage requirement, but not by very much?

24 MR. DEAVER: Yes, that's correct.

25 MR. GALVIN: My understanding, the drop is

1 10.26 meters and your normal water level would be
2 10.36 meters. So you have about 10 centimeters or
3 four inches above that, above the -- level.
4 MR. DEAVER: That's the distance above the
5 handle so, you know, if you were really considering
6 where it would become critical, it would be down to
7 the active fuel level, which is .55 meters is where it
8 would really reach the fuel, the active fuel.
9 DR. WALLIS: So you're very close to the
10 active fuel?
11 MR. DEAVER: No. We're .55 meters away
12 under these theoretical --
13 DR. WALLIS: That's close compared with
14 where you started from.
15 MR. WHEELER: Okay. On Slide 7, I want to
16 talk about FAPCS and RTNSS. The staff found the
17 following acceptable for FAPCS, for its RTNSS-B
18 function. This is for long -term cooling. Fire
19 protection system interfaces, which allows the
20 isolation and condenser passive containment cooling
21 system pools to b e filled with water, to extend
22 cooling period from 72 hours out to seven days.
23 The piping interface is safety-related, ASME
24 Class 3, and in Seismic Category 1. And as GE has
25 said earlier, FAPCS does have availability controls in

1 3.7-2 and 3.7-3.

2 MEMBER ARMIJO: Could we go back to that

3 prior discussion? I just want to make sure I

4 understand. In the boil -off calculation, at what

5 level did you start the calculation? Maybe it's for

6 GEH. At the minimum pool level, and then you started

7 the boil-off calculation, or at some other pool level?

8 I mean it's not always constant.

9 MR. WHEELER: I think GE needs to answer

10 that question. From what I remember looking at the

11 calculation, they determined what the boil -off volume

12 would be, and then from there, th ey backed up the LCL

13 to maintain that during that 72 hour boil -off period,

14 that the fuel assembly or the top of the bell handle

15 would still have water to that point.

16 MEMBER ARMIJO: Yes. But there's a range at

17 which a pool level, and I don't remember what it is.

18 If you start the boil -off at one level, you have --

19 you can have a different answer.

20 MR. WHEELER: From what I remember, there

21 wasn't more than a couple of feet between normal

22 operating range and the new number, the 7.2 number.

23 Of course now that's been raised.

24 MEMBER ARMIJO: Ask Jerry.

25 MR. DEAVER: Yes. This is Jerry Deaver with

1 GEH. We assumed the water level at the top, at the
2 weir spillover point, which is 14.35 meters.
3 MEMBER ARMIJO: Well, that's your minimum,
4 isn't it? Is t hat your minimum water level in the
5 pool?
6 MR. DEAVER: Well, that should be your
7 minimum, you know, considering that you have a flow
8 over the wet weir in operation.
9 MEMBER ARMIJO: Yes, okay.
10 DR. WALLIS: So it's not much above that
11 minimum?
12 MR. DEAVER: You can't go above --
13 DR. WALLIS: Can't go much above that?
14 MR. DEAVER: No.
15 DR. WALLIS: Because it flows over?
16 MR. DEAVER: Right.
17 DR. WALLIS: This level they're talking
18 about is always a collapsed level? It's always a
19 collapsed level they're talking about, when it was at
20 boiling?
21 MR. DEAVER: Yes. It's the fundamental --
22 during boil-off, the level is the -- with the water
23 evaporated.
24 DR. WALLIS: The collapsed level, because
25 you've got voids in there.

1 MR. DEAVER: Yes, yes.

2 DR. WALLIS: So it's actually higher. The

3 real level is higher. The surface of the water is

4 higher than you say here, because of the bubbles in

5 it?

6 MEMBER ABDEL -KHALIK: This is a simple

7 inventory calculation.

8 DR. WALLIS: It's a simple inventory

9 calculation.

10 (Simultaneous discussion.)

11 MEMBER ABDEL -KHALIK: --for the

12 vaporization. That's all there is to it.

13 MR. DEAVER: Yes. It's not that high tech.

14 MEMBER ARMIJO: So you're actually

15 evaporating 4-1/2 million pounds of water?

16 DR. WALLIS: That's a huge amount, yes.

17 MR. GALVIN: You would be correct. I mean

18 if there's voids in the water, then actually the

19 apparent water level would be higher, right?

20 MR. DEAVER: That's a true statement, yes.

21 DR. WALLIS: Well, we asked about where it

22 went. Is the staff concerned about where all this

23 water goes?

24 MR. WHEELER: I don't have an answer for

25 your question. That's something we'll have to take

1 back.

2 CHAIRMAN CORRADINI: This is a design basis

3 calculation for the purposes of what? I'm get ting

4 nervous about taking a conservative calculation and

5 taking it somewhere it's not meant to go.

6 MR. WHEELER: I mean take your fuel plus the

7 complete core offload.

8 MEMBER ARMIJO: For 72 hours.

9 MR. WHEELER: And then we add the 72 hour

10 loss of FAPCS.

11 MS. CUBBAGE: Is there a safety concern with

12 the steam?

13 DR. WALLIS: Well, you've got all this water

14 going somewhere. Does it affect some other safety

15 operation in some way?

16 MS. CUBBAGE: Well, I mean what's going on

17 in that building is nothing, as far as --

18 DR. WALLIS: There's nothing in that

19 building--

20 MS. CUBBAGE: You're not crediting any

21 active make-up or cooling.

22 DR. WALLIS: There's nothing else in that

23 building you're crediting?

24 MS. CUBBAGE: So the safety case is.

25 DR. WALLIS: That's a good answer. But

1 still, even if it fills with water, it can't do any
2 harm?
3 MS. CUBBAGE: I'm just talking off the top
4 of my head, but it would seem to me if we've already
5 said that nothing active is working and we're in this
6 worse case design basis situation where we're just
7 steaming, I'm not sure what impact it would have.
8 MR. GALVIN: GEH told us there was no
9 safety-related equipment in that building, so -- and
10 they've also said that there's a -- right now, since
11 Revision 7, they've added a, they've made events
12 safety-related. The SRP guidance says if you allow
13 your pools to boil, you need to have a place for the
14 steam to go.
15 DR. WALLIS: So it doesn't affect pumps or
16 pumps for this spent fuel pool, which are in the
17 building?
18 MR. WHEELER: Well, there are. That's why
19 you have the boiling --
20 DR. WALLIS: Would you start them up after
21 72 hours, or would you --? Do you bring in some other
22 water up to 72 hours? What do you do?
23 MR. GALVIN: The fire pumps come on, the
24 fire pumps, yes, in a separate building.
25 DR. WALLIS: So you don't care if those

1 pumps work?

2 MR. GALVIN: Yes.

3 MEMBER STETKAR: Where, and this is a

4 question of GEH or of the staff. Where are the --

5 those are manual valves that you line up the fire

6 protection syst em for make -up, is that correct?

7 They're not motor operated or otherwise operated?

8 MR. WHEELER: I've got the simplified

9 drawing. It appears that on their drawing that they

10 are manual valve.

11 MEMBER STETKAR: Yes, I believe that's the

12 case. Does the simplified drawing that I've lost show

13 where those valves are located? Are they in the fuel

14 building or are they outside of the fuel building?

15 MR. WHEELER: This drawing says that they

16 are in the yard area.

17 MEMBER STETKAR: Okay, good. Thanks.

18 That's part of the answer. Even if you flood out

19 FAPCS, they take credit for make-up from the fire

20 water system. As long as the valves are accessible,

21 they can get the water in there. That's through that

22 primary fire protection header thing, that's written

23 as B.

24 DR. WALLIS: If you drive off all the steam

25 and the outside temperature is below zero, you will

1 get an enormous, enormous stalag types of ice forming
2 around this pool. I don't know if that affects the
3 operation of --
4 CHAIRMAN CORRADINI: So what are you -- I'm
5 sorry. You're postulating a design basis action in
6 the middle of dead of winter?
7 DR. WALLIS: Yes. Why not? It could happen
8 at any time.
9 CHAIRMAN CORRADINI: We do a worse scenario.
10 MR. WHEELER: Now keep in mind, the FAPCS
11 pumps are diesel-backed, so there's that reliability.
12 That's part of their design.
13 DR. WALLIS: If you put a lot of steam out,
14 and outside temperature is very cold, you'll make an
15 awful lot of ice here, ice somewhere out there. This
16 is of no concern on accessibility of the valves?
17 MEMBER ARMIJO: Not to me.
18 CHAIRMAN CORRADINI: Is that a question of
19 staff?
20 DR. WALLIS: I'm just thinking about what
21 might happen, if I had all this steam issuing out in
22 the middle of winter.
23 VOICE: It would turn into snow.
24 DR. WALLIS: And wouldn't it, would it have
25 some effect on accessibility? People have to go

1 through an icy surface and an open valve's covered
2 with ice.
3 (Simultaneous discussion.)
4 DR. WALLIS: If the fire pumps go on.
5 MR. MARQUINO: This is W ayne Marquino, GE.
6 We do consider in our detailed design operator access
7 to these areas, especially where there is RTNSS
8 equipment. So we'll design platforms, steps, ladders
9 to provide access.
10 The question about ice forming, that's a
11 structural conc ern of the building and the roof
12 system. It doesn't apply only to steam coming out of
13 the building, but it would apply under winter weather
14 conditions as well.
15 MR. GALVIN: Can we move on to the next
16 topic?
17 MR. WHEELER: So concluding on Slide 7, we
18 have the RTNSS-B function. Staff found the following
19 acceptable for FAPCS and its RTNSS-C function. This
20 is for the pressure coolant injection node. This
21 requires a FAPCS pump to take a section from the
22 suppression pool and pump it into the RPV by the
23 reactor water clean-up and shutdown cooling loop,
24 Alpha, and the feed water loop, Bravo.
25 Once again, FAPCS does have availability

1 controls. This piping system is non-safety. However,
2 it is Seismic CAT-2. All RTNSS structure, system and
3 components are within the scope of the D-RAP.
4 Next slide. Moving on to the next FAPCS
5 RTNSS-C function is the suppression pool cooling node.
6 It requires water to be drawn from the suppression
7 pool, cooled by FAPCS and returned to the suppression
8 pool. Once again, avai lability controls apply.
9 Piping is non-safety related. It is Seismic CAT -1 or
10 2.
11 Physically separated, 100 percent cooling
12 trays, each with one FACPS pump and heat exchanger.
13 Procedures are to ensure avoidance of water hammer and
14 gas binding. That is a COL item, 13.54 -Alpha.
15 Provisions are also provided to protect FAPCS
16 components from fire, missile-generating events,
17 internal flooding, seismic event, and that would be
18 the SSE.
19 Once again, all RTNSS structures, systems
20 and components are within t he scope of a D -RAP.
21 That's for the suppression pool coolant routing.
22 DR. WALLIS: Did you analyze that the
23 procedures to avoid water hammer and gas binding are
24 adequate?
25 MR. WHEELER: Those are COL items.

1 DR. WALLIS: Oh, they're COL items, so we
2 don't' consider them, at this point?
3 MR. WHEELER: At this point, that's correct.
4 Slide 10. The staff found the following acceptable
5 for FAPCS, for its RTNSS -Charlie function, that they
6 do in fact are diesel -backed by the standby diesels,
7 and that's availability controls 3.81 and 3.82.
8 Moving over to operating experiences, the
9 staff found the following acceptable related to two
10 RAIs: Gas accumulation that could enter the system
11 and results in components or system damage was
12 adequately addressed. The gas accumulation is
13 possible from the high pressure interface between the
14 reactor water clean-up and the shutdown cooling.
15 Interface through check valves and the
16 motor-operated valves. The staff concludes that there
17 is a pressure relief valve that is located between the
18 check valve and the MOVs. In addition, FAPCS is not
19 immediately placed into service for a low pressure
20 injection, or alternate shutdown cooling nodes.
21 Therefore, there's adequate time for proper
22 venting if there was a gas bubble in the system.
23 Moving on to the second item, the refueling
24 cavity bellows. Postulated failures were adequately
25 addressed. The bellows is a permanently installed

1 CAT-1 component, stainless steel component designed
2 for a life of 60 years. This bellows includes a
3 secondary seal, which is monitored for leakage. The
4 drain down event for the refueling cavity is not
5 likely to occur.
6 Also level indications and alarms are
7 provided to alert operators to any leakage out of the
8 cavity that would develop.
9 Next sl ide. Staff review concludes for
10 FAPCS, for this RTNSS-Bravo and Charlie functions are
11 highly reliable, meets the single failure criteria,
12 and are subject to enhanced design, quality,
13 reliability and availability provisions. Once again,
14 the staff is still looking at the spent fuel pool heat
15 loads, and that's considered an open item.
16 DR. WALLIS: Why are you still looking at
17 it, when it seems such a simple calculation?
18 MR. WHEELER: Well, it just came in on
19 Monday, and we didn't want to rush through thi s, just
20 to say we had a closed item.
21 DR. WALLIS: Okay, because it does look like
22 a pretty simple thing. It's just energy and an energy
23 out for the thing.
24 MEMBER ABDEL-KHALIK: He's calculating the
25 heat flow.

1 MR. WHEELER: Right.

2 DR. WALLIS: The heat flow.

3 MR. GALVIN: Well, I mean since there was

4 confusion with it the first time, and then of course

5 there's a ten year heat load and a 20 year heat load,

6 so we want to make sure we -- at this rate, and

7 there's also a tech spec associated with it.

8 DR. WALLIS: That's fine, that's fine.

9 MR. WHEELER: Discussions and questions on

10 FAPCS?

11 MR. GALVIN: We can proceed, and you can ask

12 them all at the end. Okay.

13 CHAIRMAN CORRADINI: Keep on going.

14 MR. WHEELER: Next presentation is related

15 to the service water system, component cooling system

16 and the nuclear island chilled water system.

17 Regulatory guidance is found in SRP 9.21, 9.22, which

18 includes the relative requirements of GDC 245, 44, 45

19 and 46.

20 Next slide. Once again, we already t alked

21 about RTNSS on the FAPCS presentation.

22 Next slide. RTNSS sea water system

23 focus was part of the March 19th and 20th, 2009

24 audit. That was to resolve RAI 9-224. The staff

25 found the following acceptable: adequate design

1 margins between the cool ing tower capacity and
2 bounding heat loads for service water between the
3 component cooling heat exchanger capacity,
4 maximum heat loads, and between the nuclear
5 island chilled water system and the maximum heat
6 loads.
7 Single failure criteria has been
8 properly addressed due to the redundancy of the
9 design. Components have a diesel-backed
10 availability. Components failure positions on a
11 loss of preferred power.
12 Next slide. Service water pumps have
13 sufficient available net positive suction head in
14 the pum p sections, located for the lowest
15 possible water levels of the heat sink. The
16 component cooling and the chilled water pumps
17 have sufficient available net positive suction
18 head at the pump suction's lowest possible water
19 level in those surge tanks.
20 Next slide. Service water component
21 cooling, chilled water system, RTNSS components
22 are in fact in maintenance rule, which require
23 performance monitoring of the ISSEs. These three
24 system RTNSS components have adequate main
25 control on this rotation for system monitoring,

1 and during loss of preferred power, these three
2 systems, if their associated pumps fail, can be
3 powered by the two non -safety related on -site
4 standby diesel generators.
5 Next slide. Procedures to ensure
6 avoidance of water hammer and gas binding. We
7 talked about that earlier. That's a COL item.
8 There is redundancy in the service water
9 component cooling and the nuclear island chilled
10 water trains. Once again, RTNSS components are
11 within the scope of D-RAP.
12 Staff's conclusion for the servi ce
13 water component cooling system, nuclear island
14 chilled water system: For the RTNSS functions,
15 highly reliable, meets single failure criteria,
16 are subject to enhanced design quality and
17 reliability, and they meet applicable SRP 9.21
18 and 9.22. Any questions?
19 (No response.)
20 MR. GALVIN: We will proceed. David
21 Shum is going to speak about the staff's review
22 of the instrument air system, and cover it. It's
23 described in Section 9.36 of the SER.
24 MR. SHUM: Okay. The instrument -- the
25 system function is to provide air, compressor

1 air, try to compress the air to all the safety -
2 - I mean the air -operated equipments, and the
3 instrumental control outside the containment, and
4 to provide air to the high pressure nitrogen
5 supply system inside of containment during the
6 refueling outage operations.
7 The system is non -safety related, and
8 has no -- and not needed for safety shutdown. It
9 is RTNSS -- not RTNSS. The system was designed
10 to meet the ANSI Standard 7.0.01, the quality
11 standard for ISA, instrumentation air.
12 DR. WALLIS: The air is drawing after
13 it's compressed, is it?
14 MR. SHUM: Yes.
15 DR. WALLIS: Okay.
16 MR. SHUM: And the system has two
17 identical 100 percent filtration and dryer
18 systems, and has a cross -tie between the
19 distribution headers of th e service system and
20 instrumentation systems. Use it to bypass the
21 instrumentation air system, in the event that
22 both of them, instrumentation air and dryer
23 trains fail.
24 MEMBER STETKAR: I don't have the
25 drawing in front of me here, and I'm having

1 problems finding it quickly. My recollection is
2 that that bypass line not only bypasses the
3 dryers, but it also bypasses the filters. Is
4 that correct?
5 MR. SHUM: Right. It comes from two
6 headers. It come out from the service air system
7 discharge header, d irectly to the discharge
8 headers of the instrumentation heads.
9 MEMBER STETKAR: That's what my
10 recollection was, and so that means if for some
11 reason I have problems with both the air dryers,
12 or one is out for maintenance and I have a
13 problem with the op erating air dryer, and I need
14 to cross-tie the system, in a sense, I'm putting
15 direct service air into my instrument air header.
16 I'm effectively bypassing the dryer and
17 that really small three millimeter, micron, or
18 three whatever it was, -- that they talked about.
19 MR. SHUM: You are right. You are
20 right. If you assume both of them are not in
21 operations.
22 MEMBER STETKAR: Yes. Do you have any
23 idea of the reliability of air dryer?
24 MR. SHUM: There are no moving parts.
25 MEMBER STETKAR: Oh yeah, there are.

1 MR. SHUM: In the air dryers.

2 MEMBER STETKAR: Typically, you have

3 two towers that blow down. You have a lot of

4 moving parts there. Most plants they're out of

5 service a reasonable fraction of the time. When

6 I say "reasonable," I don't mean --

7 MR. SHUM: That's why you have two

8 trains, 100 percent trains for.

9 MEMBER STETKAR: Some plants have

10 three, and they have to occasionally bypass them.

11 MR. SHUM: I understand.

12 MEMBER STETKAR: So the question then,

13 and I think the reason for o ur original concern

14 was given the design of the system, with the

15 bypass capability, where you bypass not only the

16 air dryers, which is a good thing, because they

17 are not necessarily highly reliable pieces of

18 equipment, but also bypass the filters, what's

19 the chance of introducing now contaminants from

20 the service air system into the instrument air

21 lines, which could then migrate --

22 MR. SHUM: To answer your question, you

23 have two trains, 100 percent, okay? If both

24 fail, they only fail during the refuelin g outage

25 times.

1 MEMBER STETKAR: I'm not necessarily --
2 MR. SHUM: You only use it for that.
3 MEMBER STETKAR: Inside the containment
4 valves.
5 MR. SHUM: Outside the containment,
6 this system, the instrumentation air system, is
7 not going to operate an y air operated equipment
8 in the safety system.
9 MEMBER STETKAR: Okay. Let me make
10 sure I understand that. Maybe I might need some
11 help from GE. Does instrument air supply outside
12 the containment? Does instrument air supply air-
13 operated containment is olation valves that are
14 located outside the containment?
15 MR. ARCARO: This is Mike Arcaro, GEH.
16 I think Chapter 6 has a list of containment
17 isolations. I believe there is instrument air.
18 MEMBER STETKAR: Yes. I think that's
19 the case.
20 MR. BEARD: A nd Alan Beard of GEH
21 again. I'd also say that the CRD pilot valves.
22 MEMBER STETKAR: Oh, okay. I didn't
23 even think of that.
24 MR. BEARD: So the pilot valves will
25 get instrument air --

1 MEMBER STETKAR: I was just thinking.
2 The problem, of course, h as been historically
3 that contaminants in instrument air piping, in
4 particular oil and other contaminants, can
5 migrate through the air piping and essentially
6 collect at the ends of the distribution headers,
7 which are typically solenoids for air operated
8 valves.
9 And the problem is that the air, the
10 valves are designed to fail closed on loss of air
11 pressure, provided that the spool piece in the
12 solenoid actually can physically move when the
13 solenoid is de-energized.
14 If the spool piece is varnished in
15 place, because you now have a normally energized
16 solenoid that actually has heat associated with
17 it, and a long-term accumulation of small amounts
18 of oil perhaps. Now are all of your air
19 compressors oil free?
20 MR. ARCARO: This is Mike Arcaro, GEH.
21 That's correct. They are oil-free.
22 MEMBER STETKAR: That's good news. So
23 then it would be any entrained moist, you know,
24 any contaminants that might be entrained in
25 moisture, for example, from the intake that got

1 through the compressors. But that's less of a
2 concern.
3 MR. ARCARO: Now one of the things we
4 committed to Reg Guide 168, 168 has you take air
5 samples at the full loads --
6 MEMBER STETKAR: You're going to do
7 that down at the loads?
8 MR. ARCARO: That's correct.
9 MEMBER STETKAR: Okay, good. Thank
10 you.
11 DR. WALLIS: The compressors presumably
12 have a facility for removing moisture. As you
13 compress air, you tend to condense. So they
14 presumably remove moisture --
15 MEMBER STETKAR: They usually do have
16 moisture separators, but they're not --
17 DR. WALLIS: --all together.
18 MEMBER STETKAR: But they're not as
19 good as these air dryers. That's why they have
20 them.
21 DR. WALLIS: Because there's a
22 notorious problem with compressed air getting
23 moisture.
24 MR. SHUM: But the compressed air,
25 later on we will address that. The air coming

1 out of the compressor of the service air is
2 supposed to be less than 10 microns. It's a lot
3 less than the ANSI standard will allow. ANSI
4 standard define, you know, specify 40 microns, I
5 mean 40 microns.
6 MEMBER STETKAR: Just for particulate
7 contamination?
8 MR. SHUM: Uh-huh, so and the system
9 continues monitors for moisture contents.
10 MEMBER STETKAR: Depends where that
11 monitor is. If the monitor is right after the
12 air dryer, it's not going to help you when you
13 bypass the dryers.
14 MR. SHUM: Yes, sure. So and
15 instrumentation air is not supposed to go to any
16 safety-related systems.
17 MEMBER STETKAR: Well, the point is
18 that it does go to safety -related systems. It
19 does not provide a design basis, safety -related
20 function in the sense of the fact that pressure
21 must be supplied to operate that equipment. It
22 does connect the safety -related pieces of
23 equipment. Those are containment isolation
24 valves.
25 MR. SHUM: The containment isolation

1 valves, that's a fail safe.

2 MEMBER STETKAR: You know, I'll tell

3 the story from a plant that I used to operate at,

4 that had a notoriously bad instrument air system,

5 that supplied air -operated containment isolation

6 valves.

7 They failed safe on loss of air

8 pressure. When we did our quarterly containment

9 isolation test, we always had valves that did not

10 work because the solenoid spool pieces that were

11 de-energized, that had to move to vent the air

12 pressure from the valve, did not move. They were

13 varnished in place.

14 So altho ugh air pressure, air pressure

15 is not removed from this thing until a spool

16 piece moves to vent the pressure off the top of

17 the valve operator. If that spool piece doesn't

18 move because the spool piece was varnished in

19 place, because it was cooked, you kno w, you took

20 some oil and cooked it there, you could de-

21 energize that valve all you wanted to, and the

22 valve would stay open. The isolation valve would

23 stay open. That's the basic concern.

24 MS. CUBBAGE: May I interject please?

25 Is there a recommendation the Committee would

1 like to make on this?

2 MEMBER STETKAR: No, there isn't.

3 Actually, he's defending things too quickly.

4 MS. CUBBAGE: Okay.

5 MEMBER STETKAR: But the fact that you

6 don't have oil in your air compressors is the

7 key.

8 MS. CUBBAGE: Okay.

9 MEMBER STETKAR: And the fact they've

10 committed to monitoring the quality of the air at

11 the, you know, the loads, the end of the

12 distribution lines. Those two in parallel

13 satisfy me that this is okay.

14 MS. CUBBAGE: All right. Let's roll.

15 MR. GALVIN: Do you want to hear the

16 rest of our presentation on that or not?

17 MEMBER STETKAR: No.

18 MR. GALVIN: Okay. So I guess we're

19 done with it.

20 MEMBER STETKAR: Amy, my only point was

21 you shouldn't say that the air system does not

22 interface with safety-related equipment, because

23 it absolutely does.

24 MS. CUBBAGE: Okay. Point taken.

25 Thank you.

1 MEMBER STETKAR: And that is not as a -
2 - that is not an appropriate defense for the
3 concern.
4 MR. GALVIN: Okay. So we were going to
5 skip the rest of thi s. So Amy, I guess now you
6 can ask questions. That's the end of our
7 presentation.
8 CHAIRMAN CORRADINI: There were
9 questions being asked.
10 MR. SHUM: Am I done?
11 (Laughter.)
12 MR. GALVIN: I don't know if they're
13 done. I don't know if the rest of th e members
14 want to ask you questions.
15 CHAIRMAN CORRADINI: Other questions
16 for the staff?
17 (No response.)
18 CHAIRMAN CORRADINI: Thank you.
19 MR. SHUM: Thank you.
20 MEMBER ARMIJO: Going to do Chapter 6.
21 MR. GALVIN: We're going to do Chapter
22 6 --
23 CHAIRMAN CORRADINI: That is our plan.
24 We want to do Chapter 6.
25 MS. CUBBAGE: Okay, GE.

1 CHAIRMAN CORRADINI: GE is up.

2 (Off mic discussions.)

3 Chapter 6/GEH

4 MR. MARQUINO: Okay, so is John ion the

5 line? John Gels, are you on the phone?

6 MR. GELS: Yes, I'm here.

7 MR. MARQUINO: Okay. So we have more

8 information on our FAPCS questions from earlier

9 today, and ability to drain via one single

10 failure from one pool to another pool. There was

11 a comment made by the folks in Wilmington that

12 there wa s a check valve. Do the folks in

13 Wilmington want to go further than that and tell

14 us more?

15 MR. GELS: Right. The check valve I

16 was referring to is not in fact a check valve, if

17 I understand your question, and you're referring,

18 I believe, to the point i mmediately exiting the

19 surge tank?

20 MEMBER STETKAR: Yes. On the one -line

21 drawing, the only one that I have is the one-line

22 drawing, this single -- there's a normal, you

23 know, a manual isolation valve shown on that

24 line, but I didn't see any check valves.

25 MR. GELS: That's right. There is not

1 a check valve on that line, and if I understand
2 your concern, it was drainage from the
3 suppression pool through the suppression pool
4 suction line, and then back up the surge tank
5 suction line.
6 MEMBER STETKAR: Y eah, that's correct,
7 and the concern, now that there aren't any check
8 valves, just to make sure you have it clear, the
9 concern is kind of twofold. Number one is how
10 quickly and how far can I drain either the
11 suppression pool or the GDCS pool, because I
12 could be aligned to -- in principle, I could be
13 aligned to either one of them.
14 MR. GELS: Uh-huh.
15 MEMBER STETKAR: And that's just
16 basically line size and hydraulics, and I don't
17 know where the suction lines connect to those
18 particular pools, whether they're at the bottom
19 or whether they have, you know, some other
20 configuration.
21 So that's one question, is how quickly
22 can I drain and how far can I drain either of
23 those pools.
24 The second question is if I do have
25 this alignment, where I'm now in a water transfer

1 mode from one of those pools into essentially the
2 pull pools, you know, it will go through the
3 skimmer surge tank and back through the skimmer
4 lines and overflow the fuel pools, where does
5 that water go, and how much of it is there?
6 Can I flood all of the equipment in the
7 basement of the turbine building? Not turbine
8 building, fuel building, and in particular
9 because the FAPCS pumps and valves and everything
10 is down in the basement.
11 So it's kind of a twofold. It's
12 drainage of tanks that I'd like to have water in,
13 and a potential incapacitation of equipment that
14 it's not safety -related, but it's at least
15 identified as RTNSS functions.
16 MR. GELS: Okay. I can't immediately
17 answer the question about how fast they do drain.
18 The GDCS pool is equipped with anti-siphon
19 holes that would prevent drainage below the
20 minimum level. The suppression pool has
21 monitoring on it that would signal when low level
22 has been reached.
23 But I think the more overriding feature
24 is that there are interlocks built into the
25 FAPCS system, such that valve alignments that

1 could result in water flowing from the
2 suppression pool to either the surge tank or the
3 fuel pools would be prohibited by the logic.
4 MEMBER STETKAR: And that's in the
5 suction valves?
6 MR. GELS: That's right. There is a
7 valve bridge on the suction side of the pumps,
8 and right.
9 MEMBER STETKAR: Yes.
10 MR. GELS: And so those valves can be
11 configured in certain ways that allow both trains
12 to operate. But there are also certain specific
13 configurations that are prohibited, and one of
14 those configurations would be one that would
15 allow drainage from the suppression pool through
16 the surge pipe.
17 MEMBER STETKAR: Okay. So you're
18 basically saying that we're protected against
19 this by the valve interlocks?
20 MR. GELS: That's correct.
21 MEMBER STETKAR: Okay. Thank you. I'd
22 still be interested in the original questions,
23 only because we have operating experience where
24 people indeed have drained large pools into
25 places that they ought not to be in similar

1 configurations that have valve interlocks that
2 are overridden for one reason or another.
3 But thanks for the information about
4 the interlocks. That certainly helps.
5 MR. BEARD: This is Alan Beard, and
6 John, jump in if I get this wrong. But I t hink
7 the key points he made was on the suppression
8 pool, we are monitoring level and if it drops
9 below a certain point, the isolation valves will
10 close and terminate that drain down. Correct
11 John?
12 MR. GELS: I would have to look that
13 up.
14 MR. BEARD: W ell, we'll check on that,
15 and then the point on the GDCS pools is we are
16 sucking off the top of the water. So it's a weir
17 type of situation.
18 MEMBER STETKAR: Yeah, I see that. I
19 see that on the --
20 MR. BEARD: It's not a suction from way
21 low down in the pool. There's only so much water
22 off the top for the drain down.
23 MEMBER STETKAR: Yes. So the bigger
24 concern would indeed be the suppression, how far
25 can you drain it down before you get below level.

1 MR. BEARD: And I will take the action
2 tonight to go and check on that. But I believe
3 it's down to seven meters is where we would have
4 the isolation point.
5 MEMBER STETKAR: I have no idea what
6 that volume of water --
7 MR. BEARD: From 7 to 7.1 meters.
8 CHAIRMAN CORRADINI: You'd have the
9 isolation point because of the valve logic, or
10 you have the isolation point because of what?
11 I'm sorry.
12 MR. BEARD: To terminate a potential
13 drain down of the suppression pool.
14 MEMBER STETKAR: I mean on the
15 suppression pool, you want to keep water --
16 MR. BEARD: And as far as your --
17 CHAIRMAN CORRADINI: I understand that,
18 but I don't understand --
19 MR. BEARD: Your other thought. The
20 pumps for the FAPCS system are located in water-
21 tight rooms. So although the water would
22 accumulate in the -- area of the basement of the
23 spent fuel pool or the spent fuel building, it
24 would not get into the room where those pumps
25 are.

1 MEMBER STETKAR: Okay, good, good.
2 Thank you.
3 CHAIRMAN CORRADINI: Thank you very
4 much. Okay. On to Chapter 6.
5 MR. MARQUINO: With control room
6 habitability and EO.
7 MR. ARCARO: All right. Next slide.
8 Okay. What we wanted to talk about today was
9 control room habitability area tech specs, talk
10 about the heat sink temperatures.
11 Also, the passive heat sink validation,
12 how we validate the functioning of the heat sink,
13 and go through the bounding ESBWR standard plant
14 site parameters, specifically the temperatures
15 associated with Table 2.01 for site parameters on
16 ambient temperatures. I'll also talk about the
17 reactor building temperature monitoring
18 requirements.
19 MR. MARQUINO: And these are mostly
20 follow-up items from previous ACRS comments.
21 We've got about three slides on each of the four
22 topics that tell our story. So to get to the
23 bottom line, you have to wait for the third
24 slide. But we'll go quick.
25 MR. ARCARO: Okay. Passive heat sink

1 issues. The control room habitability area heat
2 sink is maintained below the analysis values by
3 maintaining the air temperature below the
4 requirements in the tech specs, and there's a
5 table in the basis that tells you the different
6 air temperatures for the different groups or
7 zones in the control room habitability area.
8 Permanently installed sensors will
9 monitor temperature in various locations and
10 elevations inside the control buil ding, and these
11 temperatures are what are used for the -- to
12 contain the passive analysis used for the heat
13 sink.
14 Tech specs say when the average
15 temperature of one or more of the rooms is
16 greater than the limits, we go into an action
17 statement. Action Statement A-1 requires that we
18 restore the air temperature within eight hours.
19 So if air temperature in any of these rooms,
20 zones, goes above the limit, we're in a tech
21 spec.
22 MEMBER ARMIJO: What's the limit?
23 MR. ARCARO: There's a slide that's
24 coming up, but it depends on the different area.
25 The control room habitability area is 74

1 degrees. The HVAC rooms are a higher
2 temperature.
3 DR. WALLIS: Now it says here "air
4 temperature of each heat sink." The heat sink is
5 the wall, isn't it?
6 MR. ARCARO: That's correct.
7 DR. WALLIS: So there's no air
8 temperature of a wall?
9 MR. ARCARO: The air temperature --
10 DR. WALLIS: The air temperature
11 adjacent to a wall, isn't it?
12 MR. ARCARO: Yes. The average
13 temperature of that area.
14 DR. WALLIS: Near the wall. It's the
15 average temperature of the region beside which
16 the wall is.
17 MR. ARCARO: Right.
18 DR. WALLIS: But you're not actually
19 measuring anything in the wall itself?
20 MR. ARCARO: That's correct, that's
21 correct.
22 DR. WALLIS: Right.
23 MR. MARQUINO: So we're controlling the
24 concrete at the bottom of the heat sink
25 temperature by monitoring the air temperature.

1 DR. WALLIS: That's right. It's just
2 the wording is odd. The air temperature of each
3 heat sink is very peculiar wording. Okay. I
4 understand what you're doing.
5 MR. ARCARO: Right. So prior to
6 reaching 85 degrees, and there's a basis on that
7 number, we'll restore forced ventilation, we'll
8 reduce loads, we'll make sure we get the
9 temperature within spec. So we got up to that
10 point before we end up tripping non -essential
11 DCIS loads in the control room.
12 So at 85 degrees, we tripped the heat
13 loads to maintain us below the parameters that
14 were used in the analysis.
15 MEMBER STETKAR: Mike, that 85 degree
16 set point is the same set point? That's the
17 safety-related trip set point that you used to
18 trip during any heat up?
19 MR. ARCARO: That's correct, right,
20 right. Yes. It's a --
21 MEMBER STETKAR: Because that was one
22 of my questions, is what was that temperature.
23 MR. ARCARO: Yes. The safety -related
24 instruments trip the non -safety loads in the
25 control room at 85 degrees, and that mimics the

1 analysis that we did. Okay.

2 Next slide. Okay. The other part of

3 the tech spec action statement is A-2, which

4 requires that the averag e temperature of each

5 heat sink be restored within 24 hours. So here's

6 -- before we were looking at air temperatures.

7 Now we're looking at the heat sink. The average

8 heat sinks exceed the specified limit.

9 We can verify the restoration of the

10 heat si nks, either by administrative evaluation,

11 considering the length of time and extend that

12 the heat sink average air temperature went above

13 the limits, or by direct measurement.

14 So two different cases to verify and

15 validate that the heat sink is within the

16 requirements of the analysis. Okay. The way you

17 can do that, the evaluation can provide

18 temperature profiles based on the initial

19 conditions, and you use the air temperature to

20 estimate, validate the concrete temperatures, the

21 heat sink temperatures.

22 In lieu of that, you can actually go

23 measure the heat sink temperatures. You can

24 measure the concrete temperature at the surface,

25 and determine what the temperature would be.

1 DR. WALLIS: That's probably all right.
2 But usually the radiation heat transfer
3 coefficient is about the same as the convector in
4 a room like this.
5 So if you had a hot light bulb here, it
6 would heat the wall, and then the wall could
7 conceivably be hotter than the air. You don't
8 have that situation, I think, in the control
9 room. You're just relying on the air, air
10 convection to keep the wall cool?
11 MR. ARCARO: That's correct.
12 DR. WALLIS: And that's probably right.
13 But if you did have a big radiation source in
14 there, that wouldn't be true. If the sun was
15 shining on the wa ll, the wall could well be
16 hotter than the air?
17 MR. ARCARO: That's correct, and I
18 think that's one of the assumptions.
19 DR. WALLIS: For sun in the control
20 room, so we're all right.
21 MR. ARCARO: Okay. Next slide.
22 DR. WALLIS: I'm just going to be sure
23 there isn't something else coming into this.
24 MR. ARCARO: Okay. So those are the
25 two conditions for the tech spec. If you don't

1 meet either the air temperature or the heat sink
2 temperature, requirements are to be in Mode 3 in
3 12 hours, Mode 5 at 36 hours.
4 The way we control that, the
5 implementation of that will be through a COL
6 item. We have a COL item that relates to control
7 room habitability area procedures and training,
8 and that would be where the applicant would
9 provide this operability ev aluation for the heat
10 sink and the relationship to the air temperature.
11 Okay, next slide.
12 CHAIRMAN CORRADINI: So now we're onto
13 the second topic.
14 MR. ARCARO: Okay. Second topic, why
15 was an analysis chosen for the ITAAC method for
16 the control room heat sink, rather than an
17 operational test? So in Tier 1 for the control
18 building, we validate the passive heat sink by
19 comparing as-builts with the conditions used in
20 the analysis.
21 So the critical parameters are the as-
22 built heat sink dimensions, therm al properties,
23 exposed surface area, thermal properties and
24 materials covering parts of the heat sink. If
25 you put posters up on the wall or painting, and

1 the as-built heat loads.

2 So that's how we do. The way the ITAAC

3 is written is it's a validation of the analysis.

4 An operational test that would simulate the

5 limiting design conditions would be extremely

6 difficult to perform. Like I said, the analysis

7 itself is a Tier 2 star item. So in the LTR,

8 there's a table with a list of parameters that

9 need to be met.

10 Tier 2 star means the NRC needs to

11 provide prior approval if we change the

12 methodology of the test. Okay. Next slide.

13 MR. MARQUINO: Of the calculation.

14 MR. ARCARO: Of the calculation, I'm

15 sorry.

16 MR. MARQUINO: There's a specified

17 calculation that will be done to validate the as-

18 built control room.

19 MR. ARCARO: Okay. So here's some

20 bullets why analysis rather than a test. The

21 heat capacity of the control room concrete mass

22 will be validated in ITAAC. This is similar to

23 other passiv e functions such as building

24 structural response and, you know, by validating

25 the components, the key parameters, that would be

1 all you need to do to make sure that the function
2 is met.
3 Limiting parameters associated with the
4 passive heat sink could not be readily reproduced
5 during the performance test. So to get the 117
6 degree ambient temperature with an 86 -degree
7 ground temperature during start-up testing in the
8 middle of the winter would be very difficult to
9 obtain.
10 You'd end up extrapolating outsid e of
11 your normal heat loads and parameters to a
12 condition that is beyond what you're testing to.
13 Performance tests would have to last for a
14 period of 72 hours, to simulate the entire event.
15 MEMBER ARMIJO: Before --
16 MR. MARQUINO: I think he's got one
17 more.
18 MEMBER ARMIJO: I'm sorry. I think
19 you're making it awfully hard. I've just seen --
20 I agree. Your analysis is probably --
21 (Simultaneous discussion.)
22 MEMBER ARMIJO: Let me finish asking my
23 question. Why wouldn't you just run a limited
24 test? You've got a prediction of time versus --
25 temperature versus time. You don't have to take

1 it up to the extremely, the extreme conditions,
2 and say hey, we're in the ballpark. A sanity
3 test, if nothing else.
4 MR. MARQUINO: So any test we did would
5 not be a design basis test. It wouldn't have the
6 exact weather conditions. In terms of the heat
7 loads, we have enough trouble figuring out how to
8 build the control room and get it to the pre-op
9 test state, without scheduling in a period where
10 the non-DCIS loads are going to be powered off,
11 but all the safety-related loads are going to be
12 available and powered on.
13 So in terms of the schedule for
14 performing the start-up test and pre-op test,
15 having this as a test would have some effect on
16 when you had completed all of the tests.
17 CHAIRMAN CORRADINI: But I guess, I
18 think what I hear Sam saying, I know John's going
19 to ask you more questions. But I think what Sam
20 is saying is as a pre-operational test, it
21 doesn't have to be design basis in boundary
22 condition, but it can be a way of checking your
23 calculation that you use for your design basis
24 calculation.
25 MEMBER STETKAR: You're relying on an

1 analysis and just --

2 MEMBER ARMIJO: See if the analysis is

3 good.

4 MEMBER STETKAR: You have faith that

5 the analysis indeed models reality, and you could

6 in principle change the input parameters to that

7 analysis, to be consistent with the known input

8 parameters when you run the pre-operational test,

9 run the test and see how well your analysis

10 indeed models reality.

11 And if it models reality quite well,

12 then you could have reasonable confidence that it

13 would model reality under design basis

14 conditions. If it doesn't model reality under

15 the non -design basis conditions, then there's

16 some questions.

17 MEMBER ARMIJO: Ye s, and I'm not

18 talking about cranking it up to 117 degrees or

19 anything like that.

20 MEMBER STETKAR: Well, you can't. I

21 mean that's outside. You can't do much with the

22 sun.

23 MEMBER ARMIJO: You just go with what's

24 reasonable for that, but you know, give you some

25 experimental verification that your model has got

1 everything covered.

2 MEMBER STETKAR: I think of this as the

3 analogy. We do a lot of design basis accident

4 analyses that assume that we can deliver X amount

5 of flow from injection systems, and yet we don't

6 rely on those analyses, period. We actually run

7 pre-op tests to make sure the pumps can put that

8 flow out.

9 MR. ARCARO: Well, I guess a similar

10 example would be containment air cooling testing

11 for Generic Letter 8913. You know, there was a

12 point where utilities were trying to simulate the

13 design conditions for these heat exchangers, you

14 know, and they were extrapolating on the heat

15 loads that they had to try to get to limiting

16 conditions.

17 And you know, a lot of utilities, you

18 know, gave u p on the testing and went to

19 inspection, because it didn't simulate real life.

20 You couldn't get those heat loads in the

21 containment, and it wasn't a valid test to

22 represent what it would do under accident

23 conditions.

24 CHAIRMAN CORRADINI: John, it's your

25 turn.

1 MEMBER STETKAR: I don't have much more
2 to say. I don't have much more to say.
3 MEMBER ARMIJO: I think we're in
4 engineering space, not regulatory space, I think,
5 and just take actuals and run a simple test.
6 CHAIRMAN CORRADINI: The only thing I
7 guess I can appreciate where I think they're
8 coming from is if they were to accede to a pre -op
9 -- I call it a pre -operational test is what
10 they're suggesting, not a --
11 (Simultaneous discussion.)
12 CHAIRMAN CORRADINI: Right. But if you
13 were to acce de to a pre -operational test, then
14 you'd have to develop acceptance criteria for if
15 you fall within or without. It would be the
16 equivalent, I know you don't want to hear this,
17 but the equivalent of a containment leak brake
18 test. You're building the plant . I was at the
19 same plant he was at. You shut down everything,
20 you close everything up and you do the CLRT test.
21 It doesn't work and you come back down.
22 You pump it back up and you do it until you
23 match your .1 percent. But my only point is it's
24 a pr e-operational test under some acceptance
25 criteria and operating conditions for the test.

1 That's what I think --

2 MEMBER STETKAR: And the acceptance

3 criteria would be how well the heat-up analysis -

4 -

5 CHAIRMAN CORRADINI: Matched the model.

6 MEMBER STETKAR: Matched the model, and

7 you would - max is the real world.

8 MR. MARQUINO: But in this case, in the

9 leak rate test, you pump the containment up to

10 the design pressure, so you're testing at the --

11 CHAIRMAN CORRADINI: Well, you actually

12 pump it up to 150 percent of design pressure.

13 MR. MARQUINO: So in this case, we

14 would have a different analysis that we would be

15 comparing the test to.

16 CHAIRMAN CORRADINI: What I think

17 they're suggesting, I mean and we understand

18 where we're coming from, but I think what these

19 two gentlemen are suggesting is what you're doing

20 is you're showing that your modeling assumptions

21 are being used in a controlled manner, and you

22 can match, within acceptance criteria, for

23 response.

24 DR. WALLIS: It's the same model. It's

25 the same analysis.

1 (Simultaneous discussion.)

2 MEMBER STETKAR: It's the same model,

3 you just put different inputs.

4 DR. WALLIS: Whatever nature gives you,

5 you put in there.

6 MEMBER STETKAR: And by the way, I'd

7 expand this discussion to not -- we tend to be

8 control room -centric on this, but there are

9 really three areas of the plant. It's the

10 control room envelope, and then the -- I've

11 forgotten the ventilation system, but the Q -DCIS

12 rooms in the control building. It's a different

13 ventilation system.

14 MR. MARQUINO: Right, control building,

15 general area.

16 MEMBER STETKAR: Right, and the reactor

17 building, whatever, clean air ventilation system,

18 I think, that cools the safety-related areas, you

19 know, where you have the inverters and the power

20 supplies and stuff out in the reactor building.

21 Those are the three areas, I think, you would

22 take the safety -related equipment. You take

23 credit for 72 hour passive heat removal.

24 MR. MARQUINO: Well, we'd like to

25 continue and then maybe cycle back on this after

1 the staff has their presentation.

2 CHAIRMAN CORRADINI: That's fine. Keep

3 on going, keep on going.

4 MR. ARCARO: Okay. So I think we

5 talked through all the bullets on this. Next

6 slide. Okay. This is the issue about site

7 characteristic values. In the Table 2.01 for

8 site-specific acceptance criteria, there's

9 criteria that talks about the daily temperatures

10 associated with both dry bulb temperature and

11 then the high humidity case.

12 Next slide. So I think the last ACRS,

13 we went through how does an applicant actually do

14 this? How is he going to take the numbers and

15 relate it to the conditions at the site? So in

16 3H of the DCD, we explained the notes on the

17 table, how the applicant would use his

18 temperatures to determine if the passive heat

19 sink analysis is bounding for that site.

20 So the terms that we use there, the

21 daily temperature range for summer conditions

22 associated with the dry bulb temperature, and the

23 daily temperature range for winter conditions,

24 and then there's also high humidity. S o for dry

25 bulb temperature conditions, we're looking at

1 sinusoidal ambient temperature response, as given
2 by ASHRAE 2005.
3 The applicant will look at his zero
4 percent max exceedance value, and then he'll look
5 at -- they'll look at 24 hours either before or
6 after, and come up with a range based on those
7 numbers.
8 So the historical zero percent
9 exceedance for that site, and then we'll look at
10 a range of 24 hours before and after that, and
11 come up with an average value based on that.
12 DR. WALLIS: Wasn't i t last time we
13 were looking at some typical curves, and it
14 seemed to be difficult to unequivocally define
15 what you meant by "minimum"?
16 MR. MARQUINO: Right, and we -- you
17 probably aren't recognizing what the changes are
18 on here, but they're very small changes, where we
19 replaced terms like the daily value with the
20 minimum occurring in the previous and successive
21 24 hours.
22 The staff has -- the staff is going to
23 bring back those actual temperature graphs, and
24 we believe that we have a unique definition that
25 can be used from available met data, to come up

1 with the three numbers to characterize the site.

2 DR. WALLIS: What you mean by "minimum"

3 is the lowest value over 24 hours, even though

4 it's not necessarily the bottom of a curve? It's

5 quite clear what you mean by "minimum"?

6 MR. MARQUINO: Yes. You define a

7 temperature for the dry summer conditions. You

8 define a maximum temperature, and then you look

9 at the highest low temperature plus/minus 24

10 hours, because we're not allowed to credit the

11 lower of the two temperatures. It's got to be

12 the higher of those lower temperatures.

13 MEMBER STETKAR: And I think these two

14 are relatively easy to kind of understand what

15 they're doing. It's the third, the high humidity

16 calculation on the next slide that gets more

17 convoluted.

18 MR. ARCARO: Okay. So here's the new

19 definition for the diurnal swing with the high

20 humidity. We took the maximum wet bulb

21 temperature, and we looked at the coincident dry

22 bulb temperature for that.

23 Then we looked at the minimum, the

24 highest low for the wet bulb over -- this would

25 be over three periods, three before and three

1 after. So that would be three 24 -hour segments.
2 So we looked at that, and we based -- and we
3 looked at the dry bulb associated with that
4 high/low wet bulb temperature.
5 MEMBER STETKAR: I think for this one,
6 we really need to see those same curves that the
7 staff had, because this was where the confusion
8 is, and quite honestly, even reading this and
9 trying to think about it without those curves --
10 MS. CUBBAGE: The staff's presentation
11 has the curves in them, so --
12 MR. MARQUINO: Okay. So keep, put a
13 post-it note on this page. When the staff comes
14 up, we'll read it relative to actual weather
15 data.
16 MR. ARCARO: Okay. The next issue is
17 talking about the as sumptions for the passive
18 heat calculation for the reactor building. The
19 concern is how do we -- how are the assumptions
20 of the heat -up calculation assured?
21 Specifically, how do we maintain the control
22 temperatures of the areas in the reactor building
23 associated with the passive analysis?
24 And we'll point to different sections
25 in the DCD that show that we're maintaining,

1 monitoring, alarming for those areas that have
2 input into the passive heat -up analysis, this
3 time for the reactor building.
4 Okay. I guess one of the issues was
5 why don't we include an LCO for rackable and
6 temperature monitoring, and this slide here talks
7 about this being consistent with the standard
8 tech specs, where other plants, previous vintages
9 of boiling water reactors, have gotte n rid of
10 that out of tech specs.
11 MR. MARQUINO: And the justification
12 for not having it in tech specs is that it is
13 continuously monitored and alarmed in the plant,
14 and ESBWR is consistent with that. We've
15 committed in the DCD to monitor area temperature
16 and have control room alarms on high
17 temperatures.
18 MR. ARCARO: And I think the next slide
19 will show a few of those examples.
20 MEMBER STETKAR: But if that
21 temperature instrumentation was not operable, you
22 would never get a high temperature alarm.
23 MR. MARQUINO: And you would repair the
24 inoperable temperature indicators.
25 MEMBER STETKAR: How would you know

1 it's inoperable, unless you have a continuous
2 read-out or something?
3 MR. MARQUINO: Well, I believe the same
4 indication is used in the A track system to
5 control the A track system. So if the indication
6 was wrong --
7 MEMBER STETKAR: If it's failed low, it
8 won't turn the fans on, and you won't get a high
9 temperature alarm.
10 MR. MARQUINO: Right, and when you went
11 in the room, you would find it's really hot. But
12 we're talking about one -- I think what we're
13 talking about here is you're talking about a
14 failure that would be detected by an operator
15 making -- I'm talking about a failure that would
16 be detected by an operator making his rounds, if
17 the normal way of detecting a failure in the HVAC
18 system didn't work.
19 MEMBER STETKAR: From what I heard you
20 saying, you're relying -- you know, you're
21 essentially relying on the fact that it's a
22 normally operating system. You have alarms in
23 the control room if temperature in the area is
24 too high, and as a surrogate for having a tech
25 spec requirement for operability of that

1 temperature instrumentation.

2 I'm saying if the temperature

3 instrumentation fails low, such that it does not

4 start the normal HVAC equipment, it's failed low.

5 It won't give you any indication of high

6 temperature in the control room. So the failure

7 actually is a contributor to the fact that the

8 room is heating up, and you don't know the room

9 is heating up because you don't get the hi gh

10 temperature alarm.

11 MR. MARQUINO: In one room and at the

12 same time you have the loss of offsite power, in

13 other words, that would have to be coincident

14 with a loss of --

15 MEMBER STETKAR: I'm not talking about

16 necessarily accident analyses here. I'm just

17 talking about normal plant operation. This is

18 temperature instrumentation for those rooms. How

19 do you verify that it indeed it is available.

20 I'm not talking about safety-related

21 instrumentation here necessarily.

22 MR. MARQUINO: Right.

23 MEMBER STETKAR: We're talking about

24 safety-related rooms in the reactor building,

25 right?

1 MR. MARQUINO: Also, I think we may --
2 do you expect you'll have redundancy in the
3 temperature indications in the HVAC system, Mike?
4 MR. ARCARO: Yes. You would have, you
5 know, you would have multiple channels for
6 monitoring temperature, and in the final
7 analysis, you know, if you had a failed
8 instrument, it would fail in a condition that
9 would provide you --
10 MEMBER STETKAR: It depends on what
11 kind of displays you have in the control room to
12 tell you that. I mean if you're only relying on
13 the high temperature without --
14 MR. ARCARO: In the control room, the
15 reactor building area temperature high is a
16 minimum inventory parameter. In the HVAC system,
17 you know, we'r e going to be doing air flows;
18 we're going to be doing damper positions. We're
19 going to be doing fan speed and, you know, flow
20 rates. We'll be doing temperatures.
21 So there's multiple parameters that
22 will give you the validation that you're
23 providing room cooling, you know, in addition to,
24 you know, operators doing rounds and actually
25 seeing what the temperatures are.

1 The only difference is that it's, you
2 know, it's not tech spec control, like in the
3 control building.
4 MEMBER ABDEL -KHALIK: So they're
5 monitoring. They get high temperature. What are
6 they going to do about it?
7 MR. MARQUINO: It would fall under the
8 maintenance rule, to -- depending on the area.
9 If it was a RTNSS area, it would be maintenance
10 rule.
11 MEMBER ABDEL -KHALIK: Yeah, the way
12 they do non -safety systems now is if you had an
13 indication that's out of spec, you know, it would
14 fall under the maintenance rule. That would be a
15 parameter that you would, you know, you would
16 have an indicator for that.
17 So you would, you know, write a
18 corrective action item to repair that.
19 MR. MARQUINO: Now if it's safety, if
20 it's Q -DCIS room, and it's above the EQ
21 temperature, I think that would indicate that
22 it's inoperable and they would be forced to --
23 they'd be forced to declare the equi pment
24 inoperable.
25 MEMBER ABDEL-KHALIK: And then what do

1 they do?

2 MR. MARQUINO: And take the actions --

3 MEMBER ABDEL-KHALIK: They have to shut

4 down within a certain time?

5 MR. MARQUINO: Right.

6 MEMBER ABDEL-KHALIK: So why -- what

7 difference would it make, putting this in tech

8 specs and indicating certain time lines

9 associated with LCOs?

10 MR. MARQUINO: Well, the difference is

11 you're monitoring -- we've incorporated this as

12 the basic monitoring of the HVAC functions in the

13 plant. It doesn't rise to the level of a tech

14 spec. The difference is if it's tech spec, if

15 there's any change made, there's an additional

16 burden on the utility. It has to be reviewed by

17 the NRC.

18 For example, if you change the -- if

19 you replace the equipment, you have a different

20 EQ qualification for the equipment. So you want

21 to change the number in this -- in the table.

22 There's a lot of administrative overhead in

23 changing it, versus if it's not a tech spec, you

24 can process the paper work internal to the

25 utility, make the change in the alarm set point,

1 and satisfy it that way.

2 MEMBER STETKAR: This sounds -- this is

3 more a question for the staff, I think, because I

4 kind of think they're relying on legal

5 interpretations of things. I mean I understand

6 the reason for not wanting it in a tech spec.

7 It's a question of without it in the tech specs,

8 are we sacrificing any protection of high

9 temperature in those rooms?

10 Because especially in the reactor

11 building, you're talking about not only the fact

12 that it's in the reactor building, but some of

13 those rooms tend to have fairly high heat

14 supplies. You know, you're talking about switch

15 gear; you're talking about inverters and things

16 out in there that could be reasonable heat

17 sources.

18 I don't know how big your rooms are. I

19 don't know how fast they heat up, you know. I

20 guess your heat -up calculations say passively

21 they don't heat up very quickly, but --

22 MR. MARQUINO: Yes, and we have to

23 limit the heat load in the rooms in order to make

24 that true. That's exposed in our analysis.

25 MEMBER STETKAR: But there might --

1 well, I'm not going to presuppose things. There
2 might be justification for, you know, periodic
3 rounds detecting high temperature, but people
4 tend not to rely on that for safety-related,
5 especially for safety-related areas.
6 MR. MARQUINO: But I think the concern
7 is -- if the concern is one temperature sensor
8 failure is not going to be detected for a long
9 period, I think we get more back with you on more
10 information.
11 MEMBER STETKAR: Yes, I mean that's
12 sort of the technical concern. The second bullet
13 on there -- that was curious. You said "During
14 development of the current standard tech specs."
15 Current standard tech specs apply to BWR-6s?
16 MS. CUBBAGE: Yes.
17 MEMBER STETKAR: You know, because
18 before BWR-6, you basically didn't have this same
19 kind of stuff, equipment, out in the reactor
20 buildings. So some of the concerns about high
21 temperatures for safety -related power supplies
22 and you know, inverters and things were sort of a
23 moot point up until BWR-6s.
24 MR. MARQUINO: Yes. This is the case
25 for BWR -6 tech specs. Joe Friday and our Reg

1 Affairs staff looked at, I think it was River
2 Bend and Grand Gulf, or at least two BWR -6
3 plants, in terms of their -- he confirmed that
4 they didn't have this in their tech specs.
5 MEMBER STETKAR: Okay.
6 MR. ARCARO: Okay. I think we talked
7 through these. Here's the sections of the DCD
8 that provide flows, temperatures, indications,
9 alarms, both for normal and design deficients.
10 Table 3H -3 and 9 have the environmental
11 conditions, the actual limits and the
12 temperatures that are expected during accident
13 conditions.
14 And then Table 18 -1 is the minimum
15 inventory that shows that the reactor building
16 area temperature is a parameter that's monitored
17 in the control room.
18 In summary, we think the design meets
19 GDC 19 habitability requirements for the control
20 room habitability area, related to the heat
21 removal conditions. The design validation
22 surveillance procedures assure that the functions
23 will be met, and the site paramete rs can be
24 interpreted and implemented by COL applicants. I
25 think when we see the staff's presentation, we

1 can walk through the specifics there.

2 And then the controls we have in place

3 for the reactor building, temperature monitoring,

4 are in line with existing BWR practices for tech

5 specs, and provide the same assurance for EQ life

6 for equipment.

7 MEMBER STETKAR: Mike, before we switch

8 to -- I know you've got a couple of other slides

9 here.

10 CHAIRMAN CORRADINI: Those are backups.

11 I think he's giving something to us.

12 (Simultaneous discussion.)

13 MR. MARQUINO: We have one more slide

14 on here.

15 MR. ARCARO: I've got to talk just

16 about Chapter 16 update.

17 CHAIRMAN CORRADINI: Okay.

18 MEMBER STETKAR: I was going to ask him

19 sort of a 16 and sort of a control room heat-up.

20 CHAIRMAN CORRADINI: Do you want to do

21 the update on 16 first?

22 MR. ARCARO: I think that might be

23 best.

24 MEMBER STETKAR: Actually no. I'd

25 rather ask my question now, while people are

1 thinking about control room. The question is,
2 and it's the -- boy, I wish I could speak
3 clearly. The control room envelope has
4 temperature sensors that automatically de -
5 energize non-safety related heat loads, you said,
6 when the temperature reaches 85 degrees
7 Fahrenheit.
8 MR. ARCARO: Right.
9 MEMBER STETKAR: And they're safety-
10 related, four divisions, two out of four
11 redundancy, all of that kind of stuff. Are those
12 -- is the availability and operability of those
13 temperature sensors controlled by the tech specs
14 anywhere?
15 MR. ARCARO: Yes.
16 MEMBER STETKAR: Where?
17 MR. ARCARO: It could be in the
18 instrumentation section there --
19 MEMBER STETKAR: Okay. I looked in
20 control room HVAC, and I couldn't --
21 MR. ARCARO: It's not in 3; it's 3-7.
22 MEMBER STETKAR: It's not in 3-7.
23 MR. ARCARO: Or 3-3, I believe it is.
24 MEMBER STETKAR: Okay. If you can find
25 a reference or somebody can, I'd appreciate it.

1 I didn't do a thorough search, but there's a lot
2 of stuff in the tech specs. I looked at the most
3 likely place that I thought, but it's not there.
4 MR. ARCARO: It is.
5 MEMBER STETKAR: It is, good. It is,
6 that's good. If you'd just give me the
7 reference, I'd appreciate that.
8 MR. MARQUINO: Okay. We do have
9 follow-up to one of your comments on Chapter 16.
10 You were concerned about our staggered, well the
11 lack of a staggered test interval for
12 surveillances on the passive safety systems. So
13 we had some which were simply once every ten
14 years, and you asked why don't you test one at
15 the first outage and another one at the second
16 outage and so on.
17 So we've made, we discussed this with
18 the staff, and we're in the process of making
19 changes to the tech spec, to add more staggered
20 test intervals, and they include the GDCS
21 injection lines, the GDCS equalizing line, the
22 ICPCCS pool, moisture separator flow paths, and
23 the GDCS deluge lines.
24 So they will be set on a staggered
25 interval, based on the old surveillance interval

1 and the number of systems or divisions that can
2 be tested.
3 MEMBER STETKAR: So essentially, you'll
4 test each division every ten years, if that's
5 what's the interval?
6 MR. ARCARO: Yes.
7 MEMBER STETKAR: But on a staggered
8 basis?
9 MR. MARQUINO: Right.
10 MEMBER STETKAR: Good.
11 MR. ARCARO: So your earlier question
12 about testing the N-DCIS, that's described in the
13 Surveillance Requirement 3725, and the functional
14 test is in 3372. So that's where we do the
15 instruments.
16 MEMBER STETKAR: No, I was -- I'm
17 sorry.
18 MR. ARCARO: This is the testing to
19 show that the instruments will trip the N-DCIS
20 off.
21 MEMBER STETKAR: Wh ere is it? I'm
22 sorry.
23 MR. ARCARO: 3372.
24 MEMBER STETKAR: 3372.
25 MR. ARCARO: That's correct.

1 MEMBER STETKAR: That's a surveillance
2 requirement. Okay. But there's no operability
3 requirement? There's no LCO for those
4 instruments, is there?
5 MR. ARCARO: No, there is.
6 MEMBER STETKAR: Oh, is there?
7 MR. ARCARO: Right. The logic system
8 functional tests. So we're on a --
9 MEMBER STETKAR: It's a surveillance
10 requirement?
11 MR. ARCARO: Right.
12 MEMBER STETKAR: It's not an LCO.
13 MR. ARCAR O: The LCO 3372 is the
14 instrument test for the switches that will trip
15 off N-DCIS.
16 MEMBER STETKAR: I don't have that.
17 MR. MARQUINO: You're looking for
18 surveillance on the temperature sensors?
19 MR. ARCARO: Right.
20 MEMBER STETKAR: I was looking f or an
21 operability requirement on the temperature
22 sensors, such that if you had -- you know, you
23 could have one train inoperable indefinitely. If
24 you had two trains inoperable, they could be
25 inoperable for 72 hours, or something like that,

1 not just a surveillance requirement.

2 MR. MARQUINO: All right. Let's, we'll

3 look while the staff is up.

4 MR. HARBUCK: This is Craig Harbuck

5 from the Technical Specifications Branch. I

6 could just clear that up right quick.

7 Surveillance requirements must be met in order to

8 meet the LCO. The LCO requires that the

9 instrumentation functions in 3.3.7.2 be met

10 during modes of applicability.

11 So if you don't meet that surveillance

12 on one system functional test, you're not meeting

13 the LCO, and you would enter the actions for the

14 instrumentation divisions affected.

15 MEMBER STETKAR: Well, what I was

16 curious about, and again, I'm trying to do this

17 real-time, which is not fair, as are you, which

18 is not fair. I see things in 3.3.7.2 that talk

19 about actuation divisions, but I don't know --

20 In particular, I can't find anywhere in

21 the bases document for the tech specs, I find

22 four sets of instrumentation in the bases

23 documents listed under control room/HVAC, none of

24 which are these particular temperature sensors.

25 They're actuation signals for

1 transferring to the EFUs. They're actuation
2 signals for isolation. I don't find any
3 actuation signals for turning off the non-safety
4 heat loads. So that's -- it might be in there
5 somewhere, but I'm having problems finding it.
6 MR. HARBUCK: Well, I'm pretty sure
7 there's a test to verify actuation on a simulated
8 or real signal in the CRHAVs specification in
9 Section 372, I believe it is.
10 MR. MARQUINO: Yes. Mike found that.
11 MR. HARBUCK: So I think that's the
12 test that covers this.
13 MR. ARCARO: The Surveillance
14 Requirement 3.7.2.5 verifies selected main
15 control N-DCIS electrical loads automatically de-
16 energized on an actual or simulated initiation
17 signal.
18 MEMBER STETKAR: I'm sorry. 3.3.7.2.5?
19 MR. ARCARO: 3.7.2.5.
20 MEMBER STETKAR: 3-7. 3.7.2.5.
21 MR. ARCARO: Right.
22 MR. HARBUCK: Plant Systems section.
23 MEMBER STETKAR: Okay.
24 MR. ARCARO: Right, and then in
25 addition to that, you do a logic system

1 functional test for LCO 3.3.7.2. I thought that
2 was your question.
3 MEMBER STETKAR: Well, I was looking up
4 in 3.3.7. Let me keep the meeting going here and
5 get the staff up, and I'll search through things
6 here.
7 MR. ARCARO: I think that's it for our
8 presentation, if there's no questions.
9 CHAIRMAN CORRADINI: Other questions?
10 (No response.)
11 CHAIRMAN CORRADINI: Okay, thank you.
12 Amy, is the staff ready to talk this afternoon?
13 MS. CUBBAGE: Yes, we are.
14 CHAIRMAN CORRADINI: That would be
15 wonderful.
16 MS. CUBBAGE: Our meteorologist is out
17 of the office, but we'r e going to pinch -hit for
18 him.
19 CHAIRMAN CORRADINI: Well, I trust you
20 to get a good designated hitter.
21 MS. CUBBAGE: Yes. Jim O'Driscoll is
22 going to do his very best.
23 CHAIRMAN CORRADINI: He'll do his best.
24 (Off mic discussions.)
25 CHAIRMAN CORRADI NI: You guys are

1 ready?

2 MR. GALVIN: We're ready.

3 CHAIRMAN CORRADINI: Okay. Have at it.

4 MR. GALVIN: All right. The staff is

5 here today to present on the habitability area,

6 issues related to Section 6.4 and Section 9.4,

7 and actually, as GEH ment ioned, we're following

8 up on several issues previously identified by

9 ACRS. So Jim?

10 Chapter 6/Staff

11 MR. O'DRISCOLL: Good afternoon. My

12 name is James O'Driscoll, and I, along with Craig

13 Harbuck, are here to provide the Subcommittee

14 discussion on the rem aining issues related to

15 Section 9.4, HVAC, and Section 6.4, Control Room

16 Habitability.

17 Next slide. In particular, this

18 briefing will address the follow -up items from

19 the previous briefings to the ACRS Subcommittee

20 held on 19 May 2010 for Chapter 6.4 an d 9.4, and

21 the Subcommittee meeting held on August 17th,

22 2010 for Chapters 2 and 16. We will also answer

23 your questions.

24 Here's the staff team, Dennis Galvin,

25 project manager for 9.4; Bruce Bavol is project

1 manager for 6.4; Jim O'Driscoll is a lead
2 reviewer for Chapter 6.4 and 9.4, with Ed
3 Forrest, Syed Haider and Shie -Jeng Peng
4 supporting. Also Brad Harvey for Chapter 2.3 and
5 Craig Harbuck for Chapter 16.
6 Next slide. The four issues we'll
7 discuss today are the following. One, we will
8 provide and di scuss heat -up profiles for the
9 three models, CONTAIN 2.0, GOTHIC and the NRC's
10 First Principles Analysis, used to model the
11 control room hazard heat sinks and their
12 performance post-accident.
13 Two, we will discuss details of the
14 tech spec surveillance on the control room
15 habitability area heat sink's temperatures.
16 Three, we will discuss details on verification of
17 related site characteristics, and four, we will
18 discuss how assumptions used in the reactor
19 building heat-up calculation are assured.
20 Next slide. The staff's review focused
21 on the applicant's submitted CONTAIN 2.0 analysis
22 in two areas. One was a staff review of the
23 suitability of the use of CONTAIN 2.0 as a method
24 to model the ESBWR control room heat -up, as
25 opposed to alternate analysis demon strations,

1 methods such as GOTHIC or a First Principles
2 approach.
3 The staff did this by comparing the
4 submitted analysis with a GOTHIC analysis that
5 was submitted by the applicant to support RAI
6 9.4-29, which was related to the control room
7 habitability area mixing, that's air mixing.
8 The GOTHIC analysis was updated by the
9 staff with the current control room habitability
10 area load, heat loads, and EFU, emergency fan
11 unit fan loads. In addition to this, the staff
12 requested the applicant to provide a Fir st
13 Principles calculation, which was provided to the
14 staff in September 2009.
15 Based on review of this calculation and
16 the staff's need to perform sensitivity studies,
17 the staff decided it would be worthwhile to
18 perform -- the study the problem from a Fi rst
19 Principles on its own, and it developed its own
20 First Principles calculation of the GE/ESBWR
21 control room habitability area.
22 Two, the second area the staff focused
23 on was the need to understand the sensitivities
24 in the calculations input assumptions, in order
25 to gain insight on what parameters are

1 significant to the outcome, what input parameters
2 are significant.
3 The staff's focus was on the heat sink
4 properties, heat sink initial temperatures and
5 outside environmental conditions, since these
6 things produce the most significant changes in
7 the control room habitability area temperature
8 and humidity. The results of these studies were
9 discussed in earlier ACRS meetings.
10 In summary, the staff reviewed the
11 submitted CONTAIN 2.0 analysis. The staff
12 reviewed a GE First Principles Analysis. The
13 staff developed its own First Principles model to
14 study the problem. The staff also performed one
15 run using a GOTHIC model updated by the staff, to
16 the current heat load and EFU fan flow values.
17 Upon review o f the closest in behavior
18 of the overall heat -up, and the closeness of the
19 final temperature results, in the base cases for
20 the three models, and with an understanding of
21 the remaining differences between the three
22 models, including initial conditions that were
23 not reconciled, the staff was satisfied that the
24 submitted CONTAIN model could be used to model
25 the heat of the ESBWR control room habitability

1 area.

2 Subsequently, the staff focused on the

3 submitted CONTAIN 2.0 analysis and the staff's

4 First Princi ples Analysis to perform further

5 sensitivity studies. 24 sensitivity runs were

6 performed using the applicant's CONTAIN 2.0

7 analysis and the staff's First Principles

8 Analysis.

9 Next slide. After reviewing the

10 results of the varied sensitivity studies, us ing

11 CONTAIN and the NRC First Principles Model, and

12 the results of the updated GOTHIC analysis, the

13 staff concluded the following:

14 One, after the effects of the remaining

15 differences, including initial conditions are

16 considered, the staff concluded that the heat-up

17 rates for all models agree. This can be seen in

18 a comparative run of the three models on the

19 following slide. We'll get to that slide in a

20 minute.

21 Two, CONTAIN and the staff's First

22 Principles model behaves similarly when various

23 parameters were changed during the 24 sensitivity

24 runs. The staff's First Principles model was

25 slightly higher than CONTAIN 2.0. The greatest

1 difference between the staff's First Principles
2 model and contain on these runs was less than
3 four degrees, most runs aver aging about 2.5
4 degrees.
5 The staff attributes the higher control
6 room habitability area temperatures obtained by
7 the First Principles model to difference between
8 the model and CONTAIN, described in the white
9 paper submitted by the staff to the ACRS in July.
10 Briefly, these differences are the following:
11 First, more heat is assumed to enter
12 the control room habitability area from adjacent
13 spaces from those interior wall structures that
14 face rooms with heat generation. The staff's
15 First Principles model conservatively assumed
16 that 50 percent of the heat generated in adjacent
17 rooms enters the heat structures common room
18 habitability area.
19 Second is the staff ignored steel
20 structures, which are five of the 21 heat
21 structures modeled in the applicant's CONTAIN
22 model, in order to reduce the complexity of the
23 model.
24 Third is that CONTAIN uses the
25 temperature distribution in each heat structure,

1 resulting from an earlier soaking phase in the
2 initial condition. It's a three -step --
3 structured in three steps . The initial
4 temperature distribution used in CONTAIN ranged
5 from 74 degrees to 79.9 degrees for all solid
6 structures, with the exception of the wall facing
7 the soil, with a mean initial temperature of 82.8
8 degrees Fahrenheit.
9 The staff's First Princip les model
10 assumed an initial 80 degree uniform temperature
11 for all heat structures. Since the soil -facing
12 wall is only 16.6 percent of the total mass of
13 the heat sink, overall, this is a conservative
14 simplification with respect to CONTAIN.
15 Finally, another difference is that the
16 staff's First Principles model did not credit
17 one-half of the mass oif that one heat structure
18 facing the soil, in order to account for the heat
19 absorption from the 86 degree Fahrenheit soil.
20 As previously stated, primarily d ue to
21 the similarity and response to the sensitivity
22 studies comparing the staff's model and the
23 design basis CONTAIN model, the staff gained
24 confidence in the applicant's treatment of the
25 control room habitability area, and concludes

1 that CONTAIN 2.0 is an acceptable means to
2 demonstrate the passive heat sink's performance
3 for the ESBWR control room habitability area.
4 The remaining differences in
5 temperature results between the two models is
6 judged to be small, and could likely be reduced
7 further if the staff's conservative
8 simplifications were eliminated from its First
9 Principles model. Next slide.
10 MEMBER ABDEL-KHALIK: Now your argument
11 is that these graphs are within two to four
12 degrees, and that is true. But my concern is not
13 the error in the vert ical direction, but the
14 variation in the horizontal direction. In one
15 case, you cross the boundary after 72 hours, and
16 in another case you cross the boundary after 48
17 hours.
18 MR. O'DRISCOLL: That's correct. I'm
19 going to go through why that is. The top -- I
20 want to explain each graph.
21 The staff was asked to provide a
22 graphical comparison of some selected runs from
23 different models. The slide displays is their 72
24 hour heat-up profile from CONTAIN and GOTHIC, and
25 the staff's First Principles base cas e runs,

1 along with one First Principles run showing the
2 sensitivity of the changing concrete density.
3 That's that dark blue one.
4 The bottom green line is the
5 applicant's CONTAIN 2.0 analysis, submitted and
6 referenced in the DCD, and that reaches a final
7 temperature of 92.048 degrees in the control room
8 at 72 hours. The light blue line is the staff's
9 First Principles model, using the same values for
10 concrete as those used in the CONTAIN 2.0 one.
11 It's 120 pound per cubic foot concrete, and that
12 temperature is 95.71 degrees.
13 Please note that this also includes the
14 effects of the conservatively higher heat sink
15 uniform temperature discussed earlier. There are
16 higher heat sink temperatures assumed at the
17 beginning of the analysis, which causes the heat
18 rate to go, to rise.
19 As discussed earlier, generally these
20 -- there was about a two to four degree
21 difference between the staff's First Principles
22 model and CONTAIN. Both models behaved similarly
23 when parameters were changed, thus providing
24 confidence to t he staff that CONTAIN is a valid
25 way of estimating the control room habitability

1 area heat -up in the ESBWR control room
2 habitability area. For example --
3 DR. WALLIS: This dashed line, this
4 black line is the criteria?
5 MR. O'DRISCOLL: That's the accep tance
6 criteria, correct.
7 DR. WALLIS: And two of your models
8 don't meet the acceptance criteria?
9 MR. O'DRISCOLL: Two of the models
10 don't because -- but that can be explained.
11 DR. WALLIS: So why is this a
12 confirmatory analysis, but they don't lead t o --
13 usually, you should satisfy yourself that even
14 though you're conservative, you still meet the
15 criteria?
16 MR. O'DRISCOLL: Right. What we had to
17 do -- that's a good point. ? What we had to do,
18 what I'm trying to say for this review, we had to
19 first d etermine if CONTAIN is a valid tool for
20 this application, and so we used other models to
21 get assurance, confidence that the control room
22 was behaving in the way we would expect.
23 So we used a multi -node code as updated
24 by the staff, and we used a single node that we
25 generated ourselves and created ourselves.

1 CHAIRMAN CORRADINI: The single node is
2 the red?
3 MR. O'DRISCOLL: No. I'll continue on.
4 I'll go through that.
5 DR. WALLIS: Blues are the single node.
6 CHAIRMAN CORRADINI: Excuse me.
7 MR. O'DRISCOLL: Okay. I'll just
8 continue this, and we can -- I'm almost half
9 through here.
10 DR. WALLIS: What puzzles me is that
11 the biggest, the difference between say the green
12 and light blue starts off right at the beginning.
13 MR. O'DRISCOLL: That's right. I can
14 go through --
15 DR. WALLIS: It seems to be an initial
16 condition that's somehow different, rather than
17 the model itself?
18 MR. O'DRISCOLL: That's correct, that's
19 correct, and --
20 MEMBER ARMIJO: And you made that point
21 with your initial assumption.
22 MR. O'DRISCOLL: That's right. I mean
23 one model, and the thing is is that to change and
24 to get all the clocks to align would take an
25 inordinate, in my opinion as a reviewer, amount

1 of resources. What we're trying to do here is
2 not to get all t he clocks to read the same time,
3 but to make sure that they're ticking at the same
4 rate. Those differences can be explained, and we
5 understand what they are. I believe we're at
6 that point.
7 DR. WALLIS: But isn't the initial
8 condition -- why is the initial condition so
9 different? Why don't you just have them all
10 start at the same point?
11 MR. O'DRISCOLL: Because we would have
12 to update every single heat sink temperature in
13 the model to do that.
14 DR. WALLIS: Nothing's happened yet at
15 the beginning. I mean heat sinks are irrelevant
16 at the beginning?
17 MR. O'DRISCOLL: I guess, Syed, maybe
18 you might want to explain how much -- what
19 mechanically would it take to align the initial
20 conditions for, let's say, our First Principles
21 model, and CONTAIN 2.0?
22 DR. WALLIS: Yes.
23 MR. HAIDER: Hi, Syed Haider. CONTAIN
24 uses an initial temperature distribution that is
25 -- that comes out of Phase 2. You know, CONTAIN

1 models the entire phenomenon in a three step
2 process. In the first phase, it's a soaking
3 phase. In the second phase, it's an eight hour
4 NCO digit model while keeping the room
5 temperature at 85 degree Fahrenheit.
6 So what happens at the end of the
7 second phase in CONTAIN, all structures have a
8 temperature distribution, and those temperatures
9 are somewhere between 74 to 79 degree Fahrenheit.
10 To do that within the First Principles model
11 would take a lot more effort. So we had to
12 assume a uniform temperature.
13 So we assumed a uniform 80 degree
14 Fahrenheit temperature. While to do that in
15 First Principl es model, we would have to
16 replicate exactly what the initial conditions
17 were coming out of this Step 2 of the CONTAIN
18 model, and that would take a lot of time. That's
19 why it was not done.
20 But what we assumed was conservative.
21 That's the main point, an d these individual
22 differences are not the only -- are not the only
23 difference. There are three more differences
24 that --
25 DR. WALLIS: But the biggest difference

1 is in the first hour. Once you've got that, then
2 they're sort of parallel.
3 MR. O'DRISCOLL: Yes. Let me explain
4 that. I had this question written down actually.
5 The GOTHIC model assumes, was submitted to
6 address the RAI on thermal gradience in the
7 control room. That's what that was for. The
8 input deck was reviewed by the staff and we
9 updated.
10 The model analyzed the control room in
11 a single step. That was a one -stage model. At
12 the beginning of that model, all heat sinks --
13 excuse me, the air temperature of the control
14 room was set at 87 degrees.
15 The CONTAIN 2.0 analysis consists of
16 three steps: The output of which feeds the input
17 of the subsequent steps. CONTAIN Step 1 consists
18 of a soak period, where the heat sinks and
19 sources are allowed to function, assuming the
20 control room habitability area air temperature is
21 stable at 74 degrees.
22 The output of this run is used as input
23 data for an eight hour run, where the control
24 room habitability area air temp is set up, is set
25 to 85 degrees, simulating a control room

1 habitability area ventilation system degradation.
2 The output of this run is fed into Step 3, which
3 is the 72 hour run, with the control room
4 habitability area ventilation system shut off,
5 and heat removal performed solely by the action
6 of the heat sinks.
7 The staff's First Principles analysis
8 is a single step model. The sta ff chose to use
9 an 80 degree Fahrenheit uniform temperature for
10 all heat sinks, conservative with respect to
11 CONTAIN temperature distribution condition. The
12 staff's First Principles model also set the air
13 temperature in the room to 85 degrees at time
14 zero, to match the CONTAIN analysis.
15 For CONTAIN, since there are -- there's
16 already a substantial delta T between the heat
17 sinks and the air, the heat sinks bring down the
18 temperature of the control room until the heat
19 input and the output rates are equal.
20 GOTHIC, on the other hand, has a
21 similar delta T between the heat sinks and the
22 air that started the analysis. The main control
23 air it at 78 degrees at the start of the
24 analysis. Thus, the room air temperature must
25 rise to a value to where there will b e enough

1 difference and potential to drive the heat sink
2 at a rate, excuse me, drive heat into the heat
3 sinks at a rate that matches the heat input rate.
4 For the staff's First Principles model,
5 the difference between the heat sinks and the
6 control room h abitability area air temperature,
7 80 and 85 degrees, respectively, causes the
8 control room habitability air temperature to rise
9 about a degree and a half, until the heat input
10 and output rates are equal.
11 DR. WALLIS: So it's all in that first
12 hour. I me an there's an adjustment that occurs,
13 depending on the models, in the first hour. The
14 CONTAIN goes down; the NRC models go up.
15 MR. O'DRISCOLL: That's right.
16 DR. WALLIS: And that's what the main
17 differences between them is.
18 MR. O'DRISCOLL: Well, i t's not exactly
19 -- that is a main difference. But another main
20 difference is we also assumed much more heat
21 coming in from surrounding heat sources. So that
22 will drive the rate slightly, as you go through
23 the 72 hours, which will drive a delta as well.
24 So that's also causing a change.
25 MEMBER ARMIJO: Why did you run 140

1 pound concrete case, since that's not what the
2 CONTAIN analysis used?
3 MR. O'DRISCOLL: The CONTAIN analysis
4 used 140, 120 pound concrete as their
5 conservative submitted analysis. The DCD
6 specifies 150 pound concrete to build this
7 control room.
8 So what we did is we said let's do a
9 sensitivity study of more denser concrete, but
10 one that is still conservative with respect to
11 what is specified in Tier 2, and that's put there
12 to show the benefit of the higher dense, of more
13 dense concrete.
14 MEMBER ARMIJO: Sure. In one case it's
15 converging; in the other case, that initial delta
16 stays the same.
17 CHAIRMAN CORRADINI: I guess I
18 understand what you're trying to do, but I'm not
19 sure if you're helping your case or hurting your
20 case by the calculation. I think what Professor
21 Wallace is asking is a fair point, which is your
22 green and your light and your dark blue curves
23 are going two different directions.
24 You're saying, if I understand your
25 argument, that that's because in one case CONTAIN

1 soaks it at one temperature, and then turns on
2 the transient and for eight hours to get it to
3 another temperature, but that's not enough time
4 to get all the concrete to the different
5 temperatures.
6 So you create an internal temperature
7 difference, because when you turn on the long-
8 term calculation, the concrete continues to cool
9 down the room. So that's the --
10 MS. CUBBAGE: I just want to interject
11 for a moment on the reason we did these analyses.
12 We we re trying to inform our review, do
13 sensitivities, find out what was important, find
14 out and explore margins, and then at the request
15 of the Committee, we plotted these, because you
16 wanted to see them together.
17 CHAIRMAN CORRADINI: Right, correct.
18 MS. CUBBAGE: So I think you need to be
19 careful about what message we're trying to give
20 you here.
21 MR. O'DRISCOLL: We had a choice of
22 giving you something new, but we want to give you
23 what you saw already in the white paper, and talk
24 to that.
25 CHAIRMAN CORRADINI: That's fine.

1 MR. O'DRISCOLL: That dark blue line is
2 a sensitivity run.
3 CHAIRMAN CORRADINI: Right, but let me
4 just finish my question. I think what I observed
5 is correct, which is the green line goes down
6 because I have a gradient in temperatu re in the
7 solid, which is cooling the room.
8 The light blue and the dark blue lin
9 got up, and that's what I think you said, but I
10 didn't catch.
11 MR. O'DRISCOLL: Okay, okay, sure.
12 We're talking initial conditions again. The
13 reason why the green line goes down is because at
14 the start of Phase 3 in the applicant's submitted
15 analyses, the room is at this 85 degree
16 temperature, but you have very cool heat sinks.
17 So what that acts -- it's not an
18 official condition, and it's pulling down -- it
19 doesn't need that much of a delta T.
20 DR. WALLIS: I thought the heat sinks
21 were supposed to come into equilibrium with the
22 room? They don't do that.
23 (Simultaneous discussion.)
24 MR. O'DRISCOLL: What the applicant did
25 is they did their analysis in three steps. Phase

1 zero is when the put the heat sinks in
2 equilibrium with the room. Then what they wanted
3 to do is they wanted to simulate a control room
4 air conditioning system malfunction, but
5 something that it would -- something at the worse
6 case, but would still allow you to operate for
7 eight hours, which is the limit of the allowed
8 time, before they started their accident period.
9 So conservatism.
10 CHAIRMAN CORRADINI: And just to,
11 because that's a good point. But just to make
12 sure, did we know that before? That's a piece, I
13 guess, that maybe I missed.
14 MR. O'DRISCOLL: Well, we did discuss
15 that before.
16 CHAIRMAN CORRADINI: Okay.
17 MR. O'DRISCOLL: And the other thing to
18 point is that you see, if you did this -- what we
19 found out is the room rapidly rises to 85 degrees
20 or so. But it's really -- you really want to say
21 that there's about a ten degree delta T between
22 the heat sinks and the heat sources before the
23 heat input is matched to the heat output.
24 MR. MARQUINO: This is Wayne Marquino
25 for GE. Yes, I want to confirm that for a long

1 time, we've had this Step 2 in the analysis, and
2 the reason is to provide some -- to provide in
3 the 72 hour coping period a temperature that's
4 above normal, so that if we lose HVAC in the
5 control room, we don't have to immed iately scram
6 or take compensatory actions.
7 So we have a low temperature that's in
8 the tech spec, and then we have an eight hour LCO
9 that's in the tech spec, and we've included that
10 eight hours in our heat-up analysis.
11 CHAIRMAN CORRADINI: From a
12 conservative standpoint?
13 MR. MARQUINO: Yes.
14 CHAIRMAN CORRADINI: Okay, thank you.
15 DR. WALLIS: But still, I mean
16 everything depends on what happens in the first
17 few minutes or something, to the green and blue
18 curves. Therefore, they're kind of power leve ls.
19 So what you're telling me is everything is
20 sensitive to what you do in your second
21 condition.
22 MEMBER STETKAR: Let me ask just a
23 simple question, because I don't understand all
24 of this stuff. How do these analyses account for
25 the non safety related heat sources in the

1 control room?

2 MR. O'DRISCOLL: The analysis assumes

3 that those non-safety heat sources are not in

4 operation. There's 9630 watts of sensible heat

5 assumed. That number is in Tier 2, and that

6 number is also in the design basis heat-up calc.

7 That's the Tier 2 star information.

8 So the applicant must verify. That's

9 one of the things they must verify that the end,

10 when they -- in their as-built plant, that

11 they're not going to have safety and un --

12 MEMBER STETKAR: In the real world,

13 they will be operating until they're shut off.

14 The time at which they're shut off depends on the

15 time at which -- I originally thought it was two

16 hours, because in the design basis vent, the non-

17 safety stuff maintains power for two hours. This

18 obviously is shutting them off earlier, I think.

19 MR. MARQUINO: This is Wayne Marquino.

20 MEMBER STETKAR: This is like shutting

21 them off at time zero, which is curious.

22 MR. MARQUINO: This is Wayne Marquino,

23 GE. We have provided for eight hours of all of,

24 basically all of the non-safety DCIS loads are in

25 our analysis for eight hours, provided that the

1 control room temperature is below 85. If it gets
2 to 85, then those loads have to be tripped, and
3 they are tripped.
4 MEMBER STETKAR: It's automatic.
5 MR. MARQUINO: Beyond that, I have to
6 check on this, but there's a limited amount of
7 non-safety loads that will be powered by a
8 battery for a short period of time, and they're
9 in the analysis.
10 MEMBER ABDEL-KHALIK: What's time zero
11 on this graph?
12 MR. MARQUINO: Time zero is --
13 MEMBER ABDEL-KHALIK: On this graph.
14 MR. MARQUINO: Okay. Time zero is the
15 complete loss of cooling in the control room,
16 following eight hours at 85 degrees.
17 MEMBER ABDEL-KHALIK: So time zero is
18 plus eight?
19 MR. MARQUINO: Yes.
20 MEMBER STETKAR: No, no, no. Minus
21 eight on this is the control room staffed, the
22 control room air temperature stepped from its
23 normal temperature, which is around 74 to 85
24 degrees. So there was some degradation of the
25 HVAC system.

1 DR. WALLIS: Look at the green curve
2 when -- why is it when you turn off the cooling,
3 it gets colder?
4 MR. BARRETT: This is Antonio Barrett
5 from GEH, and the reason why it gets colder is
6 because the concrete temperature is very cold,
7 but the air temperature is very high. The air
8 temperature at that exact moment is 85 degrees
9 Fahrenheit, and the concrete temperature is
10 something a lot lower.
11 DR. WALLIS: But this has been going on
12 --
13 MR. BARRETT: And the heat capacity of
14 the air is very low.
15 DR. WALLIS: But this has been going on
16 before though.
17 MR. MARQUINO: For eight hours, and
18 then at eight hours you trip these loads, so you
19 reduce -- you actually reduce the heat load at
20 time zero by tripping the non-safety loads.
21 MEMBER STETKAR: By tripping those
22 loads. I' m not a code guy, and I don't
23 understand how the codes work. I'm sort of a
24 simple-minded engineer. Is it possible to run
25 one of these codes with an initial condition that

1 says I'm starting at a temperature that is within
2 the normal tech spec operating te mperature, and
3 the air temperature is equalized with the
4 concrete temperature, which is a fundamental
5 assumption in the heat sinks?
6 And from that T zero condition, then
7 turn off normal ventilation and allow the control
8 room to heat up, at the point at wh ich the normal
9 non-safety loads would trip off as a function of
10 temperature, remove that heat input.
11 If there's some residual non -safety
12 loads that, you know, some small input that
13 remain for some additional time, keep that input
14 and do the simulation for 72 hours.
15 DR. WALLIS: That's more realistic.
16 MEMBER ARMIJO: That's what they did.
17 DR. WALLIS: No, it isn't.
18 MEMBER STETKAR: No, it isn't.
19 (Simultaneous discussion.)
20 MEMBER STETKAR: There are some
21 artificial conditions on temperatures and DTs.
22 CHAIRMAN CORRADINI: So now Antonio, go
23 ahead.
24 MR. BARRETT: So that's initially what
25 we did, and so back before we put in the eight

1 hour LCO, that's exactly how we had our analysis,
2 except where we started, and if you look at that
3 red curve they had, which is their GOTHIC
4 analysis, that's basically what they're doing.
5 But what they did instead there is they
6 have a higher heat sink temperature. They're
7 starting at 78 instead of 74. So the very
8 original analysis that we had did exactly what
9 was stated. Now the later analysis that we have
10 is more conservative, in that we exposed the
11 concrete to 85 degrees for eight hours, and then
12 started the transient.
13 So we did exactly what you said, and
14 then later, we exposed the concrete. So we
15 started at a higher concrete temperature and a
16 higher air temperature. But one difference I
17 have note that we did make from the old analysis
18 to the new analysis is we decreased the starting
19 temperature from 78 degrees to 74 degrees, which
20 is reducing the starting concrete temperature
21 from 78 degrees to 74 degrees.
22 MS. CUBBAGE: That's because you
23 lowered the tech spec limit.
24 MR. BARRETT: Right. We lowered the
25 tech spec from 78 to 74, which in effect is, you

1 know, lowering the heat sink temperature from 78
2 to 7 4, and then so like I said, we did the
3 analysis exactly as was suggested by -- I don't
4 know who it was. But then we added some
5 additional conservatism by artificially
6 increasing the air temperature to 85 degrees for
7 eight hours, and then starting the transient --
8 DR. WALLIS: It would help if you
9 showed the prediction for that eight hours, so we
10 could see what's going on in that eight hours on
11 the ground.
12 MR. MARQUINO: If you look in the
13 backup, GEH backup slide, I think it's 22, is
14 that right? It's labeled the "Asset Heat Sink
15 Issues." It's got steps on it.
16 DR. WALLIS: I didn't understand that.
17 Maybe you can explain that.
18 MEMBER STETKAR: What chart number?
19 DR. WALLIS: The one at the very back.
20 MR. MARQUINO: Slide 22, I think.
21 MEMBER STETKAR: 22?
22 DR. WALLIS: At the very back, 22.
23 MEMBER STETKAR: Yes.
24 MR. MARQUINO: So you see Step 1 is the
25 soak period that the staff referred to, and --

1 DR. WALLIS: That's the eight hours
2 there.
3 MR. MARQUINO: And Step 2 is a step
4 increase in the control room air temperature to
5 85 F.
6 DR. WALLIS: How does that happen?
7 MEMBER ARMIJO: It's assumed.
8 DR. WALLIS: It can certainly happen.
9 MR. MARQUINO: It's assumed. So for
10 this change, this change was made about 18 months
11 ago, and th e reason for the change is without
12 this, the operators would have to take
13 compensatory measures immediately on the loss of
14 HVAC. So we looked at that situation.
15 We said we don't want the plant to have
16 to immediately begin shutting down if we lose
17 HVAC in the control room. We want to at least be
18 able to accommodate a small temperature heat -up.
19 So we added the minus eight hours in the
20 analysis.
21 CHAIRMAN CORRADINI: So one
22 clarification, Wayne. I think this is an
23 excellent graph personally. Maybe no body else
24 likes it, but I like it.
25 DR. WALLIS: What's Step 1?

1 CHAIRMAN CORRADINI: So when are you
2 stopping the internal heat loads, would be John's
3 question.
4 MEMBER STETKAR: Non-safety.
5 CHAIRMAN CORRADINI: Non -safety heat
6 loads would be John's question, at zero?
7 MEMBER STETKAR: The beginning of Step
8 3.
9 MR. MARQUINO: At time zero.
10 MR. BARRETT: This is Antonio Barrett
11 of GEH, and so in the control room at time zero,
12 all the non -safety loads get shut off. Not all
13 of them, but most of th e non -safety loads get
14 shut off, with some small non -safety loads still
15 operating.
16 But in the rest of the control
17 building, the non -safety loads continue to
18 operate for two hours.
19 CHAIRMAN CORRADINI: Thank you.
20 DR. WALLIS: Is that why you get the
21 step drop in the temperature?
22 MR. MARQUINO: Yes.
23 DR. WALLIS: Where do you get the step
24 rise in the temperature at minus eight hours? I
25 didn't get --

1 MR. MARQUINO: Because that's an
2 assumed? That's assumed for them to bound the
3 fact that if they lost air conditioning, they
4 would have to not shut down. They'd have to be
5 able to sustain it.
6 DR. WALLIS: It could be as hot as
7 that.
8 MR. MARQUINO: It could be as hot as
9 that.
10 DR. WALLIS: And the eight hours is an
11 arbitrary number, because you d on't show the
12 concrete temperature here.
13 MR. MARQUINO: It's not completely
14 arbitrary. It's written in the tech specs.
15 DR. WALLIS: So because you were doing
16 this, you've got a different starting kick to
17 everything than the staff does?
18 MR. MARQUINO: No.
19 DR. WALLIS: The staff does something
20 that when they switch off the load, the thing
21 heats up, which is rather odd at the beginning.
22 CHAIRMAN CORRADINI: Well, I think
23 Graham, I think just to answer, from a
24 clarification standpoint. I think the staff
25 understands what they did. Then the staff went

1 off and did a series of sensitivities to see the
2 effect of some of these assumptions, which
3 created the light blue, the dark blue, and the
4 red.
5 DR. WALLIS: And they got confidence,
6 because they're almost parallel. If they bring
7 them down to the GEH assumptions, they'll
8 probably get the same answer.
9 MR. O'DRISCOLL: That's right, and we
10 have to decide when do we get the -- you know,
11 what's the benefit, and you find that it's --
12 we're convinced, and we want to focus on the
13 sensitivities of changing the concrete and see
14 how the model behaves.
15 But let me just talk about that one
16 sensitivity, and we'll get back on track. Let me
17 get the slide. The staff did a sensitivity run
18 in CONTAIN, using 140 pound concrete. This is
19 not shown here, okay. This is -- what we did is
20 we took their model, okay, and put 140 pound
21 concrete in it.
22 This is not shown here. The final
23 control room habitability air temperature in this
24 run was 89.9 degree Fahrenheit, or almost three
25 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

1 CONTAIN or First Principles model. Is there any
2 other questions on this slide?
3 DR. WALLIS: Well, I think GEH said
4 they did this strange Step 1 in order to be
5 conservative, and yet their values are less than
6 yours. So your lack of conservative. You're
7 overly-conservative compared with them.
8 MR. O'DRISCOLL: I attribute the rise
9 of ours to the initial conditions that we talked
10 about.
11 DR. WALLIS: The initial conditions,
12 right. That's right.
13 MR. O'DRISCOLL: Plus the fact that we
14 have made different assumptions for heat rate or
15 heat input over time into the room. There's
16 also, I mean we can go through those assumptions
17 again, but there's about four differences in
18 those models.
19 DR. WALLIS: The reason that there is
20 acceptable whereas yours would not be is that you
21 think their assumptions are more realistic?
22 MR. O'DRISCOLL: We think that their
23 input assumptions are adequate. Those inputs --
24 we had no problems wit h either CONTAIN, the way
25 it was performed, or the input assumptions used.

1 We think they're reasonable, and therefore we
2 find basically that CONTAIN, or for that matter
3 GOTHIC, or our First Principles model, it could
4 be either could be used. Any one of those models
5 could be used to demonstrate this room.
6 Therefore, CONTAIN 2.0 is adequate as
7 any. Therefore, and their input conditions are
8 adequate, and they seem to have performed it the
9 right way. We checked their input deck.
10 Therefore, their result of 92 degrees in 72 hours
11 is valid.
12 DR. WALLIS: But this jump, this sudden
13 jump to 85 degrees is really a very unphysical
14 thing.
15 MR. O'DRISCOLL: That's correct,
16 because they -- what they're doing is they're
17 artificially holding the room at a high
18 temperature, which wouldn't -- if you shut off
19 all the AC, you wouldn't get -- it wouldn't go
20 that high that fast.
21 DR. WALLIS: That's right. So it's
22 very strange --
23 MEMBER ARMIJO: If it had been a
24 calculation from the very beginning, the time
25 they shut off the air, then it would have been a

1 rise in the air temperature, and you wouldn't
2 have these strange --
3 DR. WALLIS: Everything would be
4 continuous. You wouldn't get these jumps and
5 things.
6 MEMBER ARMIJO: Except when you turn
7 off the heat.
8 DR. WALLIS: Except when you turn off
9 the heat.
10 MR. O'DRISCOLL: That's not what was
11 provided by, to the staff to review.
12 DR. WALLIS: Well, I guess your
13 judgment is that everything is okay.
14 MEMBER STETKAR: I mean Antonio said
15 that GEH originally ran essentially that
16 analysis.
17 CHAIRMAN CORRADINI: But I think -- I
18 don't think the staff would have accepted that
19 original analysis, because that essentially takes
20 credit for the fact that you were at your
21 starting condition. They essentially assumed the
22 worse case starting condition by essentially
23 going to their limiting, their LCO for eight
24 hours. Unless I misunderstood what Wayne said.
25 MR. MARQUINO: This is Wayne Marquino.

1 I believe the history is we didn't have a tech
2 spec on the control room air temperature, and the
3 staff asked us to put a tech spec in that was our
4 analysis initial temperature. We said wait a
5 minute. If we lock in this temperature, they're
6 going to be shutting the plant down as soon as
7 they lose HVAC.
8 At that time, we said we have to change
9 the analysis to accommodate some duration of loss
10 of HVAC.
11 MS. CUBBAGE: And to make up some of
12 that. That's when they changed the tech spec
13 temperature.
14 MEMBER ARMIJO: Sorry.
15 MS. CUBBAGE: Go ahead.
16 MEMBER ARMIJO: Why did you use the 120
17 pound concrete when your design is 150 pounds,
18 and NRC picked 140? If there's any, you know. I
19 just wondered why you'd make this problem
20 tougher. You ought to be able to tell how much
21 your concrete weighs.
22 MR. MARQUINO: Right, but it's just a
23 little bit of conservatism that we added in the
24 analysis, that lighter concrete has less heat
25 capacity.

1 MEMBER ARMIJO: So you're saying maybe
2 over time it may not be as good of a conductor?
3 MR. MARQUINO: No.
4 MS. CUBBAGE: It provides them some
5 cushion.
6 MR. MARQUINO: We're sure that because
7 there's a structural spec on the concrete, I
8 think we would be justified in using 150 pound
9 concrete in this analysis. But the person who
10 did it initially chose to put that as a
11 conservatism, and we haven 't -- we haven't found
12 a reason to remove that conservatism.
13 DR. WALLIS: Well, I think if you had
14 found your exceeded your criteria, you would have
15 gone back and put in a realistic value.
16 CHAIRMAN CORRADINI: Now, now, now.
17 DR. WALLIS: So the reason the staff is
18 happy is that the trends are about the same, and
19 if you put in this realistic concrete, it comes,
20 everything comes down by about the margin by
21 which the staff is over the criteria.
22 MR. O'DRISCOLL: Yes. That's correct.
23 DR. WALLIS: So this concrete thing is
24 important in reassuring us that everything is
25 okay, right?

1 MR. MARQUINO: Yes.

2 DR. WALLIS: Otherwise, I think I might

3 still have doubts, because it seems to me you can

4 wiggle these things by how you sort of shake the

5 whip at the beginning, and then it goes off and

6 does its wiggle.

7 CHAIRMAN CORRADINI: Yes. I think it's

8 called an initial value problem.

9 DR. WALLIS: Well.

10 MEMBER STETKAR: Well, I don't

11 understand the undulation.

12 (Simultaneous discussion.)

13 MEMBER STETKAR: There are two

14 different kinds of the two different models.

15 MEMBER ABDEL-KHALIK: Could you please

16 put Slide 22, GE Slide 22 up? Let's look at that

17 eight hour period initially. The air temperature

18 is pretty much constant. It varies very

19 slightly, right.

20 MEMBER STETKAR: Pretty much.

21 MEMBER ABDEL-KHALIK: What does that

22 tell you?

23 MR. MARQUINO: Can you say the question

24 again?

25 MEMBER ABDEL-KHALIK: Air temperature

1 is pretty much constant during that eight hour
2 period.
3 MR. MARQUINO: Yes.
4 MEMBER ABDEL-KHALIK: What does that
5 tell you?
6 MR. MARQUINO: That the control room is
7 above normal.
8 MEMBER ABDEL-KHALIK: In terms of
9 energy balance on the air within the control
10 room. That means that whatever heat input you're
11 putting in is --
12 MR. MARQUINO: Oh. Now let me clarify.
13 So in that eight hour period, there's some --
14 there would be some HVAC function, we expect.
15 But we've just put a boundary condition, air
16 temperature, in of 85 degrees. And you were
17 asking why did we assume it steps up versus come
18 up over time?
19 MEMBER ABDEL-KHALIK: No, no, no. I
20 was just looking at what happens during that time
21 period of eight hours.
22 MR. MARQUINO: Something happened to
23 the HVAC system, and we assumed that it stepped
24 the temperature up to 85 and then held it there.
25 Because we don't know what's going to happen.

1 All we're trying to do is provide for 85 degrees
2 as an upper limit. As long as it doesn't go
3 above 85, you can keep going for eight hours.
4 MEMBER STETKAR: They're not modeling
5 reality or anything during that T zero to T minus
6 --
7 DR. WALLIS: You are modeling
8 something. You're modeling the concrete
9 temperature, aren't you?
10 CHAIRMAN CORRADINI: Right. That's all
11 they're doing. That's all they're doing.
12 DR. WALLIS: So if you're i mposing 85
13 degrees on the concrete temperature, you know,
14 you're not worry about the heat balance for the
15 room itself.
16 MEMBER STETKAR: Correct.
17 MR. MARQUINO: Yeah. We're imposing 85
18 on the air, and then the concrete is heating up
19 in this eight hours , and then at time zero, we
20 stop all heat removal and trip most of the non-
21 safety loads.
22 MEMBER ABDEL-KHALIK: And let the air
23 and concrete float.
24 MR. MARQUINO: Yes.
25 MR. GALVIN: You also have, of course,

1 the boundary condition of, at least the peak, 117
2 degree air coming into the room.
3 MEMBER ABDEL-KHALIK: Right, which is
4 the blue line.
5 MR. GALVIN: Which is the blue line.
6 DR. WALLIS: And this is only on the
7 worse day of the year?
8 MR. MARQUINO: Yes. 117 would be the
9 worst time of the year.
10 (Simultaneous discussion.)
11 DR. WALLIS: So we are looking at some
12 extreme condition?
13 MR. MARQUINO: Yes. This is their --
14 (Simultaneous discussion.)
15 MR. O'DRISCOLL: Dennis, why don't we
16 go back to the staff's presentation?
17 (Simultaneous discussion.)
18 MR. ARCARO: This is Mike Arcaro. To
19 clarify what I did on that chart, all I did is
20 put a forcing function on the chart that already
21 exists, that showed the response. So you know,
22 before the zero point on there, it's all made up.
23 It's just a forcing function that shows what the
24 model does for air at 85 degrees.
25 MR. HARBUCK: Okay. This slide may

1 look familiar because we presented it at the
2 Chapter 16 briefing in August, and it simply
3 reiterates what was already presented by GEH,
4 explaining that the temperature specification is
5 not just for the main control room, but for heat
6 sinks in adjacent areas in the control building.
7 And just as a thought, I understand
8 that all the other spaces stay within their EQ
9 limits for the 72 hours also. So we've been
10 focused on the control room, but I think the
11 other spaces are also adequately maintained at
12 temperature rises above these that are
13 acceptable, and I don't know what those are.
14 And so the conclusion is that the
15 analysis shows that the passive heat sinks will
16 keep the control room at or below 93 degrees over
17 the course of the 72 hour period post-DBA.
18 DR. WALLIS: This is according to the
19 GEH analysis?
20 MR. O'DRISCOLL: Say again?
21 DR. WALLIS: According to the GEH
22 analysis.
23 MR. O'DRISCOLL: According to the
24 design basis analysis submitted.
25 DR. WALLIS: Submitted by GEH?

1 MR. O'DRISCOLL: That's correct.

2 MR. HARBUCK: All right, and then the

3 CRHAV spec itself, the LCO is really focused, you

4 know, it says heat sink temperatures have to b e

5 this, but as has already been explained, we're

6 assuming there's this equilibrium established

7 between the air that's enclosed by the heat

8 sinks. So we focused on what the air

9 temperatures are and based the actions and

10 conditions on that.

11 So there is this Action A, which as was

12 previously explained, you get eight hours to get

13 the air temperature back. The thought is that

14 the temperatures of the heat sinks, having

15 previously been equilibrium and a lower

16 temperature, would not be significantly affected

17 by that.

18 I think it's also -- well, if you just

19 were to assume that the cooling units turned off,

20 and the internal recirculation turned off. Then

21 the rise in the temperature of the air over

22 eight hours is also not that significant. If it

23 got up to 85, of course it would trip off the N -

24 DCIS load. So okay.

25 And of course the question is then is

1 how do we do the surveillance requirement? How
2 do we determine if we have our heat sink
3 temperatures are satisfied at 24 hours and that
4 also was discussed in the two bullets there. You
5 do some evaluation or you do a direct temperature
6 measurement, make some inferences from that.
7 However, those are things for the
8 licensee to work out in procedures, and I think,
9 as they mentioned, they were going to have
10 procedures for this.
11 DR. WALLIS: So this bulk average has
12 to be calculated?
13 MR. O'DRISCOLL: It has to be
14 justified. The spec is based on the average
15 temperature of the heat sink. So either by
16 direct measurement or by calculation, they have
17 to say what' s the temperature inside that heat
18 structure.
19 DR. WALLIS: So they may have to cool
20 the control room below normal temperatures in
21 order to recover from a high temperature
22 transient, in order to get this back to --
23 MR. O'DRISCOLL: I don't think that's
24 necessary.
25 DR. WALLIS: Calculate the transient in

1 the wall?

2 MR. O'DRISCOLL: If they restored their

3 normal cooling, the room would soak at that

4 temperature and become -- the bulk temperature

5 would be satisfactory.

6 DR. WALLIS: Concrete relaxes to th e

7 room temperature in 24 hours?

8 MR. O'DRISCOLL: Well, if you assume an

9 eight hour excursion and only an eight hour

10 excursion, you know, your LCO, Action Statement 1

11 requires you to restore the air temperature fast,

12 eight years.

13 DR. WALLIS: Right. That's right.

14 MR. O'DRISCOLL: And then it allows you

15 a longer period of time to restore the bulk

16 average temperature of the heat sink to wherever

17 it was.

18 DR. WALLIS: You've got some kind of

19 wave that goes through the concrete?

20 MR. O'DRISCOLL: That could be

21 developed through procedures.

22 DR. WALLIS: Is that you expect them to

23 do, calculate that?

24 MR. O'DRISCOLL: That's one way of

25 handling this surveillance.

1 MR. HARBUCK: Or rather this action
2 requirement.
3 MR. O'DRISCOLL: This action
4 requirement.
5 MEMBER ABDEL -KHALIK: So in the
6 calculations that we were shown, this graph here
7 --
8 MR. O'DRISCOLL: Yes.
9 MEMBER ABDEL-KHALIK: During this eight
10 hour soaking period, whatever you called it, what
11 was the assumption as far as the temperature
12 distribution within the concrete?
13 MR. MARQUINO: It was not an
14 assumption. It was calculated, so that the eight
15 hour period --
16 MEMBER ABDEL -KHALIK: No. At time
17 minus eight on this graph, what was the
18 temperature distribution in the concrete?
19 MR. MARQU INO: It's actually given on
20 the next slide. So Slide 23 shows the
21 temperature after Step 1, which is the normal
22 operating soak period, and the temperature at the
23 end of Step 2, which is the eight hour abnormal
24 high control room temperature, and the
25 temperature at the end of 72 hours, without

1 cooling and without safety-related loads.
2 MEMBER ARMIJO: So okay. So the
3 outside temperature was 76 degrees?
4 DR. WALLIS: That leaps up?
5 MR. O'DRISCOLL: No. You're looking at
6 one heat structure. I believe it's the worse
7 case heat structure. It's the ceiling of the
8 control room.
9 You have a very hot room above it, a Q,
10 excuse, me, an N-DCIS room, I believe, are above
11 the control room, and that's the heat structure
12 that was chosen by GE-Hitachi to show here.
13 That's not the outside of the --
14 MEMBER ABDEL-KHALIK: That's not the
15 outside level?
16 MR. O'DRISCOLL: That's not the outside
17 in the air. That's an adjoining room.
18 DR. WALLIS: Which is hotter somehow.
19 MEMBER ABDEL-KHALIK: But within the
20 concrete, the temperature at the beginning on the
21 concrete control room air interface, the
22 temperature was what, 74 degrees?
23 MR. MARQUINO: Yes. The air
24 temperature was 74 degrees, right.
25 MEMBER ABDEL-KHALIK: Okay, and at the

1 other side of the concrete, the temperature was
2 what, of the concrete?
3 MR. O'DRISCOLL: 76.
4 MR. MARQUINO: Yes.
5 MEMBER ABDEL-KHALIK: It looks like 76
6 something. Is that what you would expect, even
7 in the concrete that's in contact with the soil?
8 MR. O'DRISCOLL: No, no, no . That's
9 only one heat sink. There's one structure. If
10 you think about it, it's just one wall. So this
11 particular wall has got a heat source.
12 It's got some equipment that's pumping
13 some heat into that piece of concrete. So for
14 that particular wall , that's the expected soaked
15 profile, unless I'm mistaken, what you'd see
16 through that wall.
17 MR. MARQUINO: That's right, and to get
18 back to the original question, you said what's
19 the temperature after eight hours?
20 MEMBER ABDEL-KHALIK: No, no, no. I' m
21 just trying to understand --
22 MEMBER STETKAR: The graph.
23 MEMBER ABDEL -KHALIK: The assumptions
24 that you're making in doing this calculation.
25 MR. MARQUINO: Right. It was a

1 calculation of the concrete temperature. The
2 concrete temperature was not an input.
3 MEMBER ABDEL-KHALIK: But the results
4 of all this analysis depends on what you assume
5 as far as the initial temperature distribution
6 within the concrete, because that will determine
7 the initial average temperature for the concrete,
8 and that's what I'm trying to get to.
9 MR. O'DRISCOLL: Yes.
10 MEMBER ABDEL-KHALIK: And let's look at
11 a concrete wall that's in contact with the soil.
12 MR. O'DRISCOLL: Okay.
13 MEMBER ABDEL-KHALIK: Okay. At time
14 minus eight in this analysis, which is the
15 beginning of your soaking period, on the inside
16 surface of the concrete, the temperature is 74
17 degrees. What is the temperature on the outside
18 surface that is in contact with the hot source?
19 MR. MARQUINO: Well, you're asking
20 about the soil? It would be the soil
21 temperature. Is it 86 degrees?
22 MR. O'DRISCOLL: 86 degrees is what was
23 assumed as soil temperature. The uniform soil
24 temperature of 86 degrees. So for that one wall,
25 you have one side of it touching 86 degree soil;

1 the other side, 74 degrees air, correct.

2 MR. HARBUCK: Not necessarily what

3 group heat sink is that?

4 MR. O'DRISCOLL: That's a different

5 group. The heat sinks --

6 MR. HARBUCK: So it's going to be the

7 temperature for the limit on that group?

8 MR. O'DRISCOLL: That's correct.

9 MR. HARBUCK: Which could be 78, 104,

10 whichever it is.

11 MR. O'DRISCOLL: Right.

12 CHAIRMAN CORRADINI: I think what

13 Syed's asking, I know where he's going with it,

14 he's trying to understand the situation going in,

15 and I guess I'm guessing that the situation going

16 in is what you said for the soil temperature.

17 But everywhere on the building, because you have

18 active HVAC, it's cold.

19 But somewhere out there, you've got

20 damn hot air in the atmosphere that's then

21 eventually, once you get through your eight hours

22 of some artificial heat-up, it has to penetrate

23 through all of this to essentially heat up the

24 room.

25 MR. MARQUINO: That's right. So the

1 situation going in is all the rooms are at their
2 maximum tech spec temperature, even though it's
3 117 degrees out side. But all the HVAC is
4 working, at least within its specified value.
5 And then something happens to the
6 control room HVAC, and the control room
7 temperature goes up to 85 degrees, and now we
8 calculate for it at the end of eight hours, what
9 are the co ncrete temperatures, what's the
10 concrete temperature distribution, and now we
11 lose off site power and we start a 72 hour heat -
12 up from that point.
13 MEMBER ARMIJO: What fraction of the
14 total surface area that you're dumping heat to is
15 the outside wall? Is it a fourth of it or an
16 eighth or you know I know you've got a lot of
17 walls.
18 MR. MARQUINO: The control room
19 habitability area itself is, doesn't touch the
20 ground on the outside.
21 MEMBER ARMIJO: It's totally surrounded
22 by internal walls?
23 MR. MARQUINO: Right.
24 CHAIRMAN CORRADINI: But I think the
25 key thing is that I think John said it privately.

1 Because of emergency air so nobody's
2 asphyxiated, the infiltration is high. That's
3 the biggest heat source in the surrounding,
4 that's causing this whole thing to go up. Then
5 they have the swing of that stuff as it goes
6 through the time period.
7 MEMBER ARMIJO: Right.
8 MR. MARQUINO: Antonio, did you want to
9 add something?
10 MR. BARRETT: I was just going to, a
11 small clarification. This is Antonio at G EH,
12 that there is a small portion that's -- of the
13 control room habitability area that is in contact
14 with the soil. But it's not --
15 MEMBER ARMIJO: It's not much.
16 MR. BARRETT: It's a smaller portion.
17 Most of it is contained by other rooms. They're
18 surrounded by other rooms and a hallway.
19 MEMBER ARMIJO: Okay, thank you.
20 MEMBER STETKAR: Craig, I've got a
21 question of the tech specs. I've been searching,
22 you know, thanks to GEH, I found the surveillance
23 requirement for verifying that indeed the
24 temperature sensors turn off the non -safety
25 related loads. That's performed once every two

1 years.

2 I still cannot understand whether or

3 not there is an LCO on operability of those

4 temperature sensors, because you know, LCOs are

5 different from surveillanc e requirements. Why

6 can't I take out --

7 MR. HARBUCK: The LCO is on the

8 automatic function, to turn off the NDCIS loads.

9 MEMBER STETKAR: But I don't --

10 MR. HARBUCK: And that surveillance

11 requirement verifies that function.

12 MEMBER STETKAR: Where is the LCO on

13 that function?

14 MR. HARBUCK: Up in the beginning

15 section of Chapter 3, the tech specs, there is an

16 LCO, I mean a surveillance requirement called SR-

17 302. It says if you don't meet a surveillance

18 requirement, you don't meet the LCO.

19 MEMBER STETKAR: But that presumes that

20 since I'm only performing that surveillance once

21 every two years, it presumes that those things

22 are always operable.

23 MR. HARBUCK: There is a presumption of

24 operability.

25 MEMBER STETKAR: Well, but it says that

1 I can't take them out of service for maintenance.
2 Suppose one fails during normal operation? What
3 do I do?
4 MR. HARBUCK: Okay, there's three
5 divisions required. So you take one of the
6 divisions out. You would go to the actions of
7 the LCO, to see -- now I think the control room
8 habitability area is, it's got two trains. So
9 but I'm not sure about exactly how the
10 instrumentation is.
11 MEMBER STETKAR: That's the thing I'm
12 struggling with because again, I'm trying to do
13 this real-time and in fairness to every one, I've
14 not been able to -- I'm trying to flip back and
15 forth between the actual LCO statements and the
16 basis documents, to see --
17 The basis documents discuss the
18 function of de-energizing the non-safety loads.
19 But everything that I read in the LCO statements
20 is with respect to other functions, you follow
21 me? It's for things like isolation. It's for
22 things like starting. It's, you know, the two
23 trains of ventilation and things like that.
24 It's, you know, the items you have
25 identified here on Slide 9, the temperatures and

1 things like that. I don't -- if I'm an operator,
2 I don't see how my operation is limited, if for
3 example I remove two of these particular
4 temperature sensors from service, for whatever
5 reason.
6 MR. HARBUCK: I'm sure you're familiar
7 with RIS 2005 -20, that was updated in 2008,
8 dealing with degraded non-conforming conditions
9 and talks about operability, and you know,
10 operability is something that you -- it's
11 determined not, say outside the tech specs.
12 And then if you determine that you're
13 not operable, then you do what the tech specs
14 tell you to do.
15 So in this case, if you don't meet this
16 surveillance requirement for one or more of the
17 divisions, or one or more channels, one or more
18 of the detectors, then you take the actions that
19 are specified in the associated LCO. In this
20 case, you would be looking at the operability of
21 the CRHAVs.
22 MEMBER STETKAR: That's the point that
23 I'm struggling with, because --
24 MR. HARBUCK: Right. So if you
25 determine that the way the tech spec is written,

1 if you determine that this automatic securing of
2 non-safety loads at 85 degrees was not
3 functioning, either through the sensors being
4 inoperable or the logic being inoperable, then
5 you would have to declare both trains of CRHAVs
6 inoperable, be cause you could not meet the
7 surveillance requirement, and you'd be shutting
8 down.
9 That's, in this case the tech specs are
10 rather severe, I think.
11 MEMBER STETKAR: As long as that's a
12 uniform interpretation. You see, I look at other
13 parts of the SBW R tech specs, where they do have
14 explicit LCO statements for instrumentation, and
15 also surveillance requirements for the
16 instrumentation.
17 So I have both of those established.
18 If I have an instrument channel out of service
19 for 12, you know, I can have it out of service
20 for 12 hours. I only require three, but I
21 basically can have two out of service for 12
22 hours, and then I must shut down.
23 In this particular case, I don't have
24 that type of statement. That's why I was curious
25 about that.

1 MR. HARBUCK: Right.

2 MEMBER STETKAR: Because it's -- I

3 wouldn't be so concerned, but it's a pretty

4 important function in these room heat-up

5 analyses.

6 If I don't actually shut off those non -

7 essential loads at 85 degrees Fahrenheit, I'll

8 get a different response. I have no -- like I

9 said, I don't know how these things work, but I

10 have no idea what that response will look like,

11 but certainly the end point temperature will be

12 higher.

13 So it's a pretty important function. I

14 just want to make sure that people opera ting the

15 plant recognize the importance of that function,

16 and that if I happen to take two of those

17 particular temperature sensors out of service,

18 that I have -- I may have a problem. I don't

19 read that in the tech specs.

20 MR. HARBUCK: I would have to defer to

21 the instrumentation experts regarding the

22 specific design, the number of sensors and how

23 those are computed in the average temperatures

24 and how --

25 MEMBER STETKAR: Best as I can tell,

1 it's four, in the two out of four.

2 MR. HARBUCK: But how the -- you know,

3 is it -- I mean I'm just not sure exactly how

4 it's done, but --

5 MEMBER STETKAR: Well maybe -- you

6 know, we're running long here.

7 MR. HARBUCK: But I stand by my

8 statement. I think it's clear from the way the

9 tech specs are structured and written, that you'd

10 have to declare both trains inoperable.

11 MEMBER STETKAR: I understand if they

12 don't, if they run the surveillance and it fails.

13 MS. CUBBAGE: That wasn't what he said.

14 MEMBER STETKAR: I understand what I

15 have to do as an operator under those conditions.

16 That's really clear. What I'm talking about is

17 I perform the surveillance, everything works.

18 A month later, for whatever reason, Joe

19 comes into the control room and says hey, we want

20 to do some painting and those temperature sensors

21 are in the way. Can you de-energize them for the

22 next three hours or six hours or two days?

23 If I'm an operator, what do I

24 understand about that?

25 MR. HARBUCK: There's SR-301 up in the

1 front says that surveillance requirements have to
2 be met w henever the LCO is within its
3 applicability, all right. So whether -- so
4 meeting a surveillance is not just when you
5 perform it, but it's all the time.
6 So whatever criteria you have to
7 satisfy to meet the surveillance, if you have
8 reason to believe th at criteria is no longer met,
9 which you wouldn't be if you took it out of
10 service and de-energized it.
11 Then you would say hey, you know, I'm
12 inoperable. Now you have to figure out what is
13 the impact on the systems that are supported.
14 MEMBER STETKAR: Okay.
15 MR. HARBUCK: I'll just make this
16 comment. I think there are probably other ways
17 to write the tech specs for this particular
18 function, and the actions. You could be perhaps
19 more specific to this function and that sort of
20 thing. But that's not what GEH has proposed.
21 MEMBER STETKAR: Well, you know, I'm
22 just questioning. I understand what they
23 proposed, and I understand the desire to keep as
24 much equipment as possible out of the technical
25 specifications. I also understand the desire to

1 make sure that the operators don't inadvertently
2 place the plant in a vulnerable condition,
3 because they aren't -- because the tech specs
4 might be somewhat convoluted, and it's not clear,
5 you know, how they would interpret that
6 configuration.
7 MS. CUBBAGE: All right. Could I
8 interject here please? Craig Harbuck is our
9 technical specification expert. He is an expert
10 in how tech specs are interpreted, etcetera,
11 etcetera. He's well -known with the staff for an
12 expert in this area.
13 He has told you how this would be
14 interpreted. If you have disagreement with us on
15 that, we'll have to take that up. But this is
16 our position.
17 MEMBER STETKAR: Okay.
18 MR. HARBUCK: We'll go to the next one.
19 MR. O'DRISCOLL: I'll do this. I'm
20 presenting the following slide on behalf of Brad
21 Harvey. Brad is our meteorologist in the Siting
22 and Accident Consequence Branch or SAC. My name
23 is Jim O'Driscoll.
24 Within the division of -- well, Brad is
25 a meteorologist in the Siting and Accident

1 Consequence Branch within the Divisi on of Site
2 and Environmental Reviews, the SER. I'll be
3 discussing the addition of the three new site
4 temperature site parameters to support the
5 control room habitability area heat -up analysis
6 that was presented during the August ACRS
7 meeting.
8 In particular, I would like to address
9 the concern expressed during the August ACRS
10 meeting that unequivocal methodology should be
11 specified regarding how COL applicants are to
12 determine their site characteristic values, that
13 correspondence to the control room habit ability
14 area heat-up analysis site parameter values.
15 The applicant has made a change to its
16 definition of the control room habitability area
17 heat-up analysis site parameter values, which
18 they presented to you earlier this afternoon.
19 The staff believes t hese changes will help
20 alleviate the ACRS' concern.
21 My goal this afternoon is to (1),
22 describe the basis for the three control room
23 habitability area heat -up analysis site
24 parameters, (2) describe the revised methodology
25 to be used by the COL applicant in deriving the

1 corresponding site characteristic values.

2 I will also used the revised control

3 room habitability area heat-up analysis site

4 parameter definitions to review the three example

5 site-specific cases presented during the August

6 ACRS meeting. I mean we can do one, if that's

7 satisfactory.

8 The table -- next slide please. That's

9 right. The table in the slide before you lists

10 the ambient site temperature site parameters that

11 are to be included in the ESBWR DCD. The three

12 site parameters listed in bold at the bottom of

13 this table are the new set of ambient design

14 temperature site parameters related to the

15 control room habitability area heat-up analysis.

16 Also note that a zero percent

17 exceedance maximum dry bulb of 117 degrees

18 Fahrenheit, the ze ro percent exceedance non -

19 coincident maximum wet bulb of 88 degrees

20 Fahrenheit, and the zero percent exceedance

21 minimum dry bulb of minus 40 degrees Fahrenheit

22 remain as site parameters, as these values are an

23 important input to the control room habitabili ty

24 area heat-up analysis.

25 If I can just -- as the person who has

1 reviewed this, I can talk a little bit about
2 sensitivities, in case you have questions about
3 what happens if, let's say, things are different
4 than what they proposed. Next slide.
5 DR. WAL LIS: Is this different from
6 what we saw last time?
7 MR. O'DRISCOLL: The slides themselves
8 are slightly different. But the key thing, I
9 think, I believe it was you that requested or
10 brought up the point that the three day period,
11 the terminology they used, three days, was kind
12 of ambiguous.
13 DR. WALLIS: That was the problem, yes.
14 But this chart is the same, this table that we
15 just saw.
16 MR. O'DRISCOLL: Yes, yes, exactly the
17 same.
18 DR. WALLIS: So nothing has changed?
19 MR. O'DRISCOLL: That's correct.
20 MR. GALVIN: So do we want to just skip
21 the three-day thing?
22 CHAIRMAN CORRADINI: No, no. Let's
23 just continue.
24 MR. GALVIN: Okay. Just keep going
25 through it.

1 MR. O'DRISCOLL: Okay. The 103.5
2 degree Fahrenheit value for the site parameter
3 was derived by averaging the zero percent
4 exceedance maximum dry bulb site parameter value
5 of 117 degrees Fahrenheit, and the dry bulb
6 temperature resulting from a daily temperature
7 range of 27 degrees Fahrenheit.
8 The correspondence site characteristic
9 value is determined by averaging the site
10 specific zero percent exceedance maximum dry bulb
11 temperature and the dry bulb temperature that
12 corresponds to the higher of the two low dry bulb
13 temperatures occurring within 24 hours before and
14 after the zero percent exceedance maximum dry
15 bulb temperature.
16 DR. WALLIS: Now this first thing,
17 103.5, I think, is 117 minus a half of 27. Isn't
18 that what it is?
19 MR. O'DRISCOLL: Yes. It's 103.5 minus
20 half of 27.
21 DR. WALLIS: But it's not the average
22 of 117 and 27. The words are strange in the
23 slide. It's actually the mean. It's 117 minus a
24 half of 27. So it's assuming that it's a
25 symmetrical curve. But the words are strange.

1 It's not the average of 117 and 27. But I
2 understand what you did. It's just the word s
3 don't make sense. They don't seem to be
4 consistent with what was done.
5 CHAIRMAN CORRADINI: Can you just go
6 back to the definition again, and just let us
7 maybe stare at it for a minute, so we get clear
8 on it?
9 DR. WALLIS: I understand. The 103.5
10 is 117 minus a half of 27. So it's simply the
11 average when you take a curve, which oscillates
12 between 117 and 90, whatever it is.
13 MR. O'DRISCOLL: Right. I mean what we
14 had to do here, I mean we know what we're doing.
15 What we're trying to do here is giv e an
16 applicant, who is somebody -- a COL applicant who
17 is looking at sites, a box.
18 DR. WALLIS: I understand that. It's
19 just the words don't seem to correspond to what
20 you did. That's all.
21 MR. GALVIN: It could have been written
22 in a better way.
23 MEMBER ARMIJO: Yes. It's not --
24 MR. O'DRISCOLL: So that's the site
25 parameter value, and determining the

1 corresponding site characteristic value below,
2 looking at that definition.
3 CHAIRMAN CORRADINI: So is the
4 corresponding site characteristic value i s what
5 the COL applicant would have to do at their site
6 to compare to the 103?
7 MR. O'DRISCOLL: That's correct.
8 CHAIRMAN CORRADINI: Thank you.
9 MR. O'DRISCOLL: Yes, that's correct.
10 CHAIRMAN CORRADINI: Okay, thank you.
11 That's all I wanted to know.
12 MR. O'DRISCOLL: Okay. Next slide.
13 Here's an example. As an example, the blue line
14 in this slide before you shows a plot of hourly
15 dry bulb temperatures that occurred from 36 hours
16 before to 36 hours after occurrence of a zero
17 percent exceedance max imum dry bulb temperature
18 of 110.
19 So here we have a site. Here's some
20 met data. We found our hottest zero percent
21 exceedance point, and we have the time between,
22 before and after. The higher of the two low
23 temperatures occurring within 24 hours before and
24 after the zero percent exceedance maximum dry
25 value, dry bulb temperature is 77 degrees.

1 That's the dark black one.

2 The maximum average dry bulb

3 temperature for the zero percent exceedance

4 maximum temperature day is therefore an average

5 of 110 and 77, which is 93.5, which is below 103.

6 Next slide. This is basically the same

7 thing, but for the winter case. The minus 26.5

8 degree Fahrenheit value of the site parameter was

9 derived by averaging the zero percent exceedance

10 minimum dry bulb site parame ter value of minus

11 40, and the dry bulb temperature resulting from a

12 daily temperature range of 27 degrees.

13 The corresponding site characteristic

14 value is determined by averaging the site -

15 specific zero percent exceedance dry bulb

16 temperature and the dry bulb temperature that

17 corresponds to the lower of the high dry bulb

18 temperatures occurring within 24 hours before and

19 after the zero percent exceedance minimum dry

20 bulb temperature.

21 As an example, the blue line in this

22 slide before you shows a plot of ho urly dry bulb

23 temperature that occurred from 36 hours before to

24 36 hours after the occurrence of a zero percent

25 exceedance minimum dry bulb temperature of minus

1 17 degrees Fahrenheit.

2 The lower of the two high temperatures

3 occurring within 24 hours befor e and after the

4 zero percent exceedance minimum dry bulb

5 temperature is zero degrees Fahrenheit.

6 The minimum average dry bulb

7 temperature for the zero percent exceedance

8 minimum temperature day is therefore an average

9 of minus 17 degrees Fahrenheit and z ero degrees

10 Fahrenheit, which is minus 8.5 degrees

11 Fahrenheit.

12 MEMBER ABDEL -KHALIK: Well, isn't it

13 the average of minus 17 and minus 7, if I look at

14 this graph?

15 MR. O'DRISCOLL: Minus 17 and minus

16 what?

17 MEMBER ABDEL-KHALIK: Minus 7, which is

18 the mi nimum immediately prior to the minus 17

19 minimum, rather than the zero.

20 MR. O'DRISCOLL: We assume a -- we're

21 trying to figure out a diurnal swing. So we're

22 saying -- we're assuming generally that the day

23 gets -- during the day it's warmer; during the

24 night it's cooler. So when we look at the peaks

25 and we try to find the peak, and then determine -

1 - that will determine a diurnal swing.

2 DR. WALLIS: But doesn't it depend on

3 where you draw the black lines, the vertical

4 lines? I mean how do you define this diurnal?

5 MR. O'DRISCOLL: We look for the --

6 it's based on the zero exceedance low.

7 DR. WALLIS: So from 12 o'clock to 12

8 o'clock or what?

9 MR. O'DRISCOLL: No. It's based on the

10 time of the low occurring.

11 DR. WALLIS: Time of the minus 17?

12 MR. O'DRISCOLL: That's correct.

13 CHAIRMAN CORRADINI: So they looked, if

14 I -- just to say it back to you so I get it

15 right. You looked where you got over a plus or

16 minus, a 48 hour period the lowest, and then you

17 went 24 hours behind and ahead and took the

18 lowest of the two highs?

19 MR. O'DRISCOLL: That's correct.

20 DR. WALLIS: This is an effort to make

21 it unequivocal. You center yourself on that

22 minus 17?

23 MR. O'DRISCOLL: That's right.

24 DR. WALLIS: Okay.

25 CHAIRMAN CORRADINI: Oh, I see. All

1 right.

2 MR. O'DRISCOLL: Okay, next slide.

3 CHAIRMAN CORRADINI: Now the one.

4 MR. O'DRISCOLL: Yes. First --

5 DR. WALLIS: Now that number is not

6 necessarily the peak of the curve. It's the

7 maximum throughout the day, which could be at the

8 end of it?

9 MEMBER STETKAR: Which is what that

10 curve said.

11 DR. WALLIS: Okay. That was the

12 problem we had before too. Thank you.

13 MR. O'DRISCOLL: Okay. First recall

14 that the wet bulb globe temperature, WBGT index

15 is defined, for this case, for the ESBWR control

16 room in this analysis, as 0.7 times the wet bulb

17 temperature, plus 0.3 times the coincident dry

18 bulb temperature.

19 This 86.5 degree Fahrenheit value is a

20 site parameter. Site parameter was derived by

21 averaging the wet bulb glow temperature index for

22 the zero percent exceedance maximum wet bulb site

23 parameter value of 88 degrees Fahrenheit, and

24 assuming a coincident dry bulb temperature of 92

25 degrees.

1 The wet bulb globe temperature index
2 resulting from the high humidity diurnal dry bulb
3 temperature swing is eight degrees. That is a
4 dry bulb temperature of 84 degrees, assuming a
5 coincident wet bulb temperature of 84 degrees.
6 That's what was assumed in the analysis.
7 DR. WALLIS: It's 100 percent humidity?
8 MR. O'DRISCOLL: Yes, 100 percent.
9 That's what the applicant assumed as a worse case
10 wet day, wet conditions. So we have to now
11 compare our site, our picked site to this number,
12 this site parameter.
13 The corresponding site characteristic
14 value is determined by averaging the wet bulb
15 globe temperature index coincident with the site-
16 specific zero percent exceedance maximum wet bulb
17 temperature, and the wet bulb globe temperature
18 index coincident with the wet bulb temperature
19 that corresponds to the highest of the six low
20 wet bulb temperatures occurring in each of the
21 three 24 hour periods before and after that zero
22 percent exceedance maximum wet bulb temperature.
23 So in this case, we're trying to, you
24 know, a lower diurnal swing is worse. If you
25 have -- if you stay, for this particular

1 analysis, if you stay close to very high unit
2 conditions, you'll end up with a more stressful
3 effective temperature in the control room.
4 Okay. This is the Slide 16. As an
5 example, the green line in this slide before you
6 shows a plot of hourly wet bulb temperatures that
7 occurred from 84 hours before to 84 hours after
8 the occurrence of a zero percent exceedance
9 maximum wet bulb temperature of 75 degrees.
10 DR. WALLIS: All pinned on the 75?
11 MR. O'DRISCOLL: That's correct.
12 DR. WALLIS: Right.
13 MR. O'DRISCOLL: Similarly, the blue
14 line shows a plot of coincident hourly dry bulb
15 temperatures for the same time period. Notice
16 that the dry bulb temperatures coincident with
17 the zero percent exceedance maximum wet bulb
18 temperature is 95 degrees.
19 This results in a w et bulb globe
20 temperature index of 81 degrees Fahrenheit for
21 the hour when the zero percent exceedance maximum
22 wet bulb temperature occurred. The highest of
23 the six low wet bulb temperatures occurring in
24 each of the three 24 -hour periods before and
25 after the zero percent exceedance maximum wet

1 bulb temperature is 59 degrees.

2 DR. WALLIS: No, because these six

3 minimums you've shown here are all actually

4 minimums of curves. But they could be minimums

5 of the extreme of the day.

6 MR. O'DRISCOLL: Right.

7 DR. WALLIS: Because that was a point

8 we had, trouble we had before. If say the curve

9 where you show a 56, if that curve had actually

10 gone down, so that it was a 53 at the end of the

11 day, you've picked the 53?

12 MR. O'DRISCOLL: That's correct, that's

13 correct.

14 DR. WALLIS: Right. So it's the

15 absolute lowest one throughout that period?

16 MR. O'DRISCOLL: That's correct.

17 DR. WALLIS: It's not the bottom of a -

18 -.

19 MR. O'DRISCOLL: Right. Okay.

20 MEMBER ARMIJO: Sort of like the 59,

21 right?

22 MR. O'DRISCOLL: Okay.

23 DR. WALLIS: It's clear to me that

24 you've got a clearer definition. Why you have

25 this as a definition, I have no idea.

1 MR. O'DRISCOLL: I'll get to that. The
2 coincident dry bulb temperature is 68 degrees for
3 that wet bulb temperature, res ulting in a wet
4 bulb globe temperature index of 61.7 degrees for
5 that point. The maximum high humidity average
6 wet bulb globe temperature index with a zero
7 percent exceedance maximum wet bulb temperature
8 days.
9 Therefore, the average of 81 degrees
10 and 61.7 degrees Fahrenheit, which is 71.4 degree
11 Fahrenheit. That's one example of how to do
12 this. Now is there --
13 CHAIRMAN CORRADINI: Go ahead.
14 MEMBER STETKAR: Another example of how
15 to do this is if I look at your plot there, and I
16 look at the right -hand vertical dash line, which
17 is actually the maximum dry bulb temperature,
18 which looks to be about 103 degrees Fahrenheit,
19 and the coincident wet bulb temperature obviously
20 must be a little lower than 75, or else you would
21 have identified it. So let's call it 74.
22 I back up 48 hours from that, and I
23 look at the other peak over there, which looks
24 like a dry bulb temperature of 80 degree
25 Fahrenheit, with a wet bulb of let's call it 60.

1 You know, I get an average of 74.4 degrees or
2 three degree higher than yours.
3 So the point is there are other ways of
4 calculating this, and your method doesn't
5 necessarily, and I'm not trying to necessarily
6 maximize the temperature. I might be able to
7 maximize it, you know, by doing some other
8 manipulations of this particular set of data.
9 MR. O'DRISCOLL: Right.
10 MEMBER STETKAR: The question is if I'm
11 looking to an applicant now, a COL applicant, to
12 confirm that their meteorological conditions are
13 bounded by the DCD calculation of whatever it is,
14 86.6, and if they're close to that margin, the
15 way that you tell them to calculate that, you
16 know, if I'm a plant in the southeastern United
17 States.
18 If I'm close to that margin, the way
19 that I calculate this, those rules that you're
20 establishing there, might not lead to an
21 appropriate result.
22 MR. O'DRISCOLL: Right, and I think I
23 have an answer for that. I can give you an
24 answer to that, and this might, may or may not
25 help. But we did a sensitivity run. As an

1 example, the staff performed a CONTAIN run where
2 the extreme combination of dry bulb and wet bulb
3 temperatures were used, with no swing.
4 Okay, this was 100. We used 116
5 degrees Fahrenheit dry bulb, and 33 percent
6 relative humidity, resulting in 88 degree
7 Fahrenheit coincident wet bulb. Now these
8 parameters are well outside the applicant's
9 design envelope, and are not realistic for any
10 sites, in my opinion.
11 The temperature was not allowed to
12 vary, so there's no swing.
13 MEMBER STETKAR: So just to make sure I
14 understand, 72 hours, 88 degrees wet bulb.
15 MR. O'DRISCOLL: Wet bulb. 116 degree
16 dry bulb, okay? The resulting CONTAIN results
17 was 93.1, okay. This is the applicant's CONTAIN
18 analysis. It was .1 degrees above their
19 acceptance criteria, okay, in the main control
20 room, with an 86.4 degree wet bulb global
21 temperature index.
22 So for that case, they're actually
23 below their acceptance criteria, which is 89
24 degrees.
25 DR. WALLIS: Even though there are no

1 swings at all?

2 MR. O'DRISCOLL: No swings at all.

3 MEMBER STETKAR: This is flat.

4 MR. O'DRISCOLL: Right. They

5 calculated --

6 (Simultaneous discussion.)

7 MR. O'DRISCOLL: I won't ask that one.

8 MEMBER STETKAR: That's a pretty good

9 calculation.

10 MR. O'DRISCOLL: Okay. We also did a

11 run --

12 DR. WALLIS: Bounding calculation.

13 CHAIRMAN CORRADINI: I guess I -- can

14 you just say it again slower?

15 MR. O'DRISCOLL: Okay. I'm going to

16 talk about two sensitivity analyses on this.

17 CHAIRMAN CORRADINI: That's fine. But

18 just do the one you just did again.

19 MR. O'DRISCOLL: Okay. As an example,

20 the staf f performed a CONTAIN run where the

21 extreme combination of dry bulb and wet bulb

22 temperatures were used, with no swing.

23 This was 116 degrees Fahrenheit dry

24 bulb, and 33 percent relative humidity, which

25 results in an 88 degree Fahrenheit coincident wet

1 bulb. This input parameters are well outside the
2 applicant's design envelope, and are not
3 realistic for any site, in my opinion.
4 The temperature was not allowed to
5 vary. The resulting CONTAIN results was 93.1
6 degrees dry bulb in the main control room, wi th
7 an 86.4 degree wet bulb globe temperature index.
8 The calculated wet bulb globe temperature index
9 is still within the ITAAC acceptance criteria.
10 We also did a run with the worse case
11 non-coincident wet bulb allowed with no swing.
12 In order to maximize the humidity in the control
13 room, we made the coincident dry bulb 88.
14 The resulting CONTAIN results was 90
15 degrees Fahrenheit in the control room, with a
16 wet bulb globe temperature index of 88.32
17 degrees. The calculated wet bulb globe
18 temperature index is more than one degree lower
19 than the applicant's proposed ITAAC acceptance
20 criteria for the wet bulb globe temperature
21 index.
22 Based on these examples, it can be
23 reasoned that a failure to select the correct
24 high site -specific wet bulb globe temperatur e
25 index temperature result results in low risk that

1 a site would be selected that has environmental
2 parameters that would result in failure to meet
3 the ITAAC acceptance criteria.
4 That is, an error in the calculation in
5 the site-specific magnitude of the daily average
6 dry bulb swing for use in the high humidity case,
7 would result in very low risk of failure to meet
8 the ITAAC acceptance criteria for the as -built
9 plant.
10 MEMBER STETKAR: Essentially what
11 you're saying is it doesn't make too much
12 difference precisely how you specify those --
13 DR. WALLIS: You did a bounding
14 calculation, bounding the worst you could
15 possibly be. So I don't understand why you deal
16 with all these wiggles on that.
17 CHAIRMAN CORRADINI: Because the
18 wiggles are real, so they've got to --
19 MEMBER STETKAR: Well, the wiggles are
20 real. You still, you know, Jim was careful to
21 say in his opinion, those conditions would never
22 be exceeded at a site, if you have some place in
23 the swamps of Lord knows where.
24 CHAIRMAN CORRADINI: Brazil.
25 MEMBER STETKAR: That might be

1 exceeded.

2 DR. WALLIS: Oh, I see.

3 MEMBER STETKAR: So you still have --

4 the COL applicant still has to do some sort of

5 confirmation, that indeed --

6 DR. WALLIS: So it's more 116 degrees

7 on the average or something?

8 MR. MARQUINO: This is Wayne Marquino.

9 Maybe I can wrap this up. GE has done similar

10 calculations, and we agree with the staff that --

11 we found that it's the high temperature that's

12 most important, and the low temperature and the

13 swing is not very important.

14 In terms of why didn't we do the

15 analysis that way? Number one, we didn't know

16 that when we started. Number two, if we had done

17 it that way, people would say everyone knows the

18 temperature drops at night. Why didn't you

19 include that in your analysis?

20 DR. WALLIS: Because you were being

21 conservative.

22 MR. MARQUINO: So we have an analysis

23 with something similar to the sinusoid variation

24 in temperature. You see weather data which isn't

25 very sinusoidal, but the staff has worked out a

1 parameter that characterizes the real weather,
2 and it seems to be adequate to me.
3 MEMBER ARMIJO: And that's the index?
4 MR. MARQUINO: Yes, that's that index.
5 CHAIRMAN CORRADINI: I might be
6 speaking too much for the rest of the Committee,
7 but I don't think we want any more examples.
8 DR. WALLIS: Well, I'm just happy that
9 5046 is simpler.
10 (Laughter.)
11 MEMBER ARMIJO: This is a lot like IRS
12 inspections.
13 (Laughter.)
14 MR. HARBUCK: Okay. Why don't we go to
15 the language of the --.
16 (Simultaneous discussion.)
17 MR. HARBUCK: This sort of revisiting
18 the issue of the temperature monitoring in spaces
19 outside the control room, and why don't we have
20 an LCO on that. So first, let me address why we
21 have an LCO on the heat sink temperature for
22 CRHAVs. I'll be not as explicit as could be. We
23 do it through a surveillance requirement.
24 But the CRHAVs meet CLCL (ph) Criterion
25 3, and its passive cooling function depends on

1 the heat sink initial temperatures, and it's also
2 part of the primary success path for a mitigated
3 condition that you would have.
4 And then you deviated where you lost
5 power, so you didn't have the normal cooling
6 function, and because it supports control room
7 habitability to meet GDC -19. So that's why we
8 have CRHAVs.
9 Now going back to this o ther, in the
10 past, we did have technical specifications on
11 area temperature monitor and also on systems that
12 were in place to maintain temperatures, that
13 latter being Hatch Unit 1, which had custom tech
14 specs, and the Hatch Unit 2, which had the old
15 standard tech specs, and these are BWR -4, with a
16 Mark I containment.
17 In the BWR standard tech specs, it's
18 Grand Gulf Unit 1. It had an area temperature
19 monitoring tech spec. Now when we -- when the
20 interim policy statement in 1987 established the
21 criteria fo r what you have to have an LCO for,
22 the industry was asked to go and take a look at
23 the standards at the time, and specifically base
24 it on existing plant's tech specs, and for BWRs,
25 Hatch Unit 2 and Grand Gulf Unit 1 were chosen.

1 Hatch Unit 1 was chosen also, but it
2 didn't appear in the initial report from GE, the
3 topical report, which you may have heard
4 mentioned.
5 And the conclusion of that analysis was
6 that the area temperature monitors did not meet
7 the criterion, and also, when we did the
8 conversion of the Hatch Unit 1 tech specs to the
9 standard, we came to the conclusion that the room
10 air coolers also did not meet the criteria.
11 Because the purpose of both of these
12 flavors of tech specs was simply to maintain
13 equipment qualification, and indeed the action
14 requirements simply stated well, as long as
15 temperature's not too high, just write a report.
16 If it is higher than say 30 degrees, write a
17 report, but also shut down the plant.
18 So in the Hatch tech spec, the custom
19 tech specs say to say hey, if the room coolers
20 aren't working, shut down the plant, you know.
21 that was the action requirement, was to shut
22 down. So with the criteria for what needs to be,
23 we need to have an LCO for, we -- what am I
24 trying to say is that the issue here is equipment
25 qualification.

1 If the temperature of the room is not
2 what it's normally supposed to be, then you
3 evaluate what's the impact on operability of any
4 equipment in the room. And you do that using the
5 guidance that's been provided by the staff in RIS
6 2005-20.
7 There's still lots of things that go
8 into the operability of a piece of equipment, and
9 equipment qualification is one. So there's -- I
10 have summarized the criteria there's that
11 -- because to address this temperature
12 monitoring, because we don't usually inc lude
13 monitoring instrumentation or indication -only
14 instrumentation in tech specs, with the exception
15 of those that are used to detect degradation of
16 the reactor pump pressure boundary.
17 These temperature monitors are not in
18 the primary success path for an y accident, and
19 the monitors are also not in initial conditions
20 for any DBA, or the temperature is not initial
21 conditions for any design basis action.
22 However, if in your operability
23 assessment, upon having a high temperature in the
24 room, you determine t hat that equipment can no
25 longer be considered operable, then you would

1 take the appropriate LCO actions. So the
2 conclusion is is that 5036 does not require an
3 LCO for the temperature monitors on the heat
4 sinks or the temperatures themselves.
5 DR. WALLIS: Do I go back to Jim? I
6 don't understand what you said. We saw these
7 curves with these diurnal variations, and we saw
8 the response of the control room. At night, the
9 rate of increase decreased, by the way.
10 I thought you said that you did a run
11 where you kept the temperature 116 all the time,
12 without cooling down at night? Is that what you
13 said?
14 CHAIRMAN CORRADINI: That's what he
15 said.
16 DR. WALLIS: And you still met the
17 criteria, which is sort of hard to believe, when
18 you look at this curve, and the night has a big
19 effect.
20 MR. O'DRISCOLL: Well, we were above --
21 I mean we were 93.1. So the applicant's analysis
22 was 93.1
23 MEMBER STETKAR: That was a GE CONTAIN
24 analysis, not the staff's analysis.
25 MR. O'DRISCOLL: Right. We did it on -

1 - once we were satisfied with CONTAIN 2.0, we did
2 these on CONTAIN 2.0.
3 DR. WALLIS: Well, what is the -- but
4 the CONTAIN analysis, G analysis for this one is
5 pretty close to 93, isn't it?
6 MR. O'DRISCOLL: Okay. I can compare
7 the two runs. I've got them here.
8 DR. WALLIS: It's 92, right, and you've
9 got one degree more?
10 MR. O'DRISCOLL: Yes.
11 DR. WALLIS: You got one degree more.
12 MR. O'DRISCOLL: You have, let's see,
13 92.04. You have about 1.0, something, not even -
14 - a little bit of a smidgen over a degree.
15 DR. WALLIS: Well it's hard to believe,
16 when you look at how much this heats up during
17 the day, and how much it doesn't heat up during
18 the night.
19 MR. O'DRISCOLL: Well because, you
20 know, your EFU has got 460 -- there's only a
21 small amount of air c oming in. All that air is
22 coming in from that emergency fan unit. The
23 control room is buried inside the control
24 building, but it';s getting this hot air coming
25 in, and that heat that's used in the model is the

1 sensor wall heat and the humidity that's
2 contained in the air that's being pumped into the
3 room.
4 DR. WALLIS: I think the humidity may
5 do it, because the humidity -- the water content
6 stays constant, whether you cool down or not.
7 MR. O'DRISCOLL: The biggest concern
8 when we look at it generally was humidity issues,
9 and the human performance impact. We were much
10 closer to acceptance criteria on humidity for
11 this room. If the room gets very humid, it gets
12 --
13 DR. WALLIS: That could be what's doing
14 it, because I think when you cool down at night ,
15 you don't change the water content of the air.
16 The water doesn't disappear. The water just gets
17 a high humidity level.
18 MR. O'DRISCOLL: That's right, that's
19 correct.
20 DR. WALLIS: Wet bulb doesn't change
21 that much.
22 MR. O'DRISCOLL: That's right. The
23 water content stays in. The relative humidity
24 goes up when the --
25 DR. WALLIS: Well, it's still a little

1 hard to believe.

2 CHAIRMAN CORRADINI: I think John has a

3 question.

4 MEMBER STETKAR: No, I don't.

5 CHAIRMAN CORRADINI: Oh, I thought you

6 did.

7 DR. WALLIS: It's hard to believe.

8 MR. GALVIN: Okay. So this one wasn't

9 actually -- this goes down to 20 percent at --

10 (Simultaneous discussion.)

11 MR. GALVIN: 93 humidity. It's a

12 different case.

13 MR. O'DRISCOLL: Yes.

14 CHAIRMAN CORRADINI: This is a 20

15 percent relative humidity case. This is nice dry

16 air.

17 MR. O'DRISCOLL: This is a separate

18 analysis entirely from what I've shown here.

19 MEMBER STETKAR: Okay. So this is -- I

20 should take this.

21 MR. O'DRISCOLL: Yes, please.

22 CHAIRMAN CORRADINI: Other questions?

23 Okay. You guys did an absolutely excellent job.

24 I figure we'd never come to a good understanding

25 of this. But excellent job.

1 MR. O'DRISCOLL: Thank you.

2 DR. WALLIS: Excellent job. Still,

3 they still have to use some en gineering judgment

4 to decide whether it's okay or not.

5 CHAIRMAN CORRADINI: Thank God we need

6 engineers.

7 DR. WALLIS: It certainly will be nicer

8 if it would -- well, for me, it would be nicer if

9 it's more clear-cut and didn't depend upon these

10 odd init ial conditions and things like that.

11 Maybe I should just say I rely on your judgment

12 and I don't have to assert my own.

13 MR. GALVIN: I mean I think like what

14 Mike Arcaro said. It's somewhat of an artifact

15 of the way this analysis was performed and

16 developed over time.

17 DR. WALLIS: It's also the worse

18 condition. I mean it's the worse day of the year

19 and everything else.

20 MR. GALVIN: I have to do an

21 operability analysis if it gets -- if you don't

22 choose the worse day of the year.

23 MS. CUBBAGE: All right, so we're done.

24 CHAIRMAN CORRADINI: So I think --

25 should I go through and ask people's opinions, or

1 wait until we get through the glories of Chapter
2 7? I have a series of comments. Maybe we should
3 take about five minutes and go past everybody
4 without Chapter 7, and see if there's key things.
5 I have things written down, but maybe I
6 should add to my list. Dr. Cress.
7 MEMBER KRESS: Well, let's talk about
8 squib valves first.
9 CHAIRMAN CORRADINI: Oh good. I have
10 that on my list. Go ahead.
11 MEMBER KRESS: Okay. I still think
12 that you don't do an in situ test. I think the
13 process of inspection and testing the igniters is
14 what you need. I think they need some sort of
15 innovative way to inspect, and they need to be
16 thinking about how to do that.
17 I also think you need a significant
18 qualification program outside, that is
19 statistically relevant. You know, that sounds
20 very hard and expensive to me, so I don't know
21 what the trade-off is there. That's number one.
22 Number two, seismic effects on Category
23 1 components from Category 2 and 3. Seismic
24 effects.
25 CHAIRMAN CORRADINI: Okay.

1 MEMBER KRESS: I know they showed that
2 the Category 2 components and 3 wouldn't collapse
3 under this earthquake, and I still worry about
4 what earthquake would make them collapse, which
5 is a PRA issue and they did a seismic margins
6 PRA, which doesn't really capture that. So I
7 worry just a little bit about me missing
8 something there.
9 CHAIRMAN CORRADINI: Just to push back
10 a little bit though, but my understanding is the
11 seismic margin is an acceptable approach.
12 MEMBER KRESS: Oh yes, yes. I mean
13 there's lots of acceptable approaches that leave
14 me worried.
15 CHAIRMAN CORRADINI: Okay.
16 MEMBER KRESS: Added mass I'd like to
17 talk a little more about, for spent fuel pools.
18 My view of the shaking of spent fuel pools is
19 that you don't shake the racks; you're shaking
20 the wall, and it's approaching the racks, and how
21 close the wall approaches the racks depends on an
22 added mass that's brought about by moving the
23 water at the wall, up, down and down the other
24 wall.
25 That's a different kind of added mass

1 than you normally think of with an array of
2 bundles. I don't know what they used. We didn't
3 see the details of the calculation.
4 So I think we need to look a little
5 more about whether those walls are going to
6 impact those racks or not, and how did they do
7 the added mass part of it. So I'd like to see a
8 little more about that.
9 I was all right with the blow down
10 effects on the internal structures. I thought at
11 first i t was going to be a flow-induced
12 vibration, because you've got higher flows. But
13 that wasn't what they did, and I don't really
14 think that's important to those internal
15 structures. So I was all right with that.
16 I was intrigued with the comment that
17 they did the calculations for the spent fuel pool
18 using an equivalent porous medium.
19 CHAIRMAN CORRADINI: This is staff now
20 we're talking?
21 MEMBER KRESS: Yes, staff and GE. They
22 both did the same thing. But, you know, if I
23 look at a spent fuel pool and think about how the
24 flow travels through the bundles, I've got flow
25 resistances that are not isotropic. They differ

1 in all different directions, and I don't know how
2 they account for that.
3 I would like to see more about how they
4 did the equivalent flow resistance to put into a
5 porous medium.
6 CHAIRMAN CORRADINI: That's an open
7 item I think they'll provide.
8 MEMBER KRESS: Okay. It's an open
9 item.
10 MR. GALVIN: No, we were going to do
11 the open item on the temperatures.
12 MEMBER ABDEL-KHALIK: No. GE was going
13 to come back to us with that information.
14 MR. GALVIN: Oh, okay.
15 MEMBER KRESS: Yes, and there was
16 somebody suggested that go to -- when you get
17 into the operational stage, to actually use
18 thermal models for the control room, and then
19 just any old day and see if you can calculate
20 what's going on there as they check on the
21 models.
22 I think I'd support that. That doesn't
23 sound like too tough a thing to do, and I don't
24 know where you'd require this or how you'd put in
25 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 fuel 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 direction. There isn't much cross-

1 flow in there.

2 CHAIRMAN CORRADINI: I mean just to

3 make sure we're clear. The maximum temperatures

4 are still very low.

5 DR. WALLIS: Very low.

6 CHAIRMAN CORRADINI: I think from a

7 quantitative standpoint they could be --

8 MEMBER KRESS: I don't think there's a

9 problem. I just --

10 (Simultaneous discussion.)

11 DR. WALLIS: I think this boy has

12 enough experience for this and CFX is a normal

13 thing to use. So I'm satisfied with that. This

14 control room heat -up is extra ordinarily

15 complicated, and you have to use some judgment

16 when you look at all the evidence supplied.

17 I'm inclined to say that it's okay, but

18 I am puzzled by how if you keep the temperature

19 up all the time, looking at the amount of wiggle

20 you get when yo u don't keep it up all the time,

21 that it can not have a bigger effect. So I think

22 that's puzzling to me.

23 What also we talked about, I guess

24 where the water goes when you boil off the spent

25 fuel pool. Even if it all lands in the building,

1 it doesn't mat ter, because there's nothing left
2 there that you're concerned about from a safety
3 point of view, and if it goes outside, then
4 presumably it's no worse than having a bad
5 snowstorm, and that's protected against by roofs
6 and so on. So probably that is all right.
7 Again, I'd be interested to have the
8 staff make the decision rather than me, to give a
9 case about why it's all right. What else was
10 there?
11 CHAIRMAN CORRADINI: Well, the one
12 thing --
13 DR. WALLIS: Oh seismic. I was a
14 little puzzled by some of t he answers about
15 seismic, but I didn't push them too much, because
16 it's not really my subject. But I didn't really
17 understand some of those things about
18 coefficients of friction.
19 Okay, squib valve testing. Well
20 enough's been said about that, I think, already.
21 This is a tough thing to do. New device, you
22 can't test a great number of them to get
23 assurance. You can't test them in situ; it
24 doesn't tell you anything. It's hard for me to
25 see how you really get that really high percent

1 probability that they won't fail. I'm not quite
2 sure how you do that.
3 I'll write some other stuff on the
4 other issues.
5 CHAIRMAN CORRADINI: Okay.
6 DR. WALLIS: I think we do need to know
7 what equations were used in these added mass
8 models, for both the PCCS -2 and the spent fuel
9 pool.
10 CHAIRMAN CORRADINI: Sam.
11 MEMBER ARMIJO: Okay. On the squib
12 valves, I think it's a tough development program,
13 and it all depends on the requirements that are
14 put into the development program. In addition to
15 having them work one time, they have to work over
16 a period, you know, with aging.
17 I think a number of severe tests in the
18 development program, as opposed to hundreds of
19 tests, would probably be more practical. I think
20 they'll work, and I don't think it's practical to
21 test them in a plant at all.
22 As far as the boil-off stuff, pretty
23 straightforward. I didn't have any problem. I
24 don't think there's a big problem with -- I don't
25 see a problem with the seismic and impact of the

1 racks with the pool wall. I think they're
2 awfully tight in some dimensions. But just from
3 an engineering standpoint, I'd put a little more
4 room, where you've got like eight millimeters or
5 something.
6 DR. WALLIS: They're not tied down, are
7 they?
8 MEMBER ARMIJO: Oh yeah. They're
9 bolted down to the floor of the --
10 DR. WALLIS: That's what I didn't get.
11 I got the impression that they just moved
12 around.
13 MEMBER ARMIJO: I was shown a sketch
14 during off time. So I don't think there's a real
15 problem there. I think the --
16 DR. WALLIS: They were said to be free-
17 standing. Doesn't that mean they're not tied
18 down?
19 MEMBER ARMIJO: They're bolted to the
20 floor, to the floor of fuel pool.
21 (Simultaneous discussion.)
22 MR. GALVIN: The spent fuel pool,
23 they're free-standing. The buffer pool, they're
24 bolted down.
25 DR. WALLIS: They're not bolted down?

1 MEMBER ARMIJO: The racks are bolted.
2 MR. GALVIN: No. In the spent fuel
3 pool, they're not. They're free-standing.
4 DR. WALLIS: It could be a piece of
5 furniture.
6 MEMBER ARMIJO: And they're just
7 sitting there in place?
8 MR. GALVIN: Yes, like a piece of
9 furniture.
10 MEMBER ARMIJO: Yes. Okay, what --
11 where are the bolted ones?
12 MR. GALVIN: The buffer pool.
13 MEMBER ARMIJO: In the buffer pool?
14 MR. GALVIN: Yes.
15 MEMBER ARMIJO: Okay.
16 MR. GALVIN: In the reactor building.
17 MEMBER ARMIJO: Okay. Well then I'd
18 better back off on my conclusion that nothing
19 much is going to happen.
20 DR. WALLIS: Why aren't they bolted
21 down? It seems to be a simple thing to do. I
22 mean if you're worried about --
23 MR. GALVIN: It's an installation
24 problem, I think. That's what Wayne would tell
25 you.

1 MEMBER ARMIJO: It seems strange that
2 in the buffer pool they'd be bolted; in the spent
3 fuel pool, they wouldn't.
4 MR. GALVIN: There's not many racks in
5 a buffer pool.
6 MS. CUBBAGE: This is not a novel
7 design, right?
8 MEMBER ARMIJO: I think it's different.
9 MR. GALVIN: Well no, not terribly.
10 MEMBER ARMIJO: I think this is a
11 typical design. Okay. As far as the control
12 room habitability, thermal analysis, I think it's
13 pretty -- the two independent models and the
14 sensitivity studies convinced me there's, you
15 meet the requirements. So I don't see any
16 problem there.
17 I'll just, as far as the index
18 calculation, I was totally confused. That is
19 very similar to filling out your tax forms when
20 you have a complicated thing to do. I'm glad it
21 only has to be done by somebody else. That's all
22 I have.
23 CHAIRMAN CORRADINI: Okay.
24 MEMBER STETKAR: I think other folks --
25 by the way, I'd like to thank both the staff and

1 GEH. I thought the presentations today were
2 really good, and the discussions were really
3 good. They closed out a lot of kind of open
4 concerns. I'll come down on the side, would
5 advocate functional testing of the squib valves,
6 meaning to verify that they operate under design,
7 you know, pressure differential and things like
8 that.
9 It's difficult to do, but it's a new
10 piece of equipment. You can't develop statistics
11 to predict that they're going to fail ten to the
12 minus five for demand, but you m ight discover
13 something that you didn't expect. That's the
14 concern. It's a confidence builder, not a
15 reliability quantifier.
16 I'd also advocate a pre -op test to
17 verify that the passive cooling system, namely
18 the concrete in the control room works, or th at
19 more accurately, that indeed the observed
20 behavior of that system is adequately represented
21 by these models, you know, whatever best model
22 you can decide on.
23 And in all deference to the tech spec
24 experts, I'd really like to see a tech spec on an
25 LCO, specifically for the temperature sensors

1 that turn off the non -safety heat loads in the
2 control room, because --
3 MS. CUBBAGE: That would be difficult
4 to justify under 5036.
5 MEMBER STETKAR: Well, you know, I
6 don't know what 5036 is. I'll admit ignorance
7 there.
8 (Simultaneous discussion.)
9 MEMBER STETKAR: Hear me out for a
10 second. I'm staring at tech specs for the ESBWR,
11 that specifically applied to the neutron
12 monitoring system, and I have an LCO that says
13 one or more functions with one require d division
14 inoperable. I have a 12 hour completion time to
15 do something, and I have a separate surveillance
16 requirement to verify functional operability once
17 every 24 months on a staggered test basis.
18 I'm assuming that these technical
19 specifications satisfy 50 whatever it was.
20 MS. CUBBAGE: 5036, Criterion 2, I
21 believe.
22 MEMBER STETKAR: And I don't understand
23 why the analogous conditions don't apply for
24 these temperature monitor that do something to
25 verify a safety function, mainly control room

1 cooling, that I meet those room heat up things.
2 To me, I don't understand why they're different.
3 MR. HARBUCK: I believe that the
4 requirements we currently have in the tech specs
5 were, they evolved from questions from the staff,
6 from changing from the EBASS (ph) system to go to
7 CRHAVs. But as I described in my presentation,
8 the way the rules of the tech specs were, that
9 function that you're talking about actually is
10 the subject of an LCO.
11 It's not as straightforward or as clear
12 as it could be, and that might be something we
13 should look into.
14 MEMBER STETKAR: My concern is, you
15 know, I come from an operational background. My
16 concern is if I go look at the tech specs for the
17 neutron monitoring instrumentation, it's really
18 clear to me --
19 MS. CUBBAGE: Those directly pertain to
20 one of the criteria in 5036 for a fission product
21 barrier.
22 (Off mic comment.)
23 MEMBER STETKAR: Well, but don't the --
24 doesn't shutting off the non-safety heat loads in
25 the control room directly apply to control room

1 habitability for a design basis accident
2 scenario?
3 MR. HARBUCK: In the tech specs, that's
4 addressed by the functioning of the CHRAVs, and
5 it's also addressed by the instrumentation
6 functions that cause automatic -- cause different
7 configurations or starting the syst em
8 automatically on certain parameters.
9 MEMBER STETKAR: The only thing is,
10 Craig, that these particular temperature sensors
11 don't do any of that things that you just said.
12 MR. HARBUCK: It's a fairly
13 straightforward, simple function that --
14 MEMBER S TETKAR: That's a message.
15 Think about it from an operational sense, in
16 terms of consistency in the way that
17 instrumentation LCOs and surveillance
18 requirements are specified in these technical
19 specifications, and try --
20 If you're confident that indeed the
21 protection of not exceeding a required, you know,
22 plant configuration, if indeed you're convinced
23 that the current technical specifications provide
24 that protection and the way that they might be
25 interpreted.

1 Also think whether or not the owner
2 operator of the plant, reading the technical
3 specifications, could easily understand how that
4 function is met, you know, in particular for
5 those temperature sensors. Because of the
6 protection is there and there's no down side of
7 putting an LCO on them. In othe r words, your
8 assertion is there's already an LCO.
9 MR. HARBUCK: I think perhaps, you
10 know, if I hear what you're saying, is that there
11 needs to be perhaps more explicit appropriate
12 action requirements.
13 CHAIRMAN CORRADINI: I think he's
14 bringing some clarity.
15 MEMBER STETKAR: I'm looking for
16 clarity in the same way as I look at, for
17 example, the neutron monitoring system. If I'm
18 an operator, if I have two trains of neutron
19 monitoring, two channels down, it's very clear
20 that I need to do something, an d I have a
21 specific time window.
22 MS. CUBBAGE: I think we need to take a
23 timeout on this. We need to caucus. I'm not
24 proposing that we're going to ask GE to make any
25 changes in this area.

1 MEMBER STETKAR: Okay.
2 CHAIRMAN CORRADINI: Others, John?
3 MEMBER STETKAR: No. I have no
4 additional comments.
5 CHAIRMAN CORRADINI: So I can put your
6 initials anywhere on the list?
7 MEMBER STETKAR: Right.
8 CHAIRMAN CORRADINI: Okay, all right.
9 I do have three or four action items. No, I take
10 it back. Three action items that we have. Heavy
11 load lifting, to be answered relative --
12 MS. CUBBAGE: GE plans to get back
13 tomorrow on that topic.
14 CHAIRMAN CORRADINI: Right. The open
15 item on -- I thought it was more to the staff
16 than it was to GE, on the iso tropic versus non-
17 isotropic, I call them friction factors or form
18 factors relative to flow in the spent fuel pool
19 cooling.
20 MEMBER ARMIJO: Either one of them.
21 CHAIRMAN CORRADINI: Well, I think
22 Chris was answering your question, but I thought
23 we left i t with staff. But I'm sure you would
24 love to explain it to us.
25 MR. GALVIN: You're going to have to

1 get an answer from GE.

2 CHAIRMAN CORRADINI: Okay, that's fine.

3 That's right. You're not on the docket. You're

4 just checking the docket.

5 MR. MARQUINO: An answer on what?

6 CHAIRMAN CORRADINI: On your modeling

7 of --

8 (Simultaneous discussion.)

9 CHAIRMAN CORRADINI: When you're

10 modeling the porous medium, when you're flowing,

11 let's say, perpendicular to the bundle or

12 parallel to the bundle, what is your form losses?

13 How are you modeling the form losses.

14 And then the third one was that at

15 first we thought there was no check valve, then

16 we thought there was a check valve. Now it's a

17 matter of valve wind-up relative to the FAPCS.

18 MEMBER STETKAR: I think I'm okay on

19 that, except I'd still -- just to kind of, it's a

20 curiosity issue, to follow up on the size of the

21 pipe and the rate at which it would drain, if for

22 some reason you could get into that lineup.

23 CHAIRMAN CORRADINI: Good. So with

24 that, the decks are clear tomorrow for Digital

25 Inc. and we are siked (ph).

1 MR. GALVIN: All right. Is Charlie
2 going to be here tomorrow?
3 CHAIRMAN CORRADINI: God, I hope so.
4 MR. GALVIN: That's an excellent
5 question.
6 (Simultaneous discussion.)
7 CHAIRMAN CORRADINI: We're adjourned.
8 Thank you.
9 (Whereupon, at 6:17 p.m., the meeting
10 was recessed, to reconvene on Friday, September
11 24, 2010 at 8:30 a.m.)
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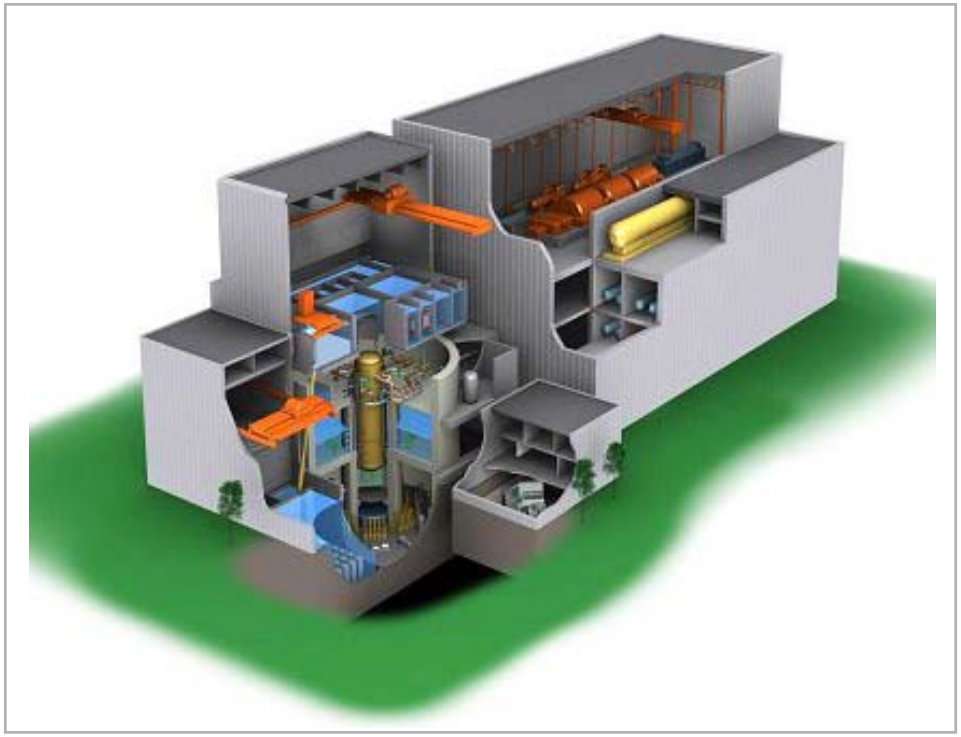
ESBWR Chapter 3: Design of Structures, Components, Equipment, and Systems



Advisory Committee on Reactor Safeguards

Sujit Niogi

September 23, 2010

HITACHI

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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)

HITACHI

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)

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.

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NRC RAI 3.8-94

Summary from RAI question:

- 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)

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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

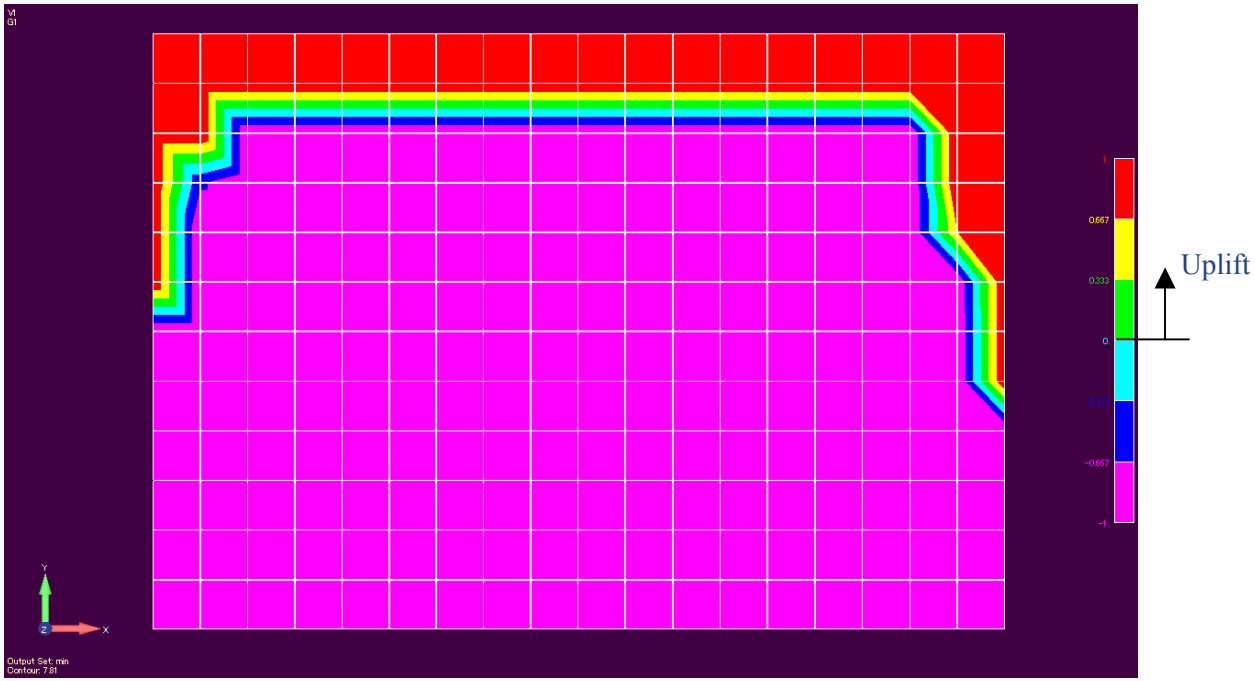

Figure 1
Plan View of RB/FB Complex Basemat
Extent of Uplift for Maximum Bearing Capacity (DL + Buoyancy)
(cont'd)

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NRC RAI 3.8-94

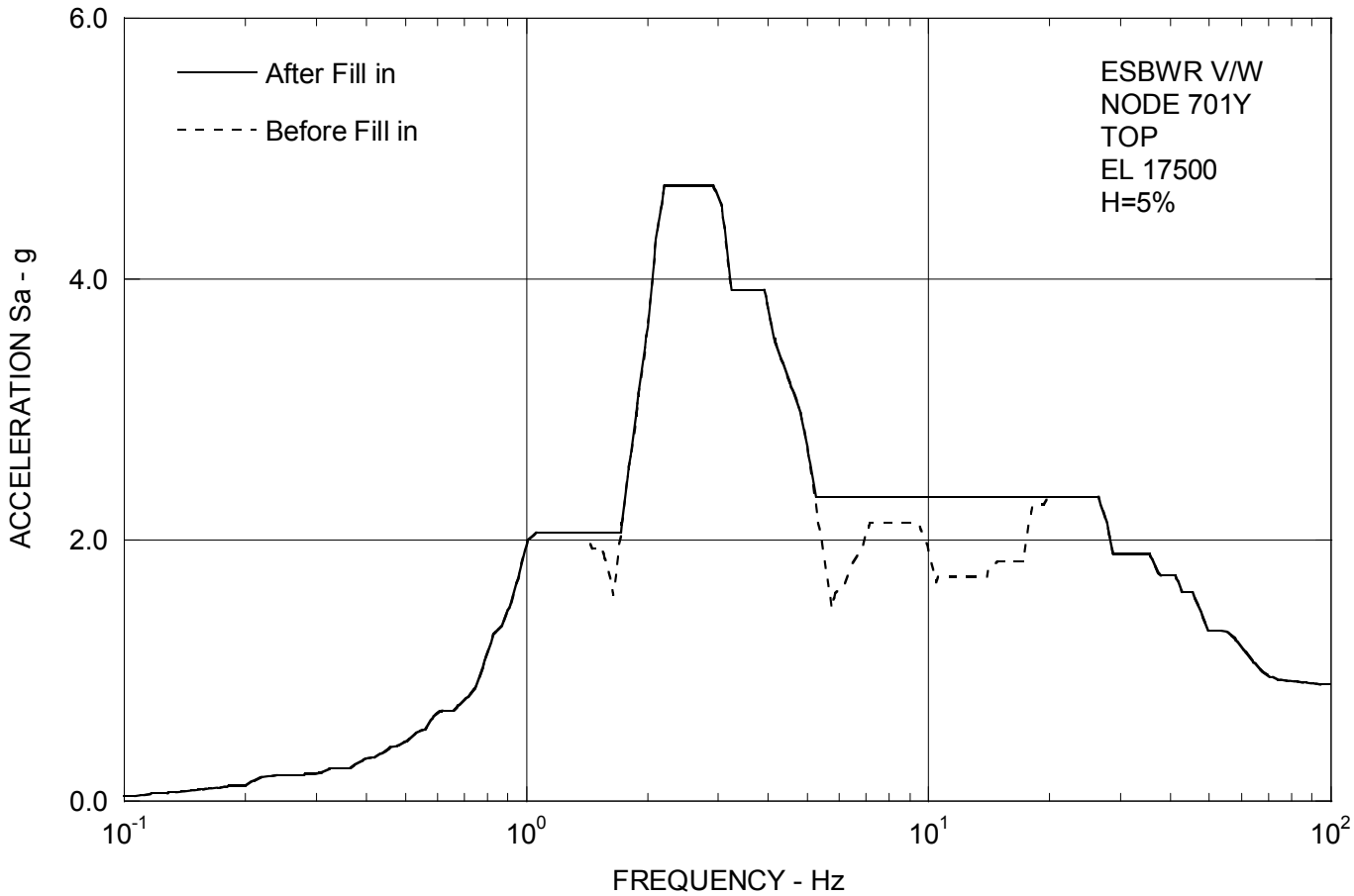

Figure 2
Floor Response Spectra with Valleys Filled-In

(cont'd)

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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.

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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)

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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.

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NRC RAI 3.8-96
(continued)

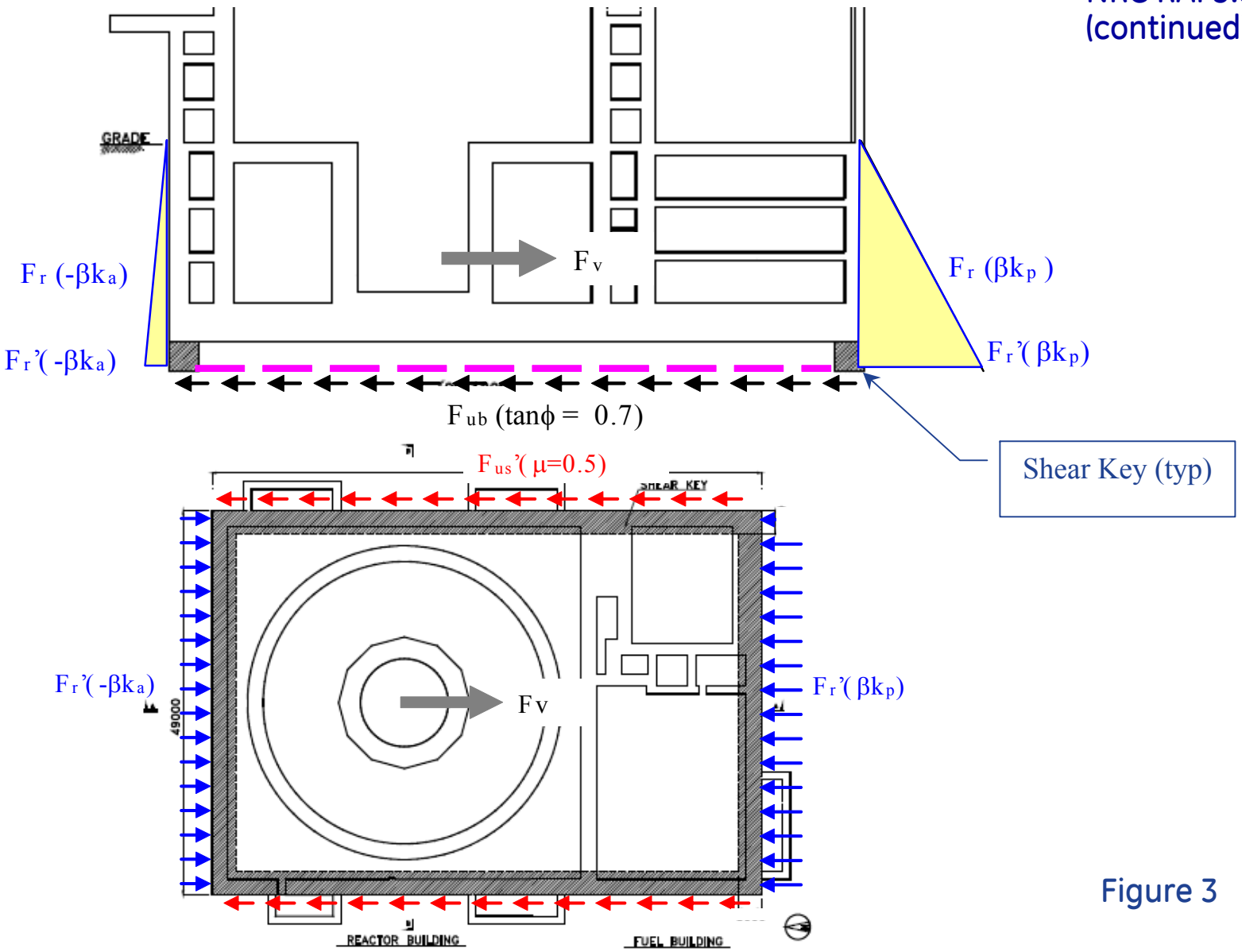

Figure 3

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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.

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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.

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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)

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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)

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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.

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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.

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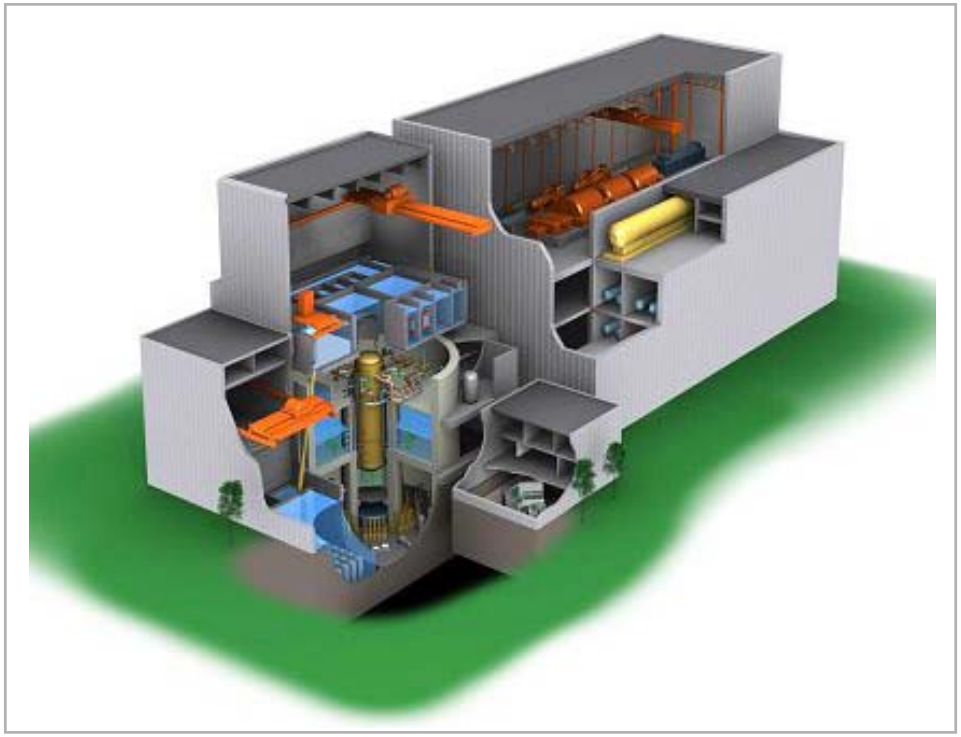
ESBWR Chapter 3: Section 3.9 Design of Structures, Components, Equipment, and Systems



Advisory Committee on Reactor Safeguards

Jerry Deaver

September 23, 2010

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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

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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

HITACHI

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

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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

Summary from SER with Open Items:

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

Response:

- 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.

Conclusion:

Since GEH demonstrated their capability to prepare component design specifications and has implemented ITAAC commitments for ASME component design documentation

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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

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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

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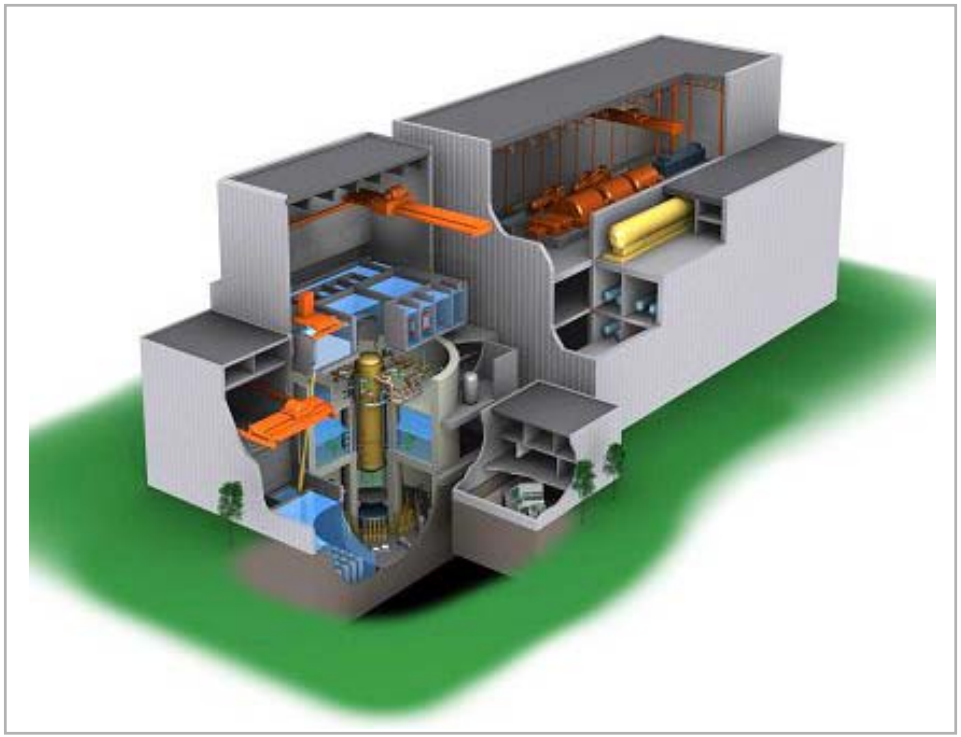
ESBWR Chapter 3: Section 3.12 Design of Structures, Components, Equipment, and Systems



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Introduction

Review of Selected Chapter 3 SER Open Issues:

- 3.12-3
- 3.12-17
- 3.12-27

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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

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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

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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

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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

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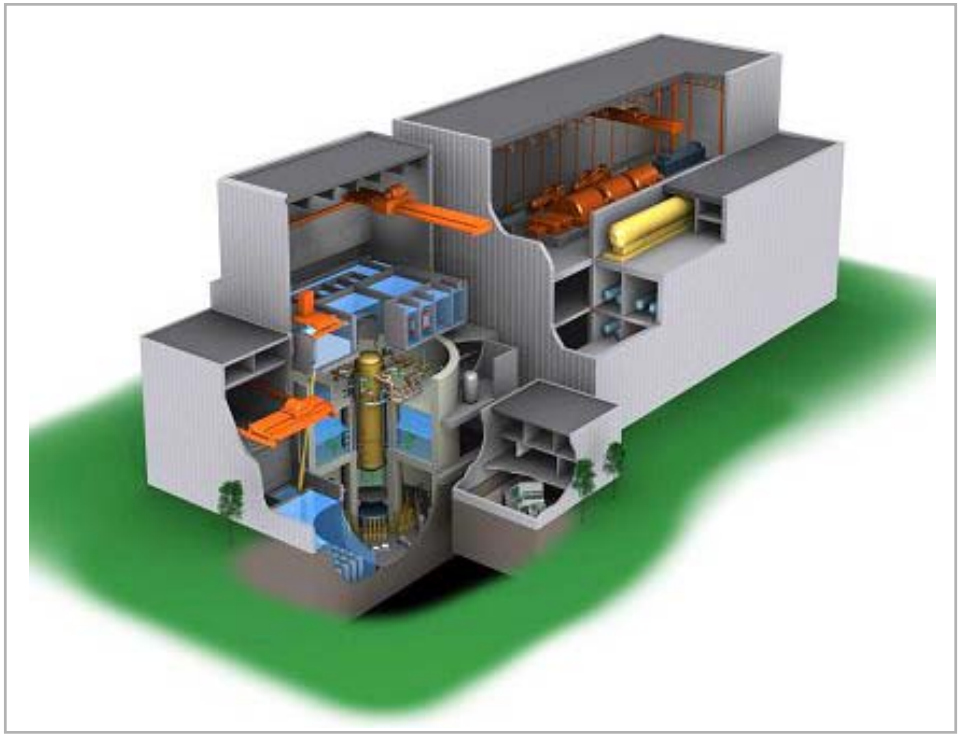
ESBWR Chapter 9: Auxiliary Systems



Advisory Committee on Reactor Safeguards

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Mike Arcaro

September 23, 2010

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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**

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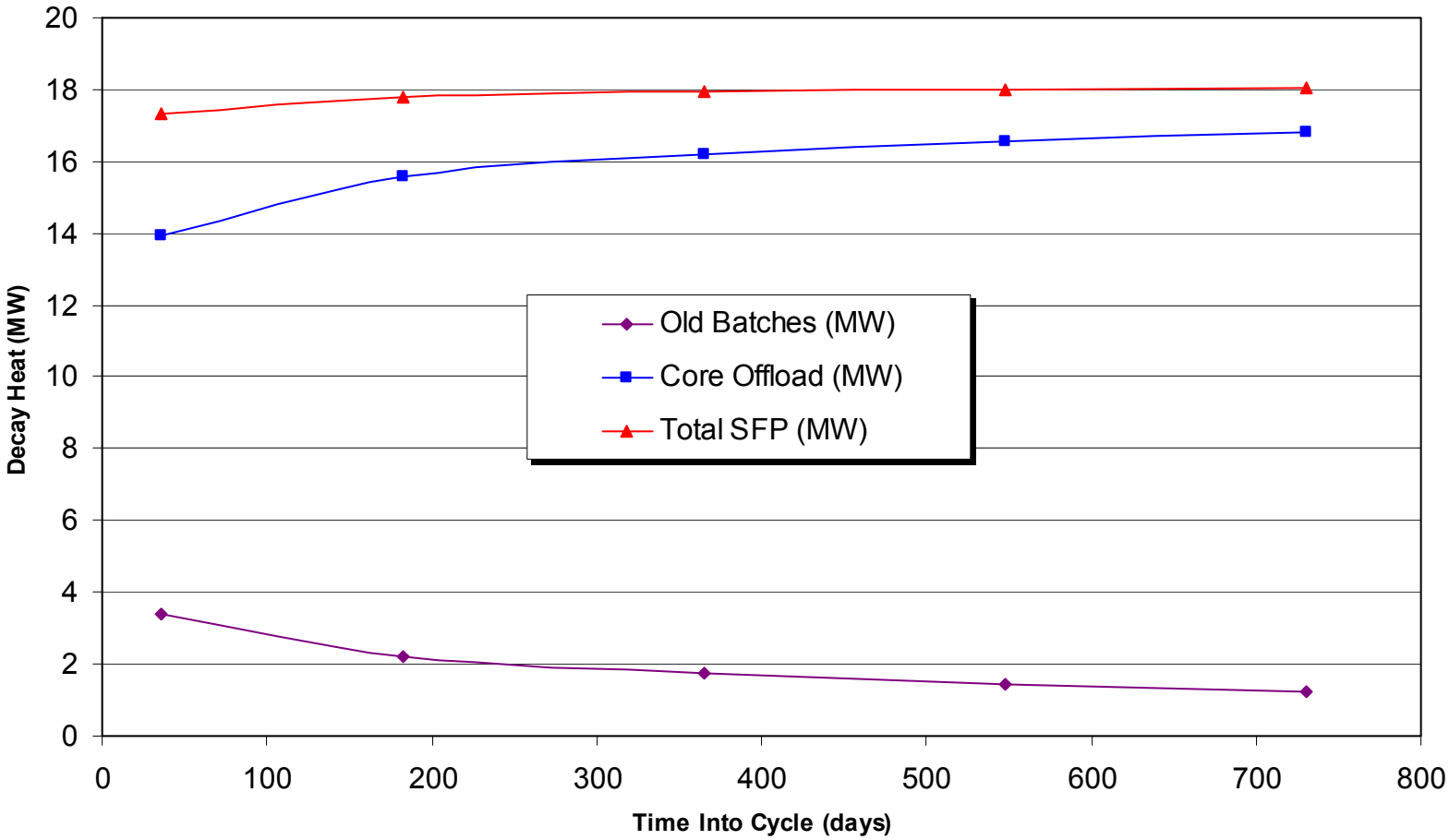
SFP Decay Heat as a Function of Irradiation Time



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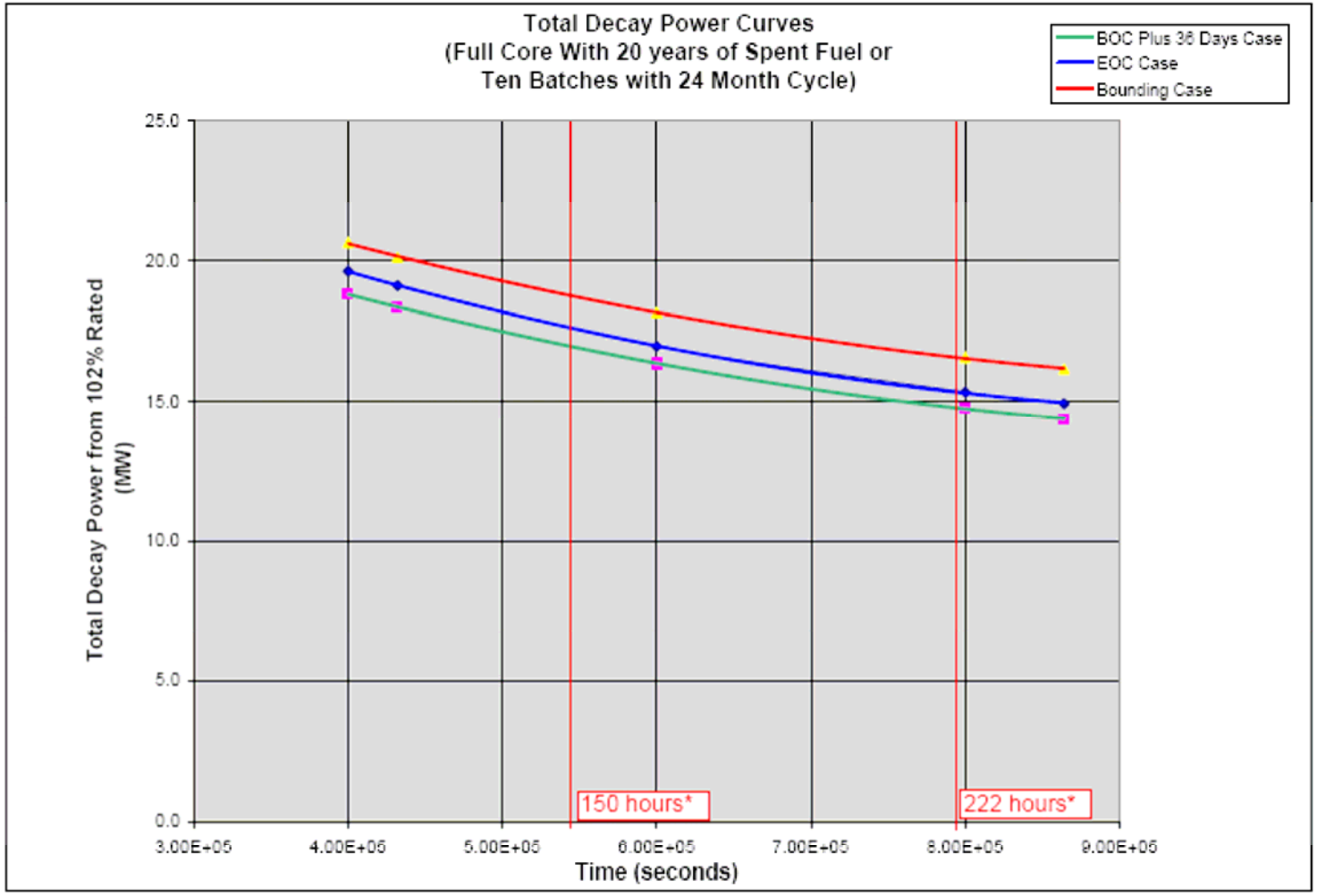
Energy Curves Used in Analyses



***The boil-off period is from 150 hours to 222 hours based on NUREG-0800, 1981 Version.**

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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

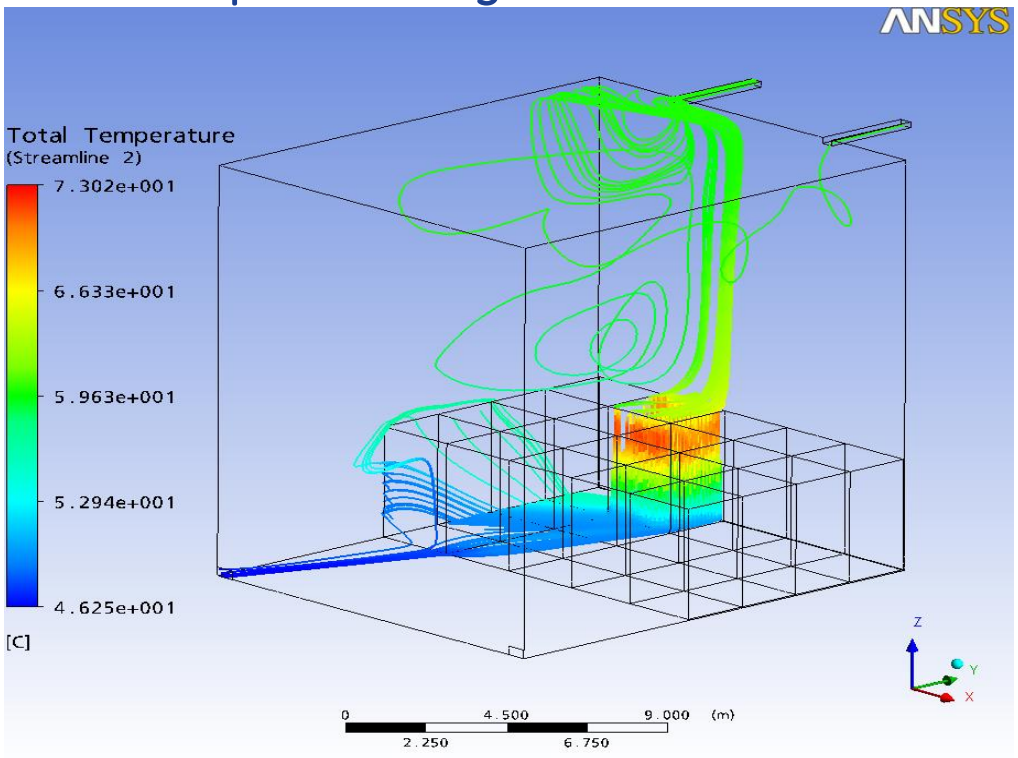
<u>Conclusion:</u>

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



HITACHI

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

HITACHI

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.

HITACHI

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

HITACHI

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

HITACHI

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

HITACHI

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

HITACHI

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.

HITACHI

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

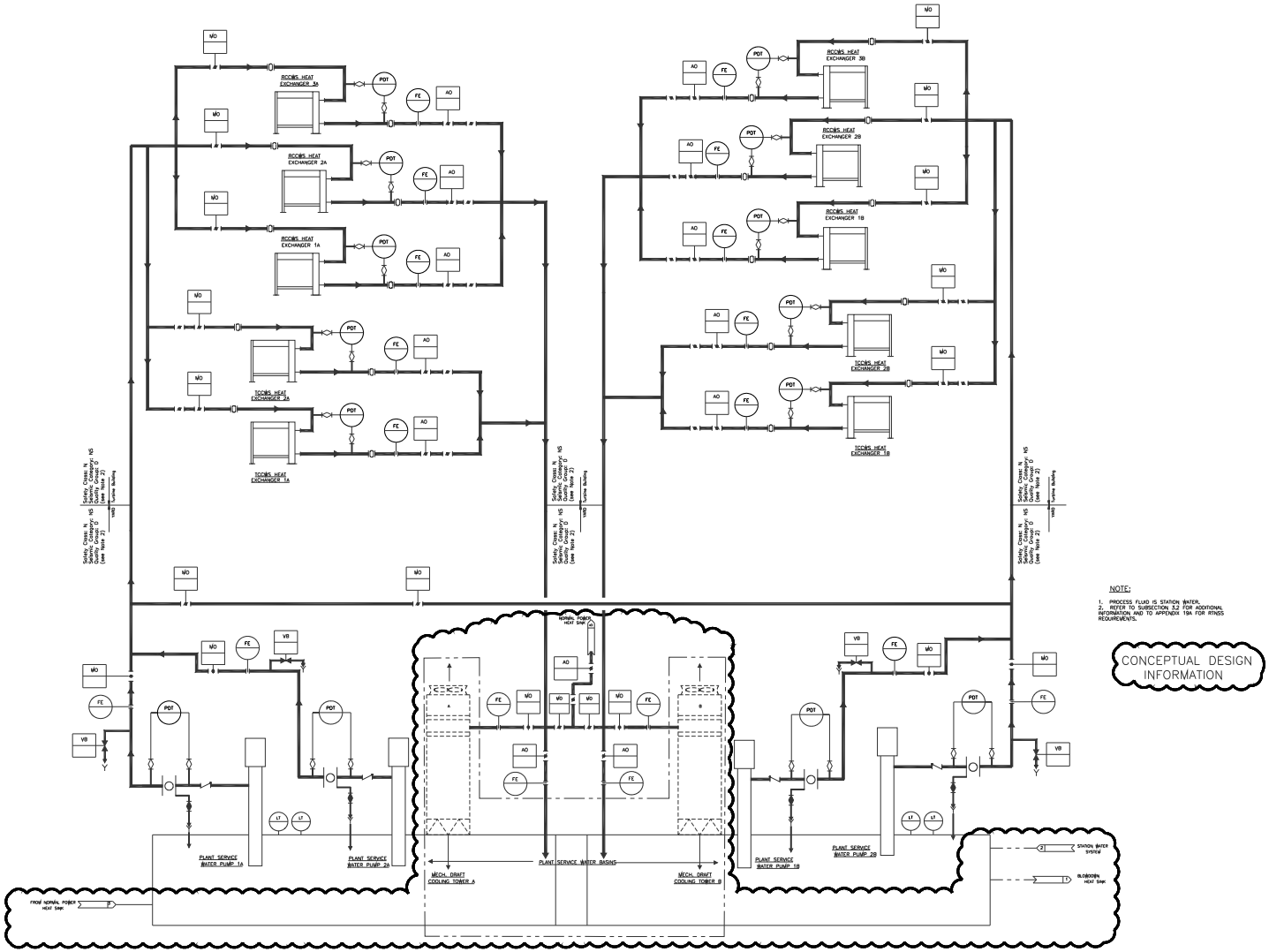
    Physical and Electrical Separation of Trains

    Seismic Requirements –IBC-2003 & Position C.2 of RG 1.29 as required

    Ability to Withstand Cat 5 Hurricane Missiles and Flood

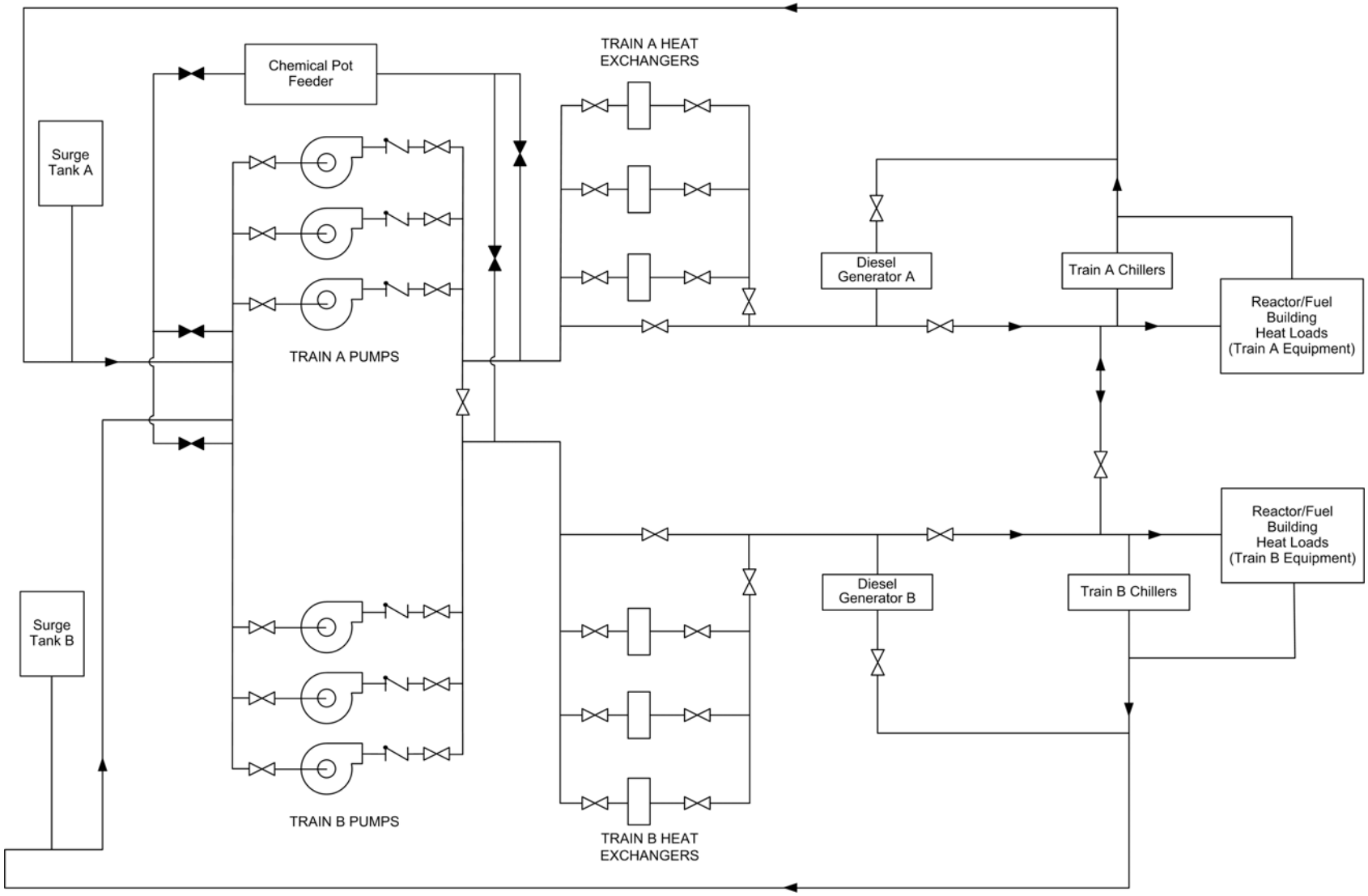
HITACHI

DCD Section 9.2 – Water Systems-PSWS



HITACHI

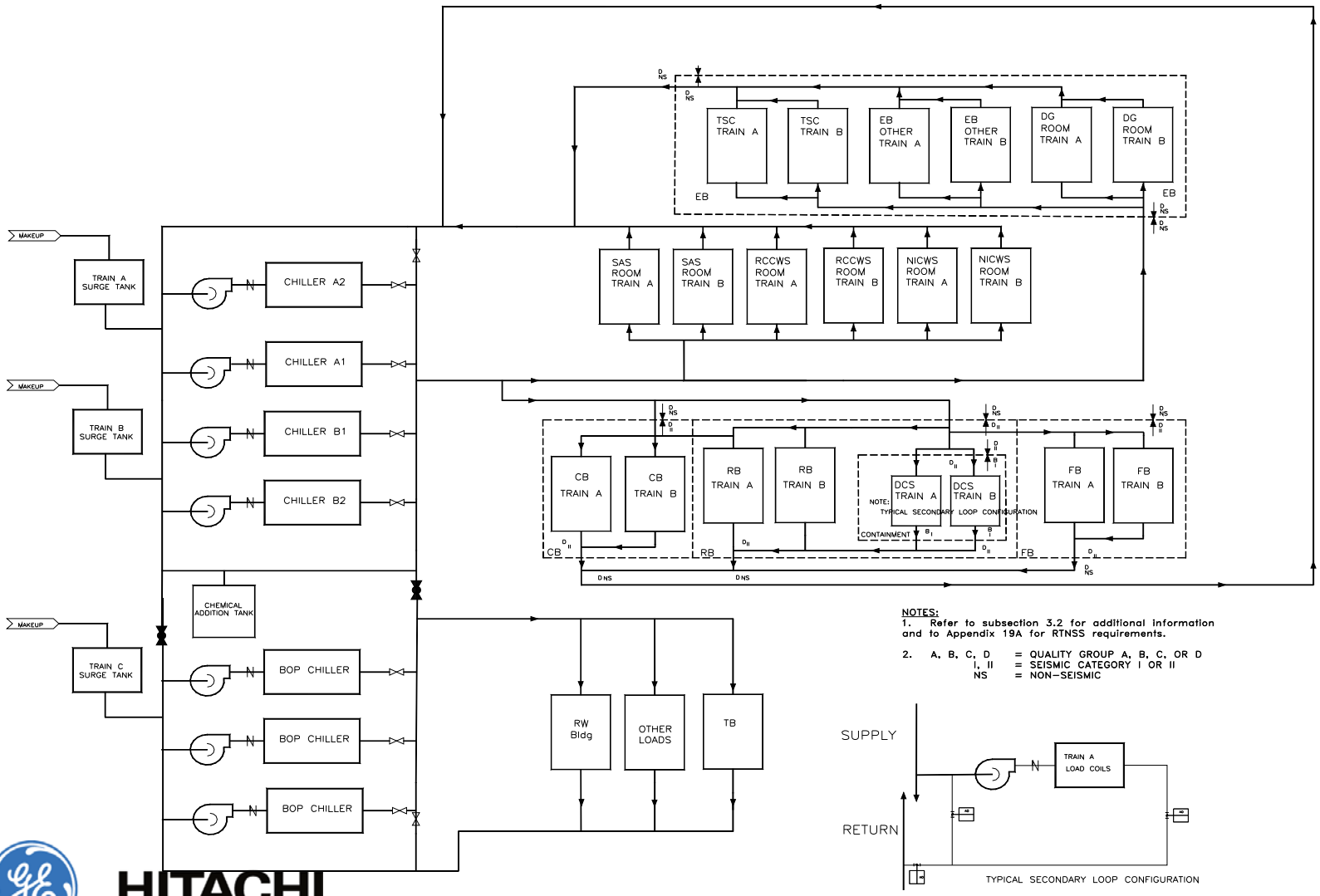
DCD Section 9.2 – Water Systems-RCCWS



HITACHI

DCD Section 9.2 – Water Systems

Chilled Water System (CWS)



HITACHI

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)

HITACHI

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)

HITACHI

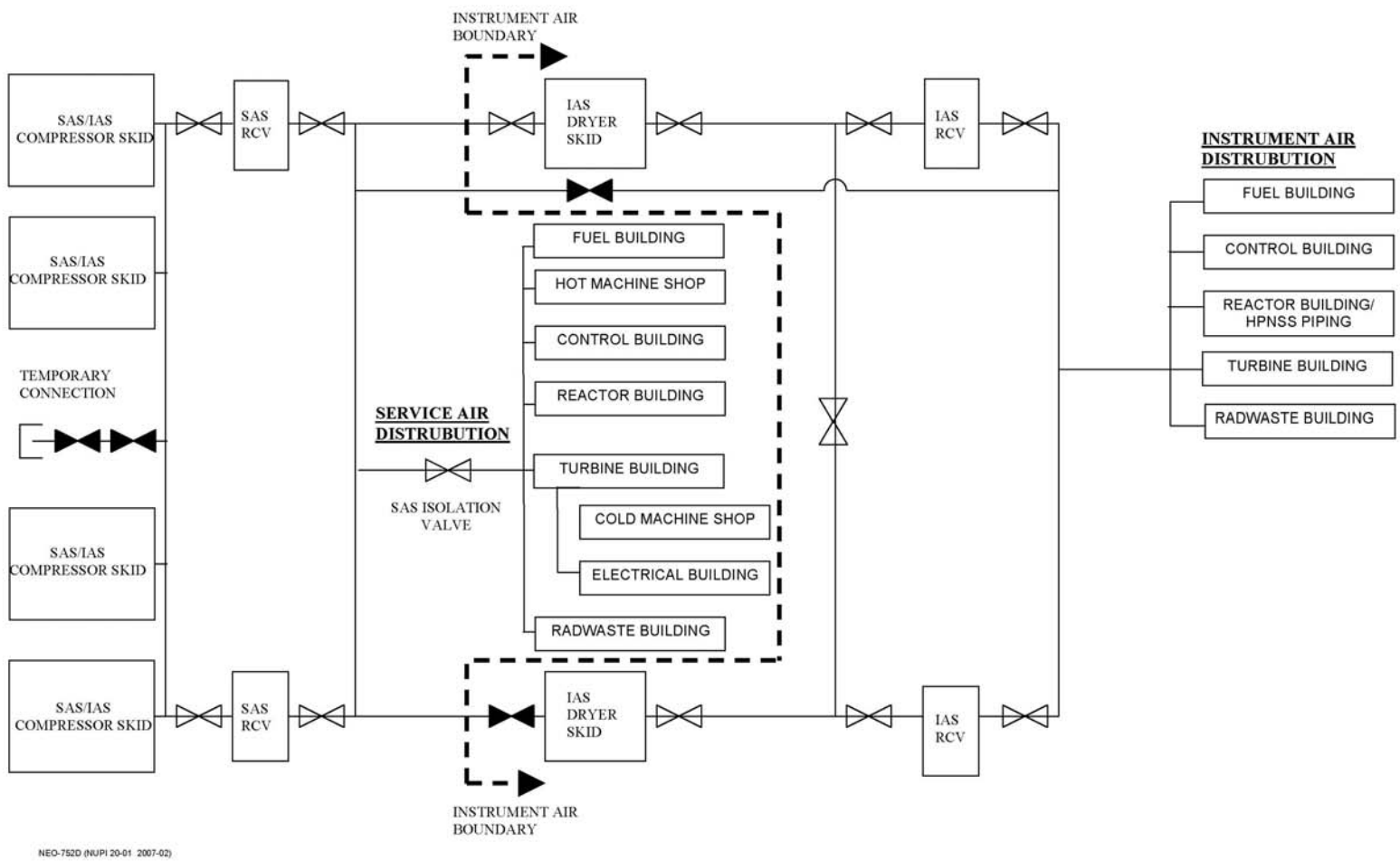
Instrument Air / Service Air System Overview

- 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]

HITACHI

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

HITACHI

BACKUP SLIDES

HITACHI

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.

HITACHI

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

HITACHI

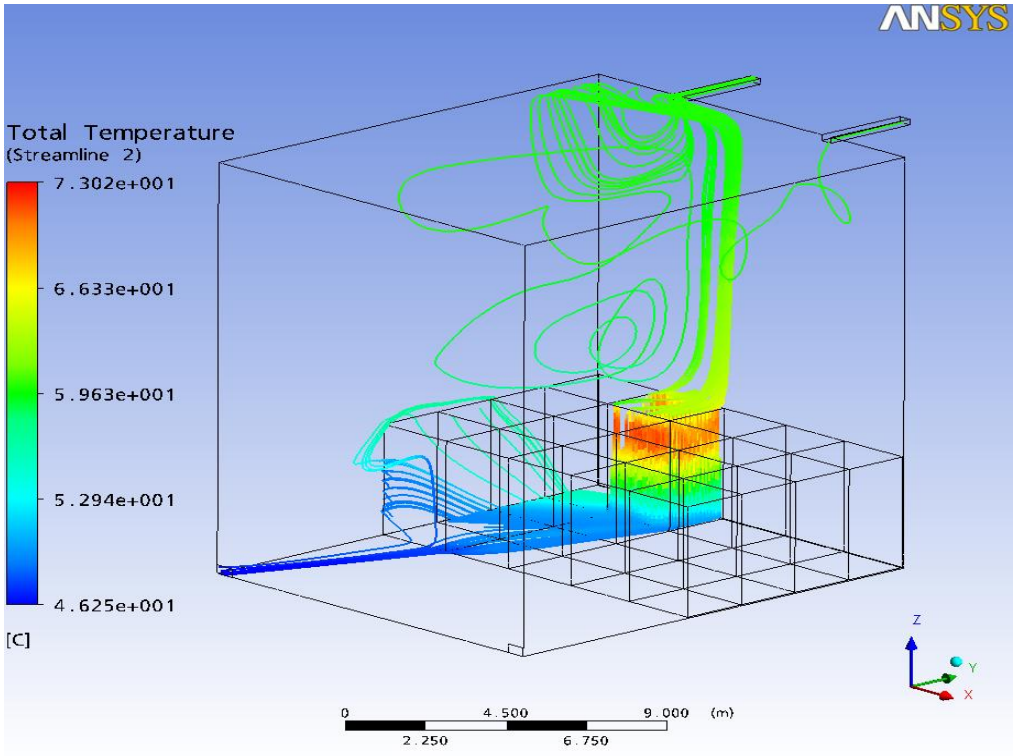
Fuel Decay Heat Input

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)

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)
- 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



HITACHI

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

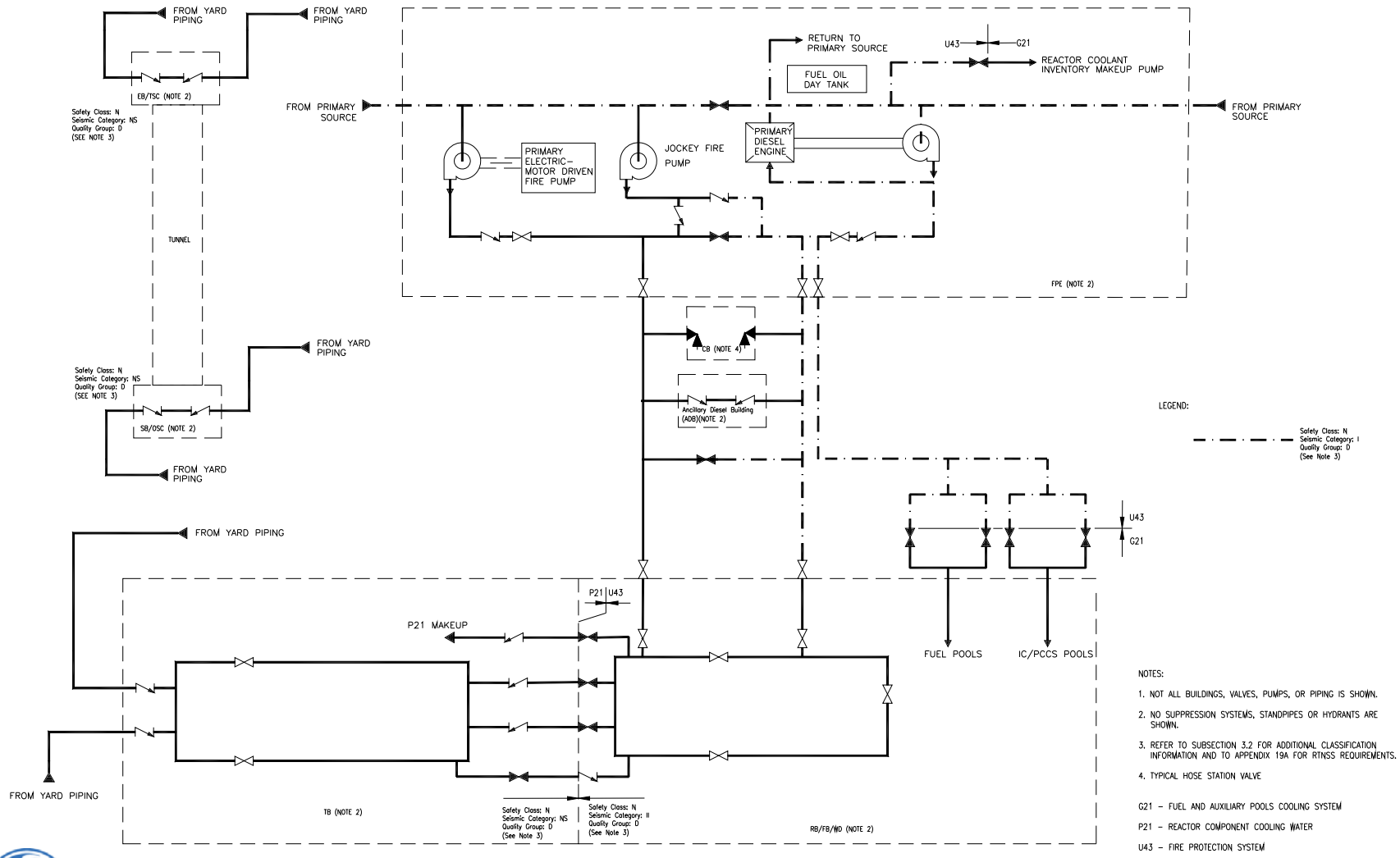
HITACHI

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.

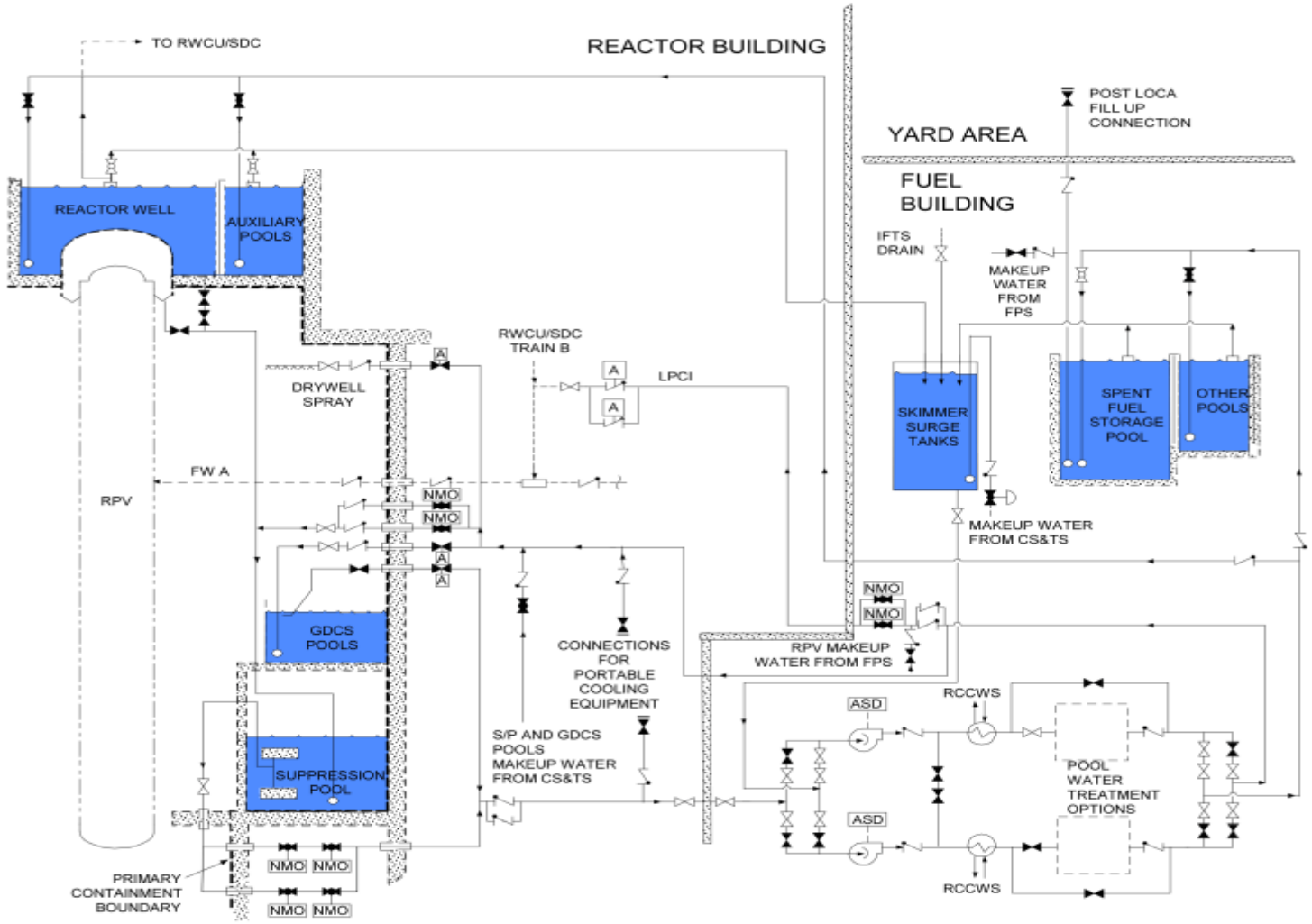
HITACHI

Fire Protection System



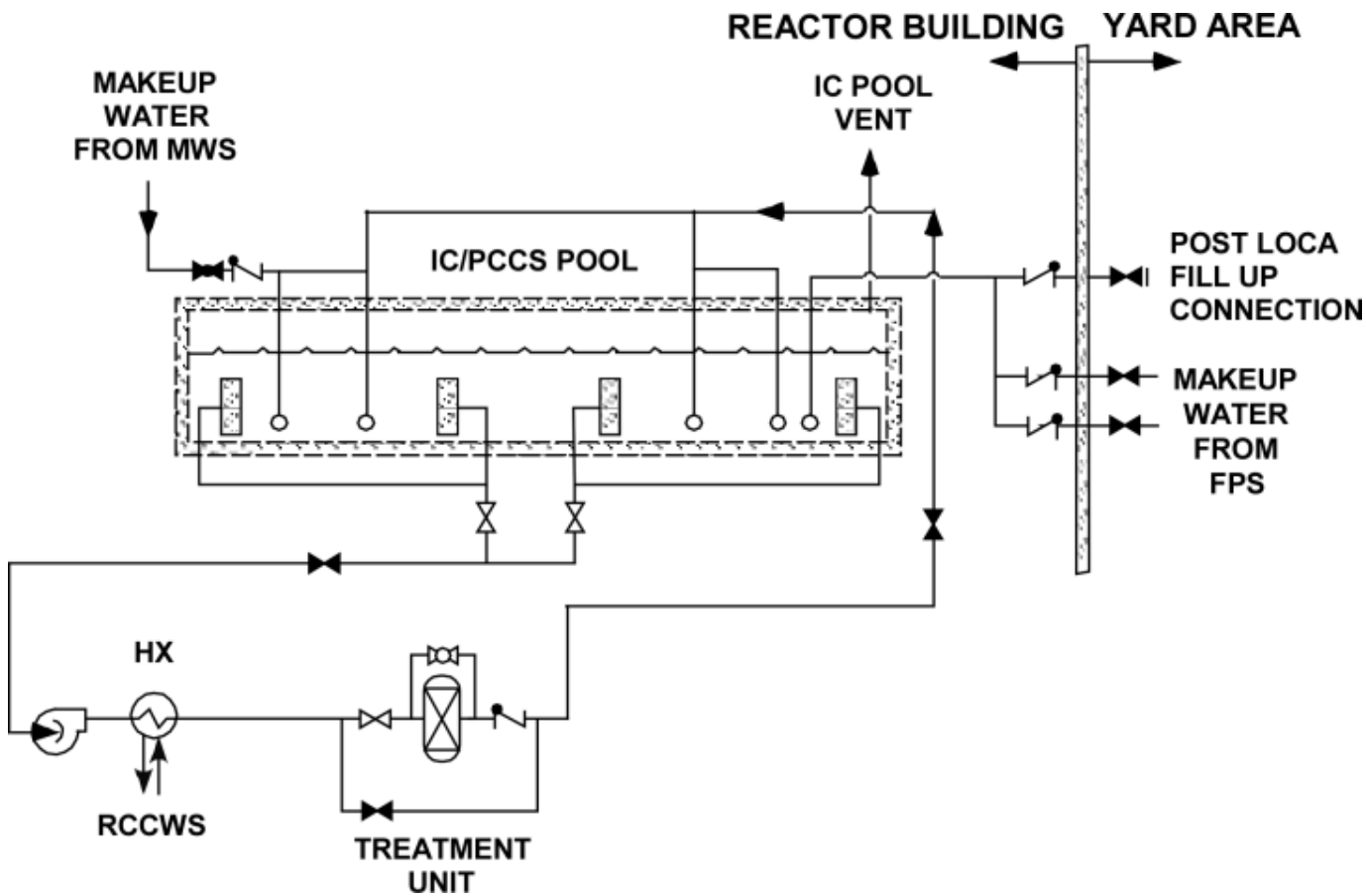
HITACHI

FAPCS Schematic



HITACHI

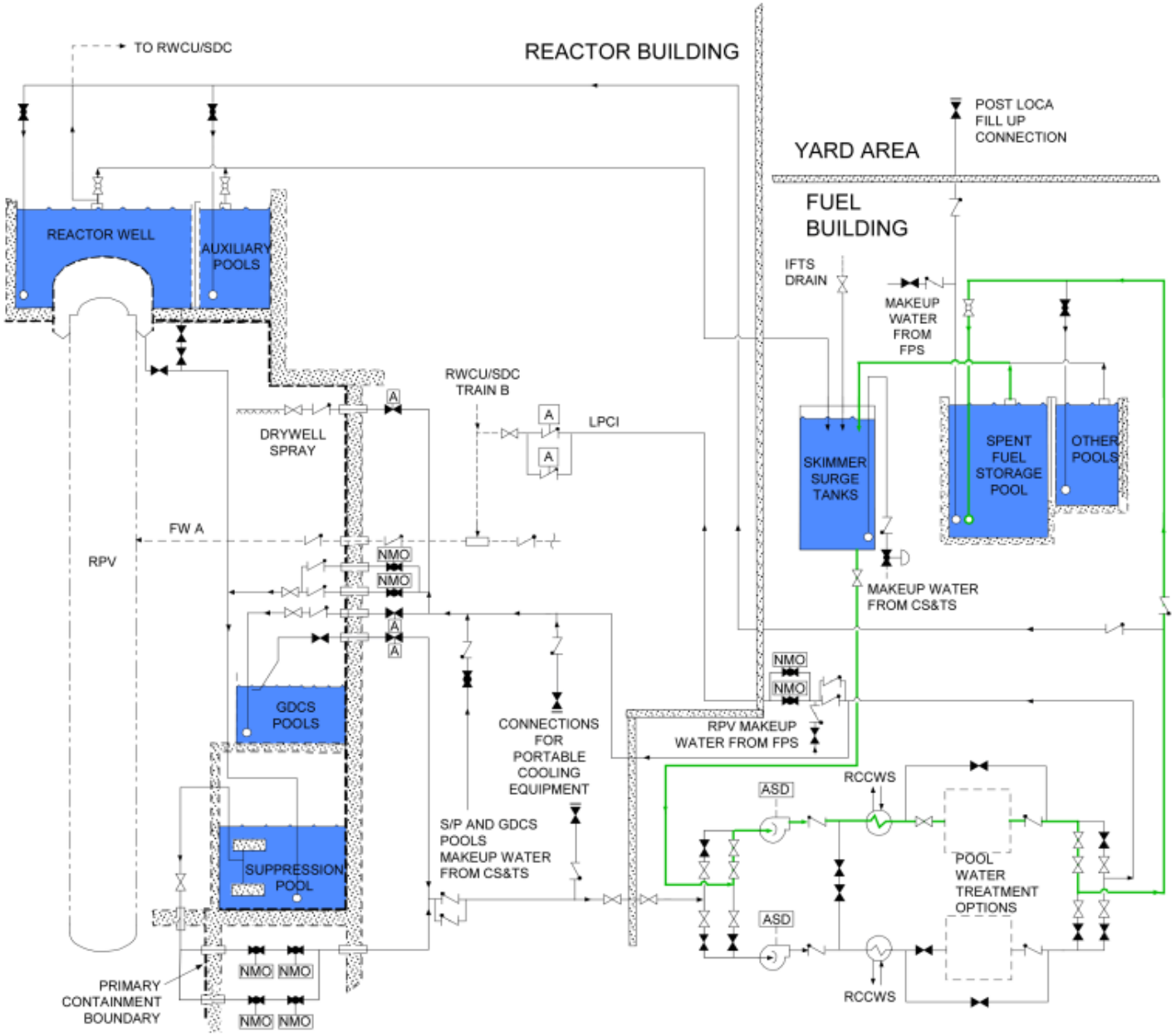
FAPCS – IC/PCCS Subsystem



Clean & Contaminated Water Kept Separate

HITACHI

FAPCS – Fuel Pool Cooling Mode



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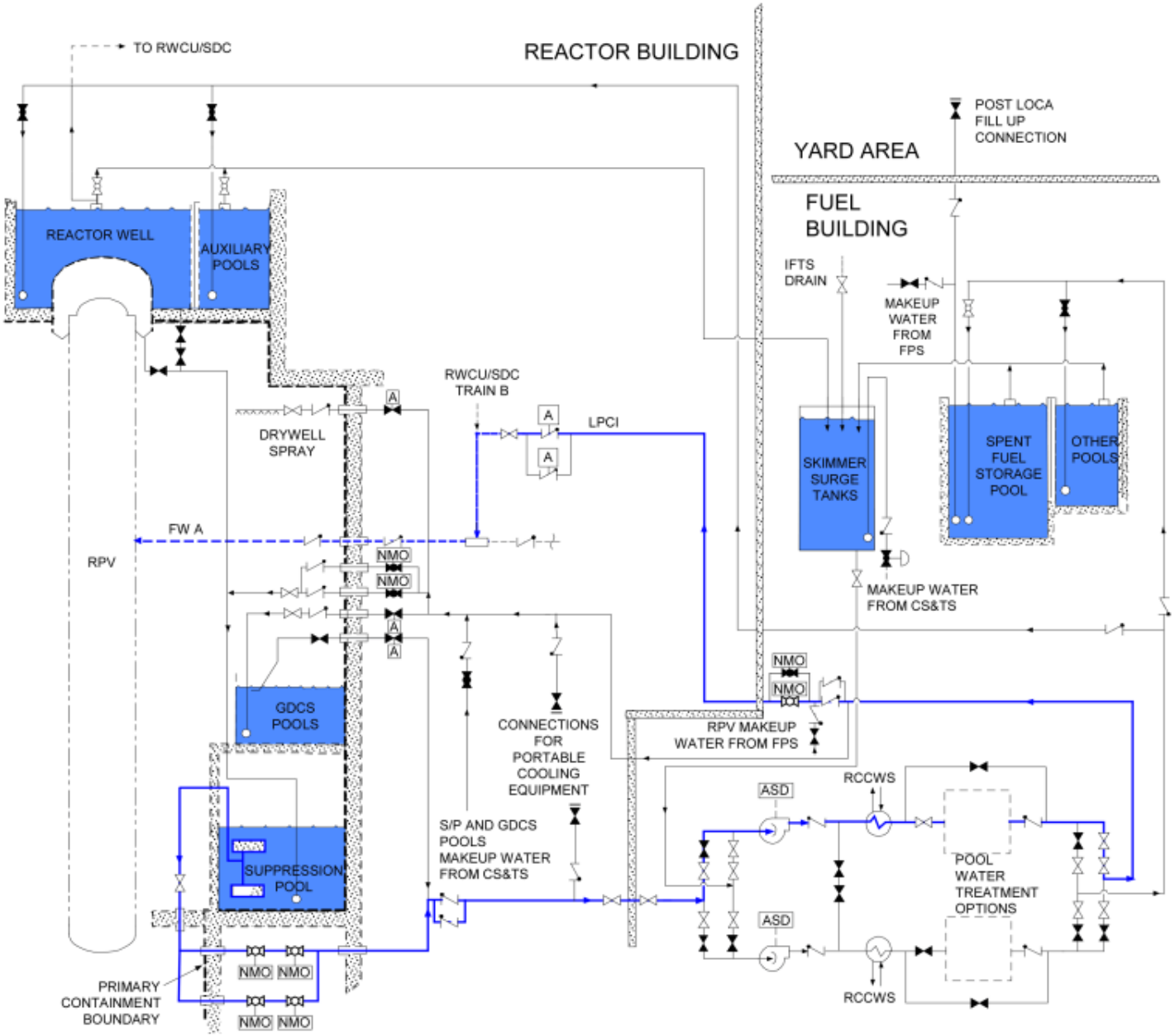
FAPCS – LPCI Mode

Non-safety related LPCI mode



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Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Section 3.12 – Piping Design
Kaihwa Hsu - NRO/DE/EMB1

September 23, 2010

ACRS Subcommittee Presentation
ESBWR Design Certification Review

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

RAI 3.12-17

- 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

RAI 3.12-27

- 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

Regulations and Regulatory Guidance

- 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

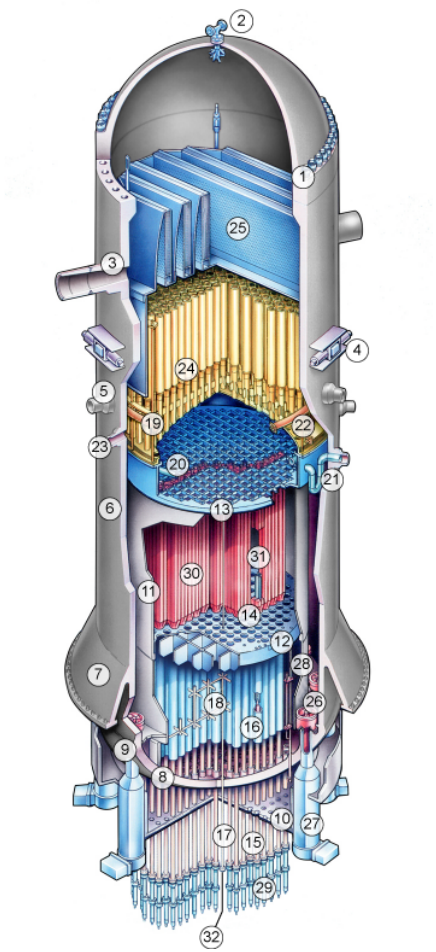
RAI 3.9-177:

- 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:

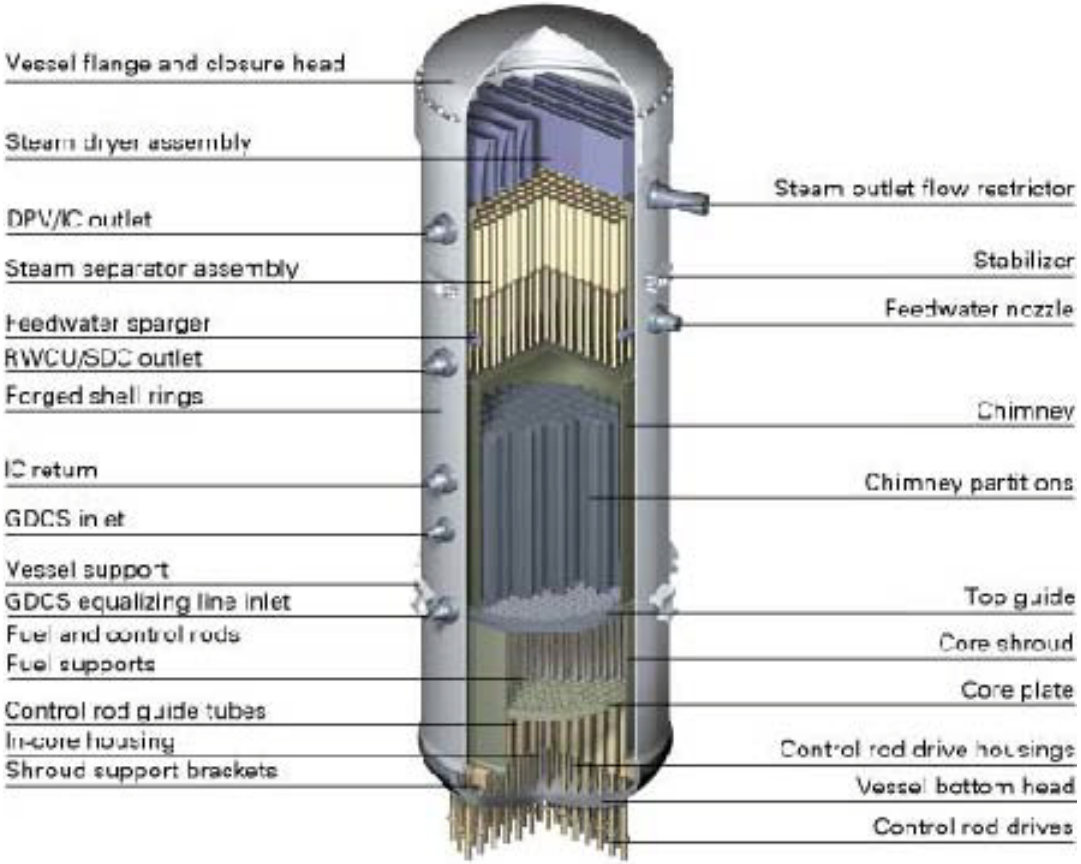
- ITAAC for review of Design Reports
- Completion of Design Specifications for risk significant components prior to Certification.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.2 – Backup Slide – ABWR Reactor Internals

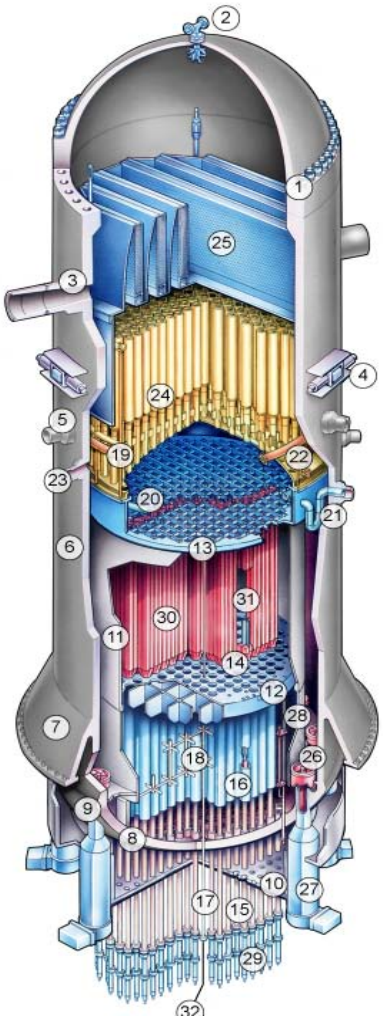


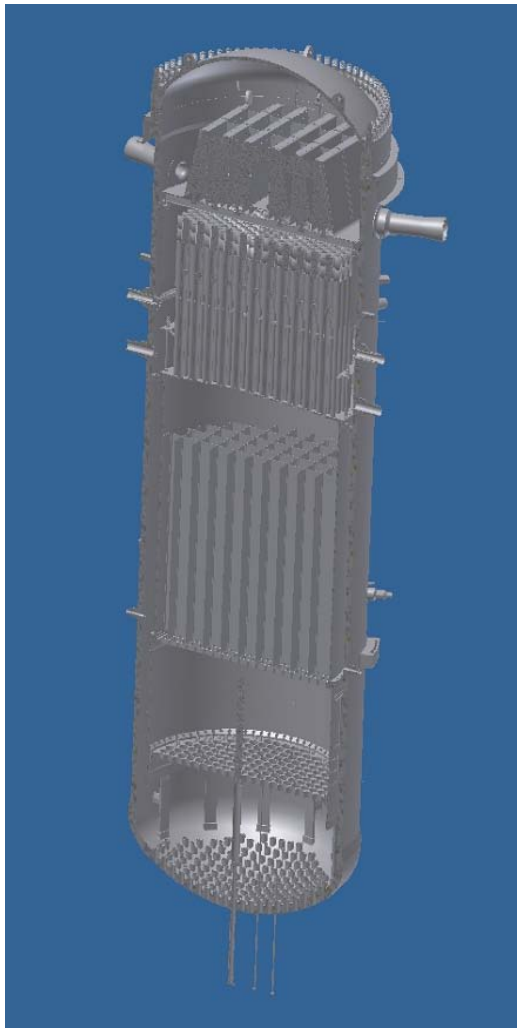
1 - Vessel flange and closure head
2 - Vent and head spray assembly
3 - Steam outlet flow restrictor
4 - RPV stabilizer
5 - Feedwater nozzle
6 - Forged shell rings
7 - Vessel support skirt
8 - Vessel bottom head
9 - RIP penetrations
10 - Thermal insulation
11 - Core shroud
12 - Core plate
13 - Top guide
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

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Protecting People and the Environment

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

<u>Regulations, Regulatory Guidance, and Key Industry Codes & Standards</u>

- 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

<u>Closure of Open Items Discussed in Last ACRS Meeting</u>

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

<u>Closure of Open Items Discussed in Last ACRS Meeting</u>

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

<u>Closure of Open Items Discussed in Last ACRS Meeting</u>

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

Closure of Open Items Discussed in Last ACRS Meeting

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

<u>Closure of Open Items Discussed in Last ACRS Meeting</u>

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

<u>Closure of Issue Subsequent to Last ACRS Meeting</u>

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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Protecting People and the Environment

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

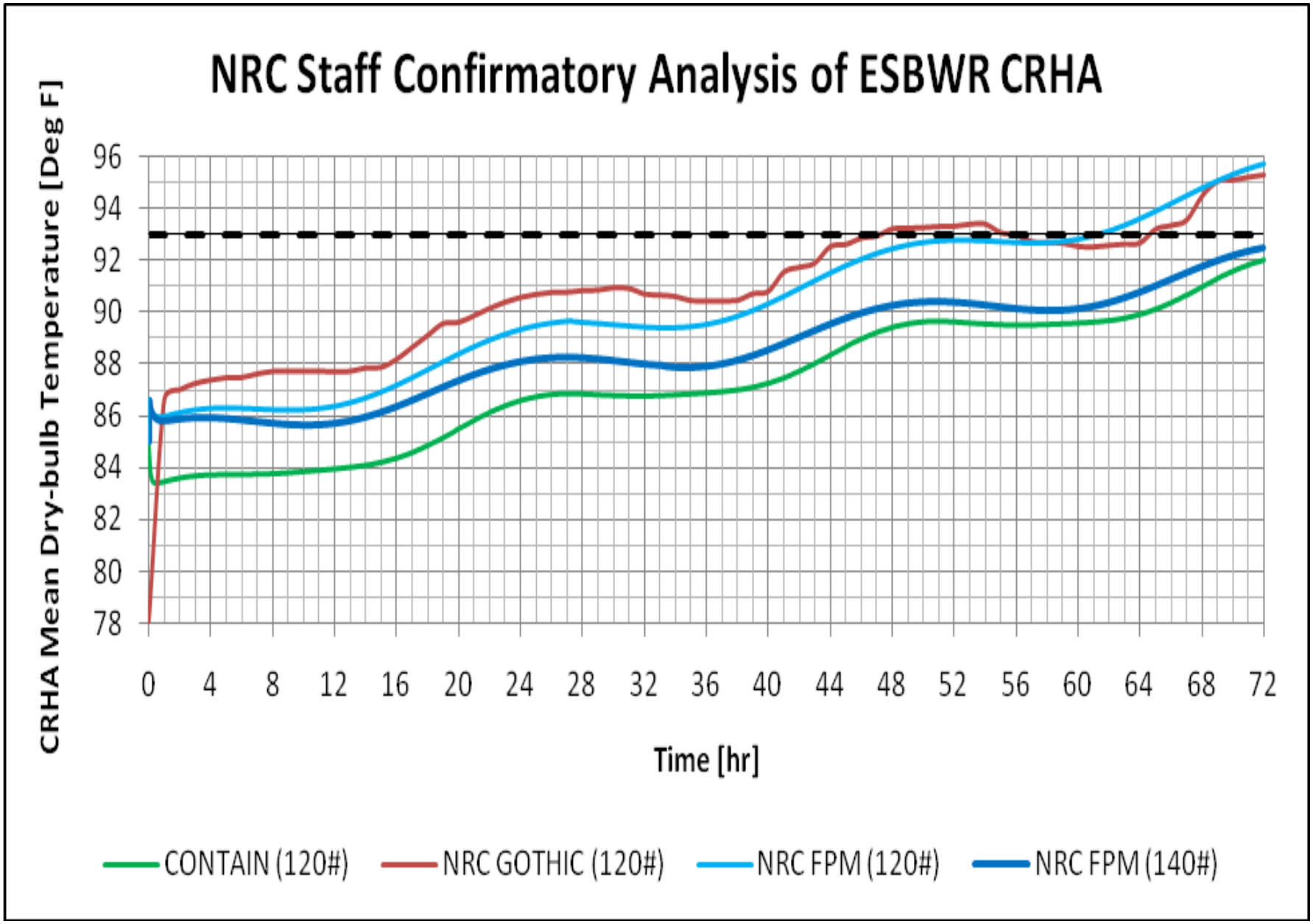
- **Provide and discuss heat up profiles for three models; CONTAIN 2.0, GOTHIC, and NRC First Principles Model (FPM)**
- **Discuss details of the Tech Spec Surveillance on Control Room Habitability Area (CRHA)heat sink temperatures**
- **Discuss details of verification of related site characteristics**
- **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: 103.5 °F

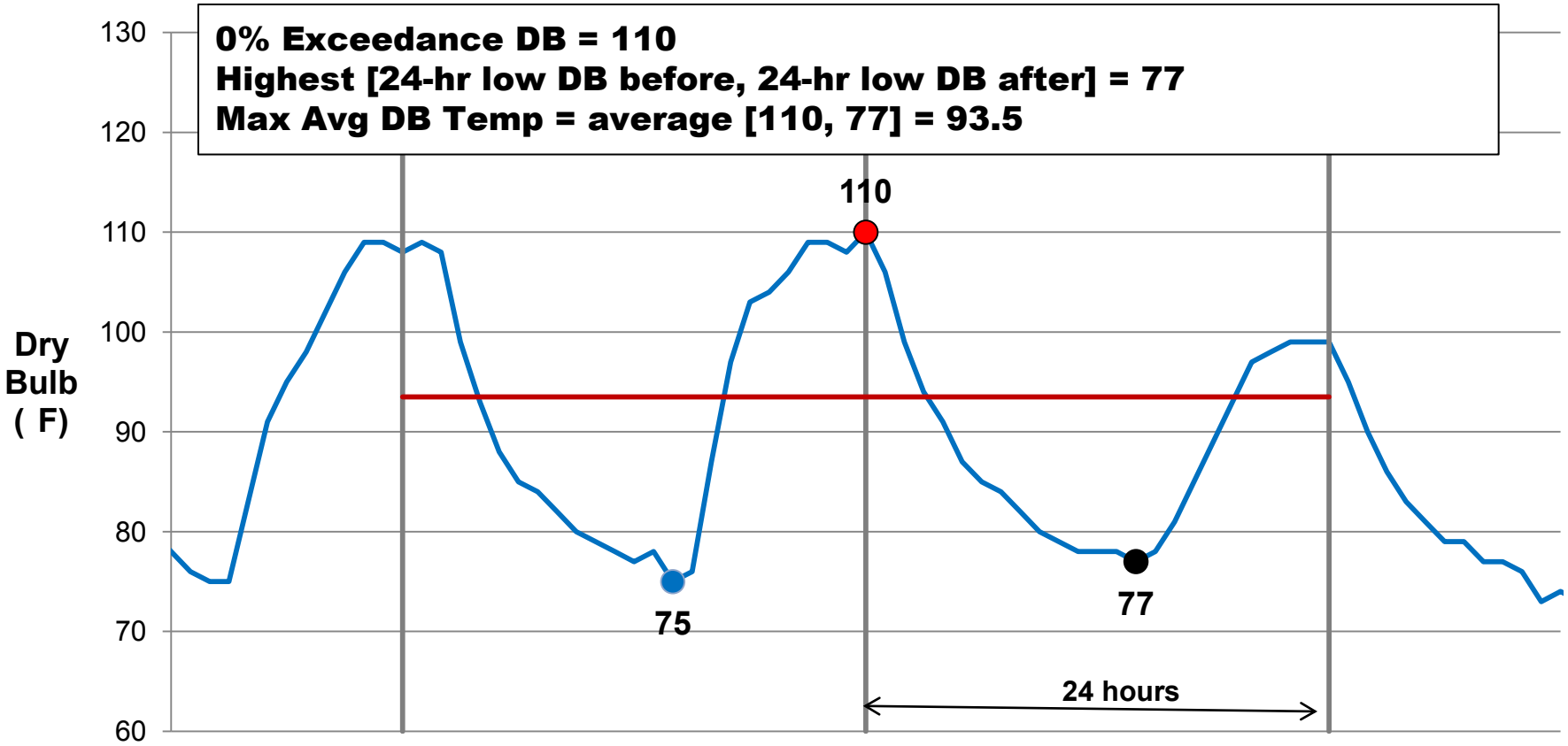
- **Defined as the average of:**
  - **0% exceedance maximum dry bulb site parameter value of 117 °F**
  - **Dry bulb temperature resulting from a daily temperature range of 27 °F**

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 two lows occurring within 24 hours 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: 93.5 °F**



Minimum Average Dry Bulb Temperature for 0% Exceedance Minimum Temperature Day

Site Parameter Value: -26.5 °F

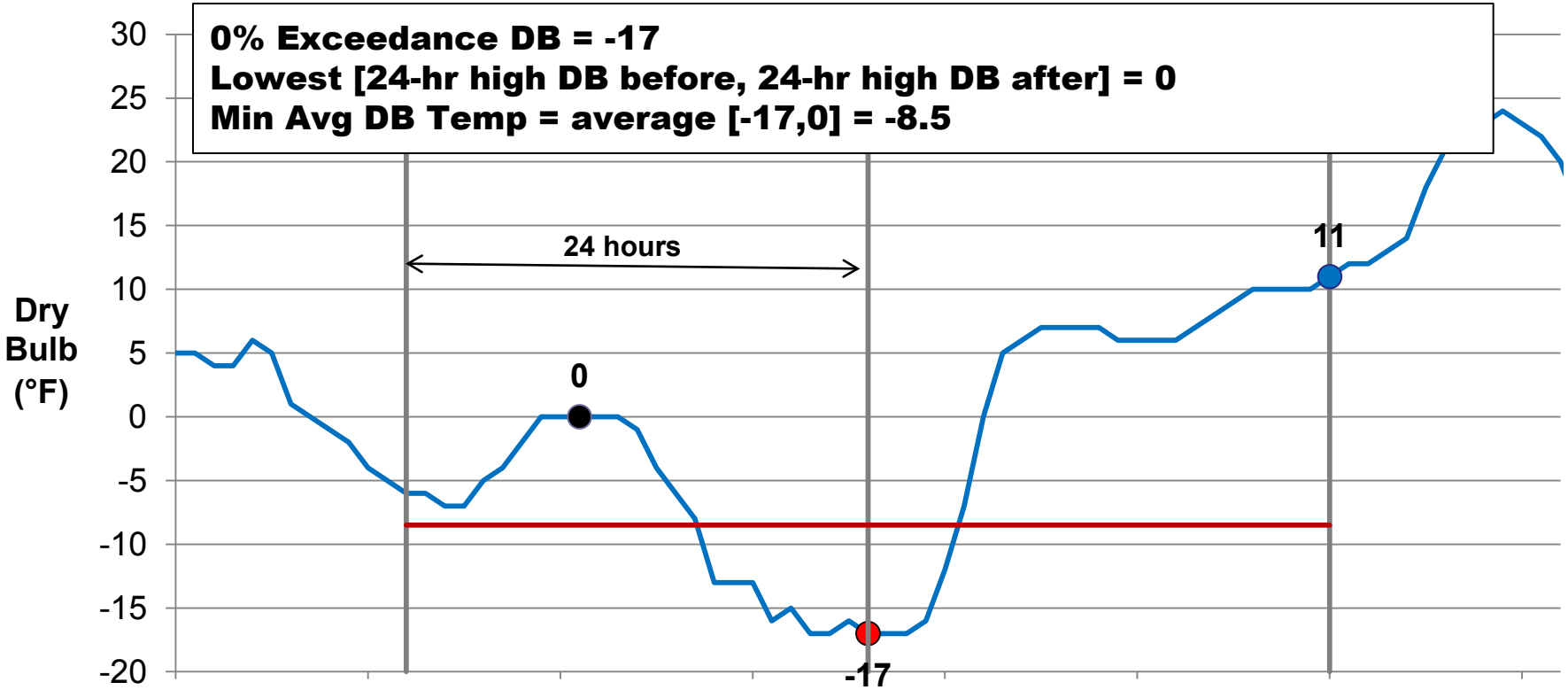
- **Defined as the average of:**
  - **0% exceedance minimum dry bulb site parameter value of -40 °F**
  - **Dry bulb temperature resulting from a daily temperature range of 27 °F**

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 two highs occurring within 24 hours 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>

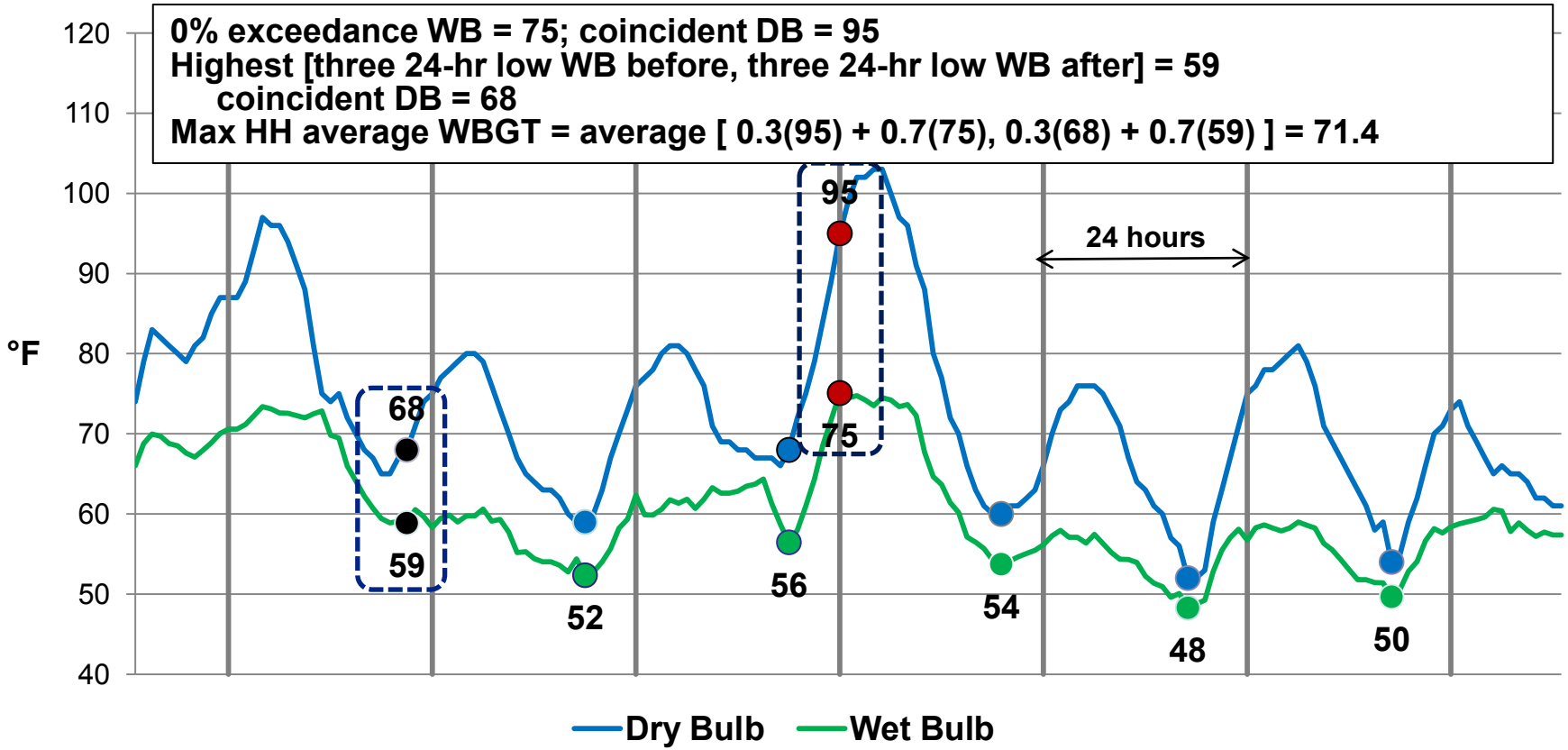
- **Defined as the average of:**
  - **WBGT index for the 0% exceedance wet bulb site parameter value of 88 °F (and a concurrent dry bulb value of 92 °F)**
  - **WBGT index resulting from a high humidity diurnal dry bulb temperature swing of 8 °F (dry bulb temperature of 84 °F and concurrent wet bulb 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**

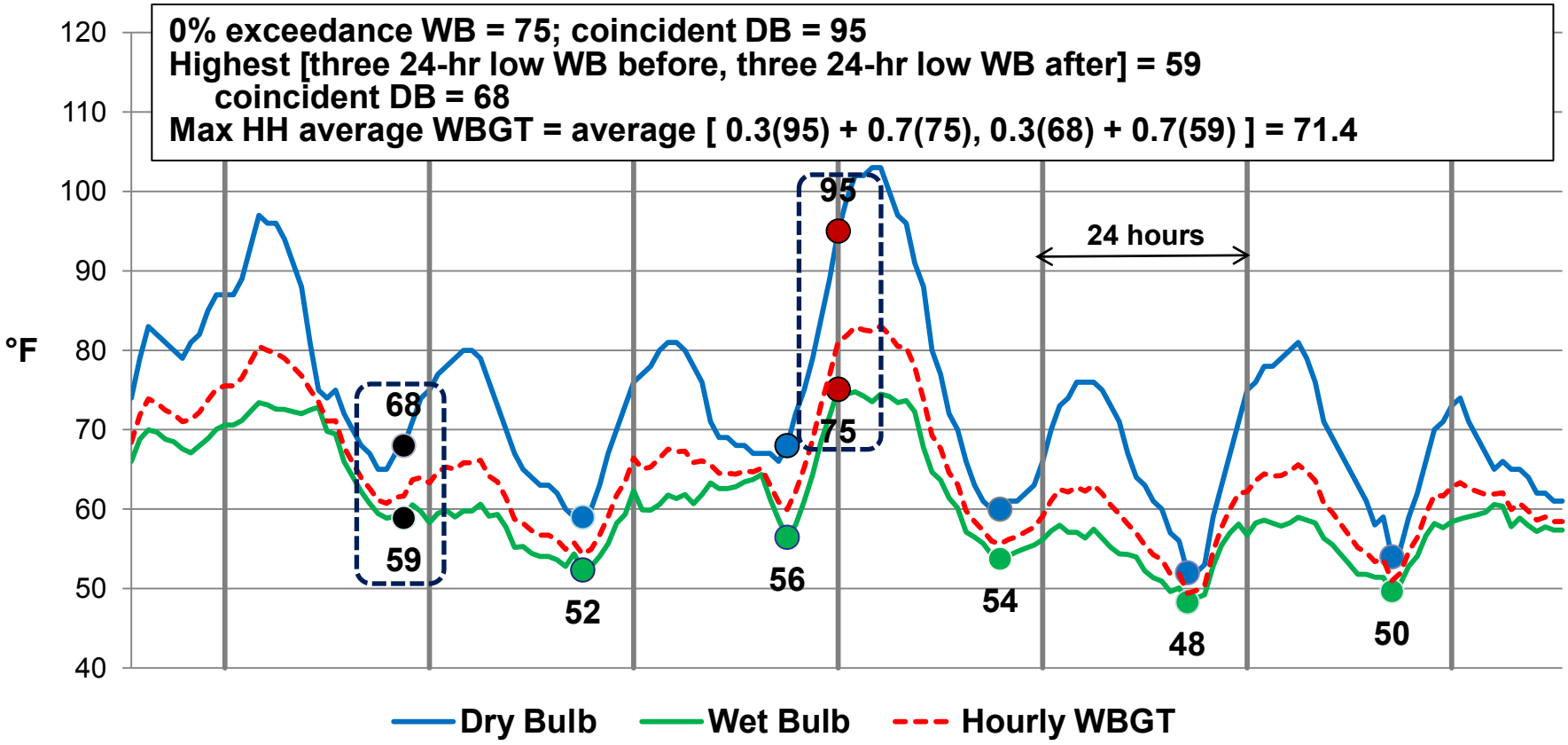
Verification of Related Site Characteristics
Example Calculation #3 (sheet 1 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 71.4 °F**



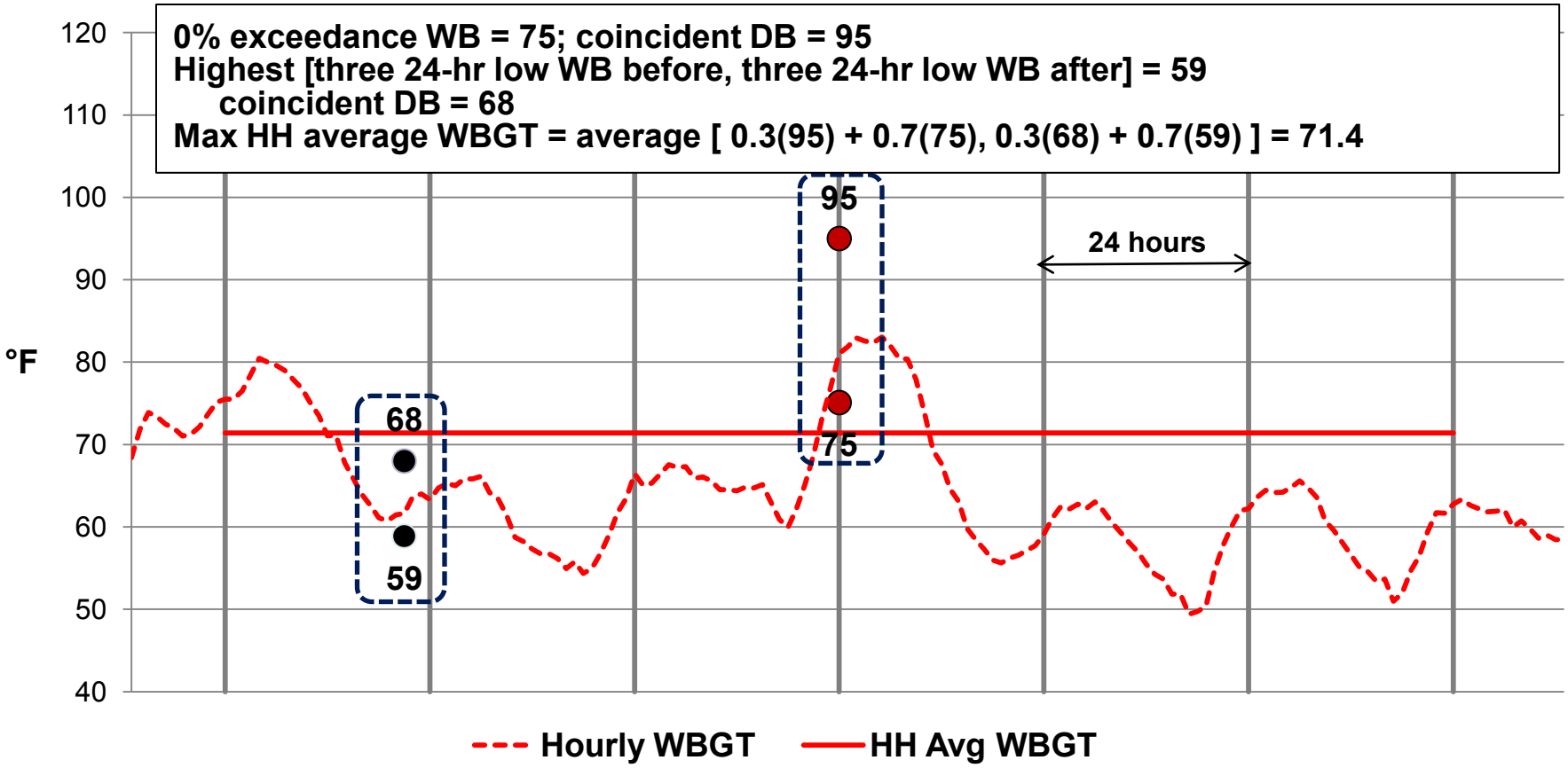
Verification of Related Site Characteristics
Example Calculation #3 (sheet 2 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 71.4 °F**



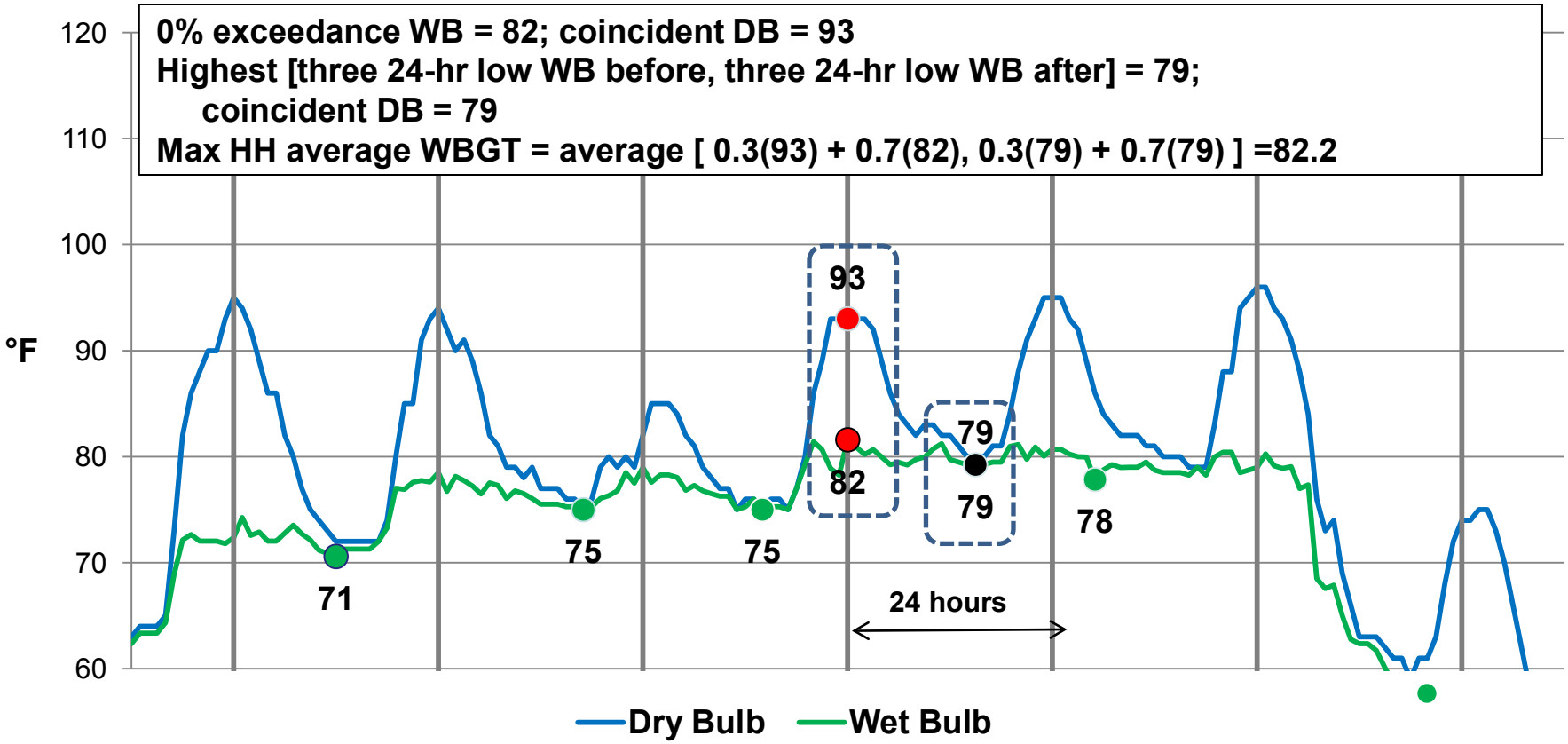
Verification of Related Site Characteristics
Example Calculation #3 (sheet 3 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 71.4 °F**



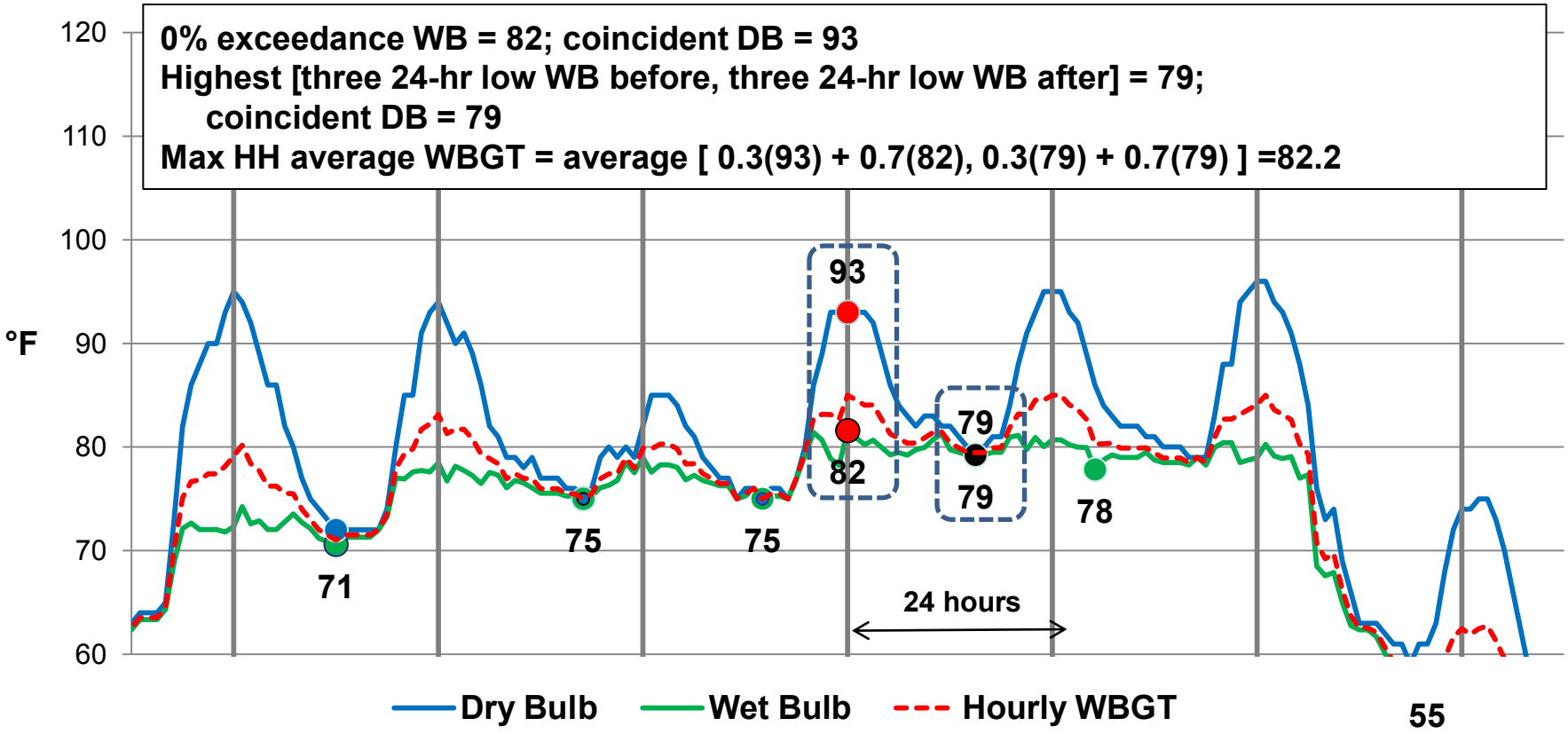
Verification of Related Site Characteristics
Example Calculation #4 (Sheet 1 of 3)

- **Maximum High Humidity Average WBGT Index for 0% Exceedance Maximum Wet Bulb Temperature Day: 82.2 °F**



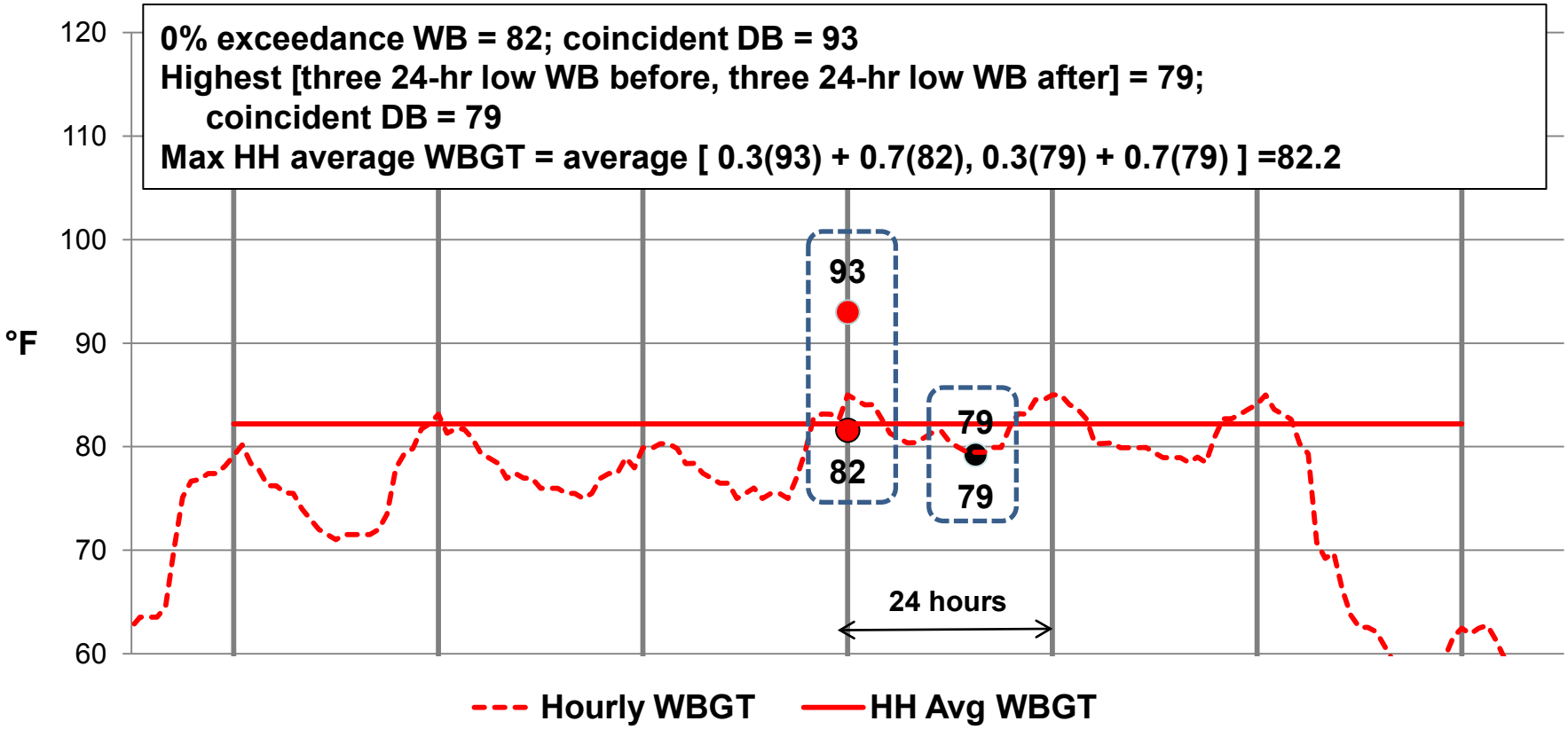
Verification of Related Site Characteristics
Example Calculation #4 (sheet 2 of 3)

- **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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Protecting People and the Environment

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

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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

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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)

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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

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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)**

Discussion/Committee Questions

United States Nuclear Regulatory Commission

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)

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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

- **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)

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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

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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

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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)

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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

Discussion/Committee Questions

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

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Instrument Air System

System Description

- 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.

Concern Raised during ACRS 2007 Subcommittee and 2008 Full Committee Meetings

- 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.)

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.

United States Nuclear Regulatory Commission

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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.

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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

Discussion/Committee Questions

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UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

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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Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review

Chapter 7, "Instrumentation and Controls"

September 24, 2010

Chapter 7 Review Team

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Chapter 7 Overview (cont.)

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- 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

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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

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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

Discussion/Committee Questions