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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

June 18, 2008

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARD

(ACRS)

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SUBCOMMITTEE ON ESBWR

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WEDNESDAY

JUNE 18, 2008

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ROCKVILLE, MARYLAND

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OPEN SESSION

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The Subcommittee met in open session at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. Michael Corradini, Chairman, presiding.

COMMITTEE MEMBERS:

MICHAEL CORRADINI, Chairman

JOHN D. SIEBER

CHARLES H. BROWN

DENNIS C. BLEY

COMMITTEE MEMBERS PRESENT (CONTINUED):

J. SAM ARMIJO

WILLIAM J. SHACK

OTTO L. MAYNARD

JOHN W. STETKAR

CONSULTANTS TO THE ACRS PRESENT:

GRAHAM B. WALLIS

THOMAS S. KRESS

NRC STAFF PRESENT:

AMY CUBBAGE

CHANDU PATEL

MOHAMMED SHAMS

MOHAMMED ABID

RICHARD McNALLY

DAVID SHUM

GEORGE GEORGIEV

RAO TAMMARA

AMAR PAL

PAUL SHEMANSKI

JAY RAJAN

ANDREY TURILIN

PAT SEKERAK

TOM SCARBROUGH

NRC STAFF PRESENT (CONTINUED):

JOHN FAIR

RENEE LI

ALSO PRESENT:

JEFF WAAL

CLEMENT RAJENDRA

JERRY DEAVER

KEVIN BAUCOM

PIJUSH DEY

DAVE KECK

STEVE HAMBRICK

AGENDA

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

8:30 A.M.

CHAIRMAN CORRADINI: The meeting will come to order. This is a meeting of the Advisory Committee on Reactor Safeguard Subcommittee on the ESBWR. My name is Mike Corradini, Chair of the subcommittee. Subcommittee Members in attendance are: Jack Sieber, Charles Brown, Dennis Bley, Sam Armijo, Bill Shack somewhere, Otto Maynard, John Stetkar, and our consultants, Graham Wallis and Tom Kress.

The purpose of this meeting is to discuss Chapter 3 of the Safety Evaluation Report with open items associated with ESBWR design certification application.

The Subcommittee will hear presentations by and hold discussions with representatives of the staff and the ESBWR applicant, General Electric Hitachi Nuclear Energy regarding these matters.

The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full committee.

Harold Vandermolen is the designated Federal Official for this meeting. The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on June 5th, 2008.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice. It's requested that speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We've not received any request from the members of the public to make oral statements or written comments. And just a couple of side notes, this is our sixth, or seventh, I've lost track, subcommittee on various of the chapters of the ESBWR.

We will, just to remind the members of the subcommittee, the full committee will take up a possible interim letter for Chapter 3 in the July full committee meeting.

So, we'll proceed now with the meeting. I'll call upon Jeff Waal with General Electric. Jeff, to begin. Is it Waal?

MR. WAAL: Waal, right.

CHAIRMAN CORRADINI: Okay.

MR. WAAL: My name is Jeff Waal. I'm

from regulatory affairs staff of GEH in Wilmington North Carolina. And we're here today to discuss Chapter 3 of the DCD Application for the ESBWR.

As you know, Chapter 3 is a large chapter. So, we've broken it down into four separate discussion areas. And sometimes it might be presented out of order, just for ease of understanding.

We're going to start off with Sections 3.1 to 3.5, and then 3.10, 3.11 and 3.13, followed by Sections 3.9, 3.12 and 3.6. And then tomorrow, we'll follow up with sections 3.7 and 3.8.

What we're going to do right now, and it's divided into those four sections, and we're going to start with the first section now, which is Sections 3.1 to 3.5, which will be presented by Clement Rajendra.

MR. RAJENDRA: My name is Clement Rajendra. I'm with ESBWR Engineering Group. I'm a civil structural engineer. We start with an overview of Section 3.1 to 3.5.

We start with an overview of Section 3.1 to 3.5. Section 3.5 describes the components of ESBWR with the NRC's General Design Criteria. Section 3.2 provides the seismic, safety and the quality group classifications of system structures and components. 3.3 describes wind and tornado loadings. 3.4 describes the flood protection design basis and 3.5 describes missile protection design basis.

In Section 3.5, provides evaluation -- sorry. Section 3.1 it provides an evaluation of the ESBWR design versus the NRC General Design.

MR. WALLIS: I have a question right off the field. When you say --

CHAIRMAN CORRADINI: I thought you were going to just sit there and relax.

MR. WALLIS: When you say the -- well, if I don't get an answer to this question, I may relax. You say evaluation of ESBWR design. What seems to be being evaluated by the staff is not a design at all. It's the design approach and the procedures followed in the design.

It's not design-specific. It seems to me it could apply to a generic reactor that looked something like the ESBWR.

MR. WAAL: Yes.

MR. WALLIS: Isn't that what we're talking about today?

MR. WAAL: Yes.

MR. RAJENDRA: You also provide design details of Seismic Category 1 structures.

MR. WALLIS: Requirements.

MR. RAJENDRA: Well, we actually provide details and --

MR. WALLIS: Well, for instance, it says your tornado velocity must be so many miles an hour and so on. There's no evaluation of the actual response of the structure to this velocity.

MR. WAAL: Great.

MR. RAJENDRA: That is correct in Section 3.5. But in Appendix Z --

MR. WALLIS: Well, maybe you've got something hidden that I didn't see.

CHAIRMAN CORRADINI: Let him finish, Graham.

MR. WALLIS: Yes. Yes.

MR. WAAL: I think --

CHAIRMAN CORRADINI: Go ahead.

MR. RAJENDRA: Appendix 3G, we actually provide the response of the structures to, of Seismic Category 1 structures. So, the results of a certain amounts of details are provided in Section 3G for Seismic Category 1 structures.

MR. WALLIS: Okay. Well, please go

ahead. Maybe we'll find that when we get there.

MR. DEAVER: Many of the appendixes provide lots of the details.

MS. CUBBAGE: Well, they are part of the DCD. This is Amy Cubbage. They're part of the DCD, they're just not part of the main chapter.

CHAIRMAN CORRADINI: Yes. All the seismic, specifics seismic responses are in sections Appendix 3F and 3G, as I remember.

MR. RAJENDRA: 3A --

MR. WALLIS: So you have to go through so many inches of paper, and then you find there's an appendix somewhere?

CHAIRMAN CORRADINI: Oh, sure. All the fun graphs are in the appendixes.

MR. WALLIS: Oh, okay.

MEMBER SIEBER: But they still revert to -- discuss fundamentals. There's a big ITAAC for all of this, right?

MS. CUBBAGE: Yes.

MEMBER SIEBER: So that's where you're going to get to the details. And we aren't going to get there if some inspector's going to get there with his trouble.

MR. RAJENDRA: In 3.1 --

MS. CUBBAGE: I think that comment needs to be addressed by GE.

CHAIRMAN CORRADINI: Say it again. I didn't hear Jack's comment then if I misunderstood what you're saying. Repeat it Jack.

MEMBER SIEBER: I think that there's going to be a big ITAAC associated with the details of the design. What we've said out here is a lot rules. We've got parameters, enough of them to say, yes, this will fit 90 percent of the sites. But the details will occur during constructions and that's where inspection will determine whether it's designed and constructed properly as opposed to having the details in the DCD.

MR. KINSEY: I guess -- this is Jim Kinsey from GEH. That's generally the structure of the application. We provide a significant level of detail in the DCD, in the associated appendixes and topical reports that have been or are being reviewed and evaluated by the staff.

And then as you mentioned, we have some criteria that are applied and they're described in Section 14.3 of the DCD that provide the criteria for establishing the ITAAC and those criteria are confirmatory at a later point in the process, post-certification.

MS. CUBBAGE: Right. I just wanted to make it -- it sounded like you were saying that everything was DAC, and that's not the case. They've done the seismic design and the seismic analysis, the structural analysis, the staff.

In addition to the DCD, the staff has audited detailed calculations at GE Hitachi's offices and we're prepared to discuss those tomorrow.

MR. KINSEY: Right. So, specifically in the subject of Chapter 3, as Amy mentioned, we've done a predominate amount of the design. The staff's evaluated that. And there really is other than some piping design-work, there is no DAC per se in this section of chapter.

CHAIRMAN CORRADINI: But just, maybe I misunderstood Jack's point. But let's just take, if we're at North Anna, then in some sense, this is a site which has been considered. If I go to a different site, then the subsequent COL would have to be submitted and show it fits within that envelope.

That's my interpretation of what I thought Jack was saying. Maybe I misunderstood you, Jack.

MEMBER SIEBER: No, that's correct.

MS. CUBBAGE: But I think it's the expectation that this site would be fit within the envelope that's been established for the certification.

CHAIRMAN CORRADINI: But it --

MS. CUBBAGE: It would need to be verified.

CHAIRMAN CORRADINI: Right. But just to take it one step further, it would be that applicant's job to show that it fits within.

MS. CUBBAGE: Well, that would be a departure from the certified design.

CHAIRMAN CORRADINI: Right.

MS. CUBBAGE: They would have to actually apply for an exemption with then come in with their combined license application if they don't fit within the seismic spectra that this plant's analyzed for.

CHAIRMAN CORRADINI: Okay. Thank you.

MR. RAJENDRA: All those parameters are spelled out in Chapter 2. So, all the binding parameters, the wind velocity, the tornado speeds, the seismic spectra, they're all spelled out in

Chapter 2. And the applicant, when they prepare their Chapter 2, they have to compare site-specific parameters with the plant, standard plant parameters and show that the standard plant bounds all of those characters.

And if they're not bounding, then they have to provide a site-specific evaluation.

MEMBER BLEY: I want to ask a question of how the process goes on --

CHAIRMAN CORRADINI: Sure.

MEMBER BLEY: -- when you get to COL stage. Because I still haven't completely gotten my thumb in this. Something Jack said was that these will be decided by an ITAAC by an inspector, rather than coming back for this kind of an issue for a review by staff and our opportunity to review and confirm that the site specific things are in fact making --

MS. CUBBAGE: The site-specific, the question you just asked sir, that's part of the combined license application review. That will be part of your scope of review, our scope of review, before we issue a license.

MEMBER BLEY: Thank you.

MS. CUBBAGE: And then once the design is approved, then the verification that it's been constructed in accordance with the licenses, the ITAAC, in most cases, except for the DAC areas which we've discussed at length on other discussions --

CHAIRMAN CORRADINI: Even though you've done it at length, can you just for the people with a bad memory, can you just sail over them?

MS. CUBBAGE: Those are areas where the ITAAC are provided in lieu of design detail. And those ITAAC verify that the design is completed in accordance with the proscribed acceptance criteria that are certified. So, we approve the process and the method.

MEMBER BLEY: And those therefore, do not come back for review by us or by staff?

MS. CUBBAGE: They do not. They do not.

CHAIRMAN CORRADINI: Right. Once approved --

MS. CUBBAGE: Well, I mean, when you say the staff --

MEMBER BLEY: Okay, yes.

MS. CUBBAGE: The staff includes Region 2, and the staff --

CHAIRMAN CORRADINI: The Headquarter Staff.

MS. CUBBAGE: -- the headquarter staff will be involved in the verification of ITAAC that are associated with DAC, and that will not be a sampling. That will be 100 percent.

MEMBER BLEY: I guess that's the piece I don't have a complete handle on. What kind of things end up in DAC. And it sounded like much of the INC results will be DAC and won't actually come back for that kind of detailed review that might find places where things aren't properly like in line the way you might expect.

MS. CUBBAGE: Right. And I don't want to completely highjack this, but I will just offer a little bit on that. Is that we're not fully established on the process yet for ITAAC verification for DAC. But it's very likely that the vendors will submit topic reports for review and the staff will review and approve those.

And then the combined licensed applicants would reference those as part of their DAC closure.

CHAIRMAN CORRADINI: All right. Does that help?

MEMBER BLEY: It helps, just a little concerned.

CHAIRMAN CORRADINI: Go ahead.

MEMBER BROWN: If it only meets the majority or a large number of the criteria, the site-specific that's what the report said, you know, 80-90, meets most of the -- the design meets most of the sites, if it doesn't, does that invalidate the design? It's a question.

MS. CUBBAGE: It means that the --

MEMBER BROWN: Who goes back and does, and makes sure that what you've got is now going to be satisfactory for that site where the criteria didn't match relative to the spectra and whatever else to it.

MS. CUBBAGE: That's part of the combined license review. So, if we were to receive a combined license application today, as part of their application, they would need to provide the verification that they fall within the envelope of the certified design.

And if they don't they would need to provide site-specific information for our review and approval before we could issue a license. And they would actually be -- it would be a departure to the certified design.

MEMBER BROWN: Okay. Somebody has to

re-review the design?

MS. CUBBAGE: Absolutely.

MEMBER BROWN: In those areas?

MS. CUBBAGE: Yes.

MEMBER BROWN: Is it across the board? I mean, is this -- are you able to break it down into some areas you'd be okay, and not? I presume you --

MS. CUBBAGE: We would only have to review those areas that they were departing. So, only the criteria that they didn't meet.

CHAIRMAN CORRADINI: Just to send it, for an example, if they met wind loads, flooding but seismic was different, you'd review seismic?

MS. CUBBAGE: Review seismic.

MEMBER BROWN: One hundred percent?

MS. CUBBAGE: Well, I mean, yes. I mean, we're actually doing that on some areas right now in other design centers. That's not the case with this design center.

MR. RAJENDRA: In Section 3.1, provides a road map to the different DCD sections where the general design criteria are met. So, in Group I, we have the overall requirements for criteria 1 and 5, in Group II, the protection by multiple fission product barriers, criteria 10 and 19, Group III, protection and reactivity control systems, Group IV, fluid systems, Group V, reactor containment and Group VI, fuel and radioactivity control.

MR. WALLIS: Let me go back to my other question. Are you going to give us any indication about how your design meets Group II in terms of any detail?

MR. RAJENDRA: It refers to other sections of the DCD.

MR. WALLIS: That's right.

MR. RAJENDRA: It provides only a --

MR. WALLIS: On your presentation, if I look through your slides, it's all at a very high generic level.

MR. RAJENDRA: Right.

MR. WALLIS: It doesn't give any detail at all of the ESBWR itself. So, apparently, you're not going to get into any detail today?

MR. RAJENDRA: Not in this presentation.

CHAIRMAN CORRADINI: Not for that topic.

MR. RAJENDRA: Not for that topic.

MR. WALLIS: Well, I will have no --

MR. RAJENDRA: Not for that topic.

MR. WALLIS: -- idea when I leave about

how the ESBWR meets these criteria? I'm just assured that you have designed it so that it should meet these criteria?

MS. CUBBAGE: Graham, I think 3.1 is more of an introduction roll-up type of a section. I think you'll be hearing more detail later.

CHAIRMAN CORRADINI: To put it different, Graham, if we had 3.1 in September of 2007, you'd be a happy camper. But it just happens to appear in a chapter that didn't start in September 2007. This is essentially, if I remember correctly, 3.1 is where you actually point to the rest of the DCD --

MR. RAJENDRA: Rest of it.

MS. CUBBAGE: DCD.

CHAIRMAN CORRADINI: -- as to where all these individual things will be addressed.

MR. RAJENDRA: Right.

MR. WALLIS: So, it's sort of backwards.

CHAIRMAN CORRADINI: Well, we could say it that way.

(Laughter)

MEMBER MAYNARD: Our review of it is backwards.

MR. RAJENDRA: Section 3.2 provides

classification of Structure Systems and Components. The Section 3.1 is the seismic classification. And this is based on RG 1.29 and SRP 3.2.1.

Seismic Category I is required for all safety-related systems, structures and components. We are using a Seismic Category II for those non-safety-related systems, structures and components whose failure could degrade the performance of safety-related systems, structures and components.

We also have some safety -- non-safety-related SSCs that are assigned to Seismic Category I, when required by certain reg guides.

MEMBER ARMIJO: Could you give me a couple of examples of those non-safety systems?

MR. RAJENDRA: The fire water service complex, the fire water storage tanks, they are not supporting a safety-related function. But RG 1.13, because it provides make up water for the spent fuel pool, they have to specify it requires a seismic Category I classification.

MR. DEAVER: Sometimes we do upgrades also. Line cranes, we do the floor net, only need to be Category II, but we're making them a Category I in order to provide our customers you know, maneuverability and flexibility in operation.

MR. RAJENDRA: Some, the remaining SSCs are assigned Seismic Category NS.

MEMBER SHACK: One of the things that I was curious about are the components that you didn't classify as Seismic I or II, but you had designed to meet SSCs. Now, if you're designing to meet SSCs, why aren't they Seismic I or II?

MR. RAJENDRA: Because we are not using the same -- like for instance, Seismic Category II, we don't use the same QA requirements. The components are not required to meet Appendix B 50 Program for QA.

In the case of -- but the Seismic Category II, follows the acceptance criteria of Seismic Category I. But in the case of NS, if you're using full SSC, we could use international building code for the -- the design rules will be different. We don't have to use nuclear codes for the design.

MEMBER SHACK: Okay.

MR. RAJENDRA: But the seismic input will be SSC.

CHAIRMAN CORRADINI: So, it's a -- I guess I'm -- I heard your answer. I don't fully appreciate it. Can you try it again? Are you saying that it's the QA trail, but from a structural standpoint, they will be just as robust as a Category I? Is that what I heard you just saying?

MR. RAJENDRA: Yes. For Seismic Category II, yes. The Seismic Category II, the design as far as the design calculations, acceptance criteria, the design codes, will be just as robust. But as far as material traceability and whether or not we have paper trail on the materials, whether or not we have the appropriate inspections, those will not be -- will not follow the Appendix B 50 Program, 10 CR 50 Appendix B Program.

CHAIRMAN CORRADINI: So, just to make sure I'm clear, so even though they are seismic -- let's just go with your explanation. I don't think I could repeat that.

MR. RAJENDRA: Yes.

CHAIRMAN CORRADINI: So, in an analysis of an event, they will be credited, or they cannot be credited? They cannot be credited for their performance?

MR. RAJENDRA: They are credited for their performance, but they themselves do not perform a safety-related function. The system does not contain safety-related components, and is not supporting a safety-related function.

But, if it fails, it will not degrade the performance -- the safety-related performance of a safety-related structure.

CHAIRMAN CORRADINI: It won't fall upon a credited audit.

MR. RAJENDRA: Fall upon -- that's exactly right.

CHAIRMAN CORRADINI: Fine. Okay. That's what I thought.

MR. RAJENDRA: Right. And that is seismic related. But we also have non-seismic structures that are designed to the same SSC, but use different codes and standards, like international building code.

But the seismic input would be the same.

CHAIRMAN CORRADINI: Identical.

MR. RAJENDRA: Yes. Because in Chapter II, we define seismology and the seismology is only a single seismology defined for the standard design.

MR. WALLIS: Now I have another question, I'm sorry. These categories are very nice. But then you have to design specific reactors. Do you know how to design large masses of water which are being shaken in some seismic fashion in a structure? Do you know how to design a structure to hold large masses of water which is being sloshed around in a seismic event?

MR. RAJENDRA: They are considered in the design for -- the sloshing is considered as one of the loading conditions.

MR. WALLIS: Is this something that's covered by these categories in some way? Or, you know how to do it?

MR. RAJENDRA: They're part of the load definitions, the hydro-dynamic loading is part of the load definitions.

MR. WALLIS: So well understood it's a state-of-art technology?

MR. RAJENDRA: Yes.

MR. WALLIS: Okay.

CHAIRMAN CORRADINI: Be careful what you just said. He's leading you -- that's a lawyer question.

(Laughter)

MR. KINSEY: This is Jim Kinsey, from GE Hitachi.

CHAIRMAN CORRADINI: Careful.

(Laughter)

MR. KINSEY: It's an understood

technology. I don't know that we would consider, state-of-the-art at the moment, but I'll let Clement handle it.

CHAIRMAN CORRADINI: They will follow the codes.

MR. KINSEY: We will follow the established standard.

MR. WALLIS: And the codes adequately cover this large masses of water.

CHAIRMAN CORRADINI: By definition.

MR. WALLIS: That's a yes answer?

MR. RAJENDRA: To the best of our knowledge, yes. The hydrodynamic, or the way we understand it, yes.

MR. WALLIS: Thank you. Thank you.

MR. RAJENDRA: Section 3.2.2, we deal with System Quality Group definitions. They follow RG 1.26 and SRP 3.2.2. We have Quality Group A, that's pressure-retaining portions and supports for reactor coolant pressure boundary.

Quality Group B, pressure-retaining portions and supports not in Quality Group A for safety-related containment isolation, ECCS and RHR functions.

Group Category, pressure-retaining

portions and supports for other safety-related functions not included in Quality Groups A and B.

And finally, we have Quality Group D, which is pressure-retaining portions and supports for other systems that contain radioactive material.

MR. WALLIS: It doesn't mean anything to a layman, does it? A, B, C, D, it could as well be X, Y, Z and Q. It doesn't mean anything. These are standard terminologies, and so forth?

MR. RAJENDRA: These are terminologies developed in -- the Quality Group A and C are addressed in RG 1.26.

MR. WALLIS: This is traditional Nuclear Regulatory --

MR. RAJENDRA: Yes, 1.26. Yes.

MR. WALLIS: -- style. Okay.

MR. RAJENDRA: RG 1.26. Section 3.2.3 Safety Classification. These classifications are consistent with those use in ABWR DCD. They are closely tied to Quality Group classifications for safety-related SSCs.

We define Safety Class I as the reactor coolant and pressure balance components and supports. We define Safety Class II as mechanical SSCs involving containment isolation functions not included in Safety Class I, ECCS and RHR functions.

Then we define Safety Class III as all other mechanical safety-related SSCs not included in Safety Class I and II, and all safety-related electrical and I&C SSCs are Safety Class III. And finally, the Safety Class N, which is non-safety related SSCs.

These are excerpts of Table 3.2.1, we have shown here the -- an example for System B11.

MR. WALLIS: I'm sorry. If you're trying to explain this to a member of the public, what's the difference? Does Safety Class I mean that the chance in failure is one in a million, or something like that? And Safety Class II means one in a hundred thousand? What's the difference in terms of relationship to safety?

MR. RAJENDRA: If I could skip forward to -- yes, that's right. Go back. This gives an explanation of Safety Class I. If you have Safety Class I, that's the Quality Group is A and --

MR. WALLIS: But these are just numbers. What's the --

MR. RAJENDRA: No, no, I mean it gives you --

CHAIRMAN CORRADINI: I think he's going

to explain.

MR. RAJENDRA: It gives you what Quality Assurance we are using, and what is the corresponding ASME code class, and when you use ASME code class gives you for ASME.

MR. WALLIS: But if I go back to my students and I try to explain to them, they've designed this thing so that the reactor system boundary is in tact and will only fail with a probability of one in a billion, or something, what do I tell them?

I can't tell them this, because it means nothing to me.

MR. WAAL: I think what you tell them is that, you know, Safety Class I has a higher level of quality assurance.

MR. WALLIS: But is it good enough? How do I know -- how do they reassure the layman that it's good enough. How do you do that? This is gobbledygook to a layman.

MEMBER SIEBER: Safety classes refer to components within a group of components. If you look at slide seven, it tells you what the safety classes are.

MR. WALLIS: Is there anyway to put it

in perspective for the public, or is it all just to some sort of arcane regularly world that we're in.

MR. RAJENDRA: The ASME rules, for instance, the difference between safety --

CHAIRMAN CORRADINI: It's arcane ASME rules, it's not arcane regulatory rules.

MEMBER MAYNARD: I think we're asking them a question though, that maybe should be -- that's more of an NRC philosophy. The applicant's here to show whether they comply with the regulatory requirements. It not necessarily their job to defend the regulations as being adequate.

MR. WALLIS: So you think I should ask the question of the NRC rather than the applicant?

MEMBER MAYNARD: Well, I actually think it's more of one that's for outside of design certification. It's more of the regulatory philosophy than it is for a design application. They're showing whether they comply or don't comply with the --

MR. WALLIS: So there's no way to interpret it to a public meeting? There's no way you can explain this to a public meeting?

MEMBER SIEBER: These code requirements actually apply to existing plants too.

CHAIRMAN CORRADINI: It would be to their benefit they were able to.

MR. WALLIS: It would. It would help, I think.

CHAIRMAN CORRADINI: But I think they don't have to.

MR. WALLIS: Okay.

CHAIRMAN CORRADINI: It's not their job to.

MR. WALLIS: Good enough. I know. It would be nice if they could.

MEMBER STETKAR: Let me see if I can -- I might be able to help. This might be too detailed, but let me try it.

CHAIRMAN CORRADINI: I was afraid of this.

(Laughter)

MEMBER STETKAR: No, I just -- I didn't think about this before, but given the discussion just recently. If I look on table 3.2.1, which is your classification table, not on your slides, but back in the details, and I look at the plant service air system, and I look at the plant instrument air system, I notice that the plant service air system is Safety Class II, the instrument air system is N, the service air system is Quality Group B, the instrument air system is D, dog, the QA on service air is B, boy, and the instrument air is E, Edward the service air piping is Seismic Category I, and the instrument air is NS.

That sounds somewhat contrary to me, because as I understand the systems, the instrument air system is much, much more important than the service air system. So, I'd like to understand how this classification process, the decision process to come to these classifications, works, in regard to this specific example.

MR. DEAVER: Well, I think that requires a full understanding of what the systems are, what their functions are and so forth. Those are really covered in the other chapters.

MEMBER STETKAR: And I thought I did understand what the system functions were. The instrument air, in fact, is a backup to the high pressure nitrogen system, which is a safety-related system. It has containment penetrations.

CHAIRMAN CORRADINI: You're on page 3.2.27.

MEMBER STETKAR: I'm on page --

CHAIRMAN CORRADINI: 3.2.27.

MEMBER STETKAR: Indeed, 3.2.27 of the DCD rev four. So, I was curious, to try to help Graham understand how these classification criteria are applied in practice, those two classifications indeed seemed a bit reversed to me, understanding how the functions that those two systems provide.

MEMBER SIEBER: Well, the failure of the instrument air system, everything in there is failsafe, right? If you have a valve that ought to close to achieve its safety function, the lost of instrument air, the value will close because it's --

MEMBER STETKAR: But that's also true for the service air, which doesn't supply anything.

MR. DEAVER: Well, in many cases, like on valves we have accumulators, and maintaining that pressure in the accumulator is the safety part of it, is supplying the air isn't necessarily important. You know, it's necessary to keep it pressurized, but the plant in its day-to-day operations, the accumulators are --

MEMBER STETKAR: But whatever you say for the instrument air system, I could say equally bad things about the service air system and say it's much less important, and yet it seemed to be designed, it's designed --

MEMBER SIEBER: To a higher standard.

MEMBER STETKAR: -- and quality requirements seem to be higher than, consistently higher than the instrument air system.

MR. KINSEY: This is Jim Kinsey at GE Hitachi. This may not be all of the answer, but just on a first glance on the table, it appears that the portions of the service air system also form a portion of the containment boundary. So, I believe that a portion of this classification is related to that boundary function, rather than the --

MEMBER STETKAR: That's also true for the instrument air system RG then, I think. I think. I'm not quite sure about that.

MR. KINSEY: It's not called out that way in the table, but I understand.

MEMBER STETKAR: I'm not sure about the instrument air system, because I didn't look at the piping plan. I know the service air does go through the containment.

MR. KINSEY: It's only those components that are part of the boundary that are Class II. Everything else is --

MEMBER STETKAR: It's Class M.

MR. KRESS: Well, having been around for

a while with this committee, maybe I could add something to this here. There was a process of using importance measures to reclassify SSCs. And this is a partial answer I think to Graham's question. Because these importance measures have something to do with the failure probabilities.

Now, there's a little bit of a problem there, but if you're looking for why something may be classified as it is, you can go to these importance measures and back-relate it to the probability that it's going to fail. So, it does -- it is disconnected, because it's the old problem of here's the PRA, and here's design basis. They're disconnected to some extent, but when you go through the importance measures, you find out why some of these things may have to be, have a better treatment, more quality assurance.

There never was to my mind a connection between how much quality assurance goes into the failure probability. That connection never has been made. But that's the rationale behind the classification system use in the PRA. And it makes some sense.

MR. WALLIS: that was very helpful, Tom. You said you could use -- what I'm trying to determine is what GE used.

MR. KRESS: Yes. They'll follow the design basis.

MR. WALLIS: Is there a traceable rationale somewhere which can be followed to see why we have these Es, Ds, Cs and Bs and I's, II's, and III's for these various systems? Is there a traceable rationale somewhere?

MS. CUBBAGE: I think we should wait until the staff presents and we can attempt to address the regulatory requirements.

MR. WALLIS: If I wanted to know why is this and E, and not a C, can I find that in your documentation somewhere?

CHAIRMAN CORRADINI: That's your last question to try to answer and then we'll move on.

MR. WALLIS: We'll move on.

MEMBER SHACK: There are reg guides that tell you how to do this classification.

MEMBER SIEBER: Yes, there are.

MR. WALLIS: What did they do?

MEMBER SIEBER: They followed the reg guides.

MR. RAJENDRA: Yes. We followed the reg guides. Now, in the case of 3.2.3, the safety classifications we used, they are consistent with the ABWR DCD.

CHAIRMAN CORRADINI: So that leaves me -- so I get one question here. I guess I'm -- so is there anything in here that is different than is already in existence on how you would classify things? I guess that's what I was going to do. I can't -- everybody else is much more energetic than I am on this.

I'm taking a look at an ABWR that's in Japan, if it was put here, or a current BWRs, and if I overlaid them to here, what systems or components or structures appear up at top different, or unique. In my list it was, essentially the isolation condenser, the PCCS that would be in this classification scheme.

But other than that, these all look the same. Am I off base, or is there something -- can you give us a perspective about what is different about this, and if I were to classify current reactors under this scheme. You see my question?

MR. RAJENDRA: Right.

CHAIRMAN CORRADINI: Is there something different here about it?

MR. DEAVER: I think you would find a

very consistent pattern for components and systems that have been traditional BWRs.

CHAIRMAN CORRADINI: Okay.

MR. DEAVER: Obviously, for new systems, we have to --

CHAIRMAN CORRADINI: Right.

MR. DEAVER: -- you know, classify them based on the standards and our understanding of them.

CHAIRMAN CORRADINI: But in those cases, and I probably missed a few, but I was looking at the new design, the different design of the vacuum breakers, the isolation condenser, the PCCS, the GDCS, those are all in a classification scheme that I would expect are important relative to seismic category and importance.

But save those and some others, is there anything here that's different in terms of how you'd classify current plant components? No?

MEMBER ARMIJO: Maybe if they interfere with a passive safety system in some unique way.

MEMBER SHACK: RTNSS is something that doesn't arise in conventional PW --

CHAIRMAN CORRADINI: B.

MEMBER SHACK: -- operating reactors --

BWRs, not PWRs, but operating reactors. I mean, that's an advanced light water reactor concepts. But most of the RAIs that I could find in this chapter were basically on your treatment of component -- everybody agrees on the safety class I and II sort of things. It was how you treated RTNSS components that seemed to bring up discussions with the staff.

And that that's a different classification than the conventional design basis acts in classification. That really is something that gets closer to the PRA and to some other requirements. And that's you know, where the controversies seem to be by and large.

MR. RAJENDRA: That is correct.

MEMBER SIEBER: If you just go by the code and regulations, RTNSS systems are non-safety. And if you desire to have more reliability, or substance to them, then you pop some regulatory --

MR. SHACK: Well, no, we have SECY guidance that tells us how to do things in RTNSS.

MR. DEAVER: But I would say that many of these systems that are quote, basically non-safety, if there's a segment of pipe --

MEMBER SIEBER: -- that goes through a

penetration --

MR. DEAVER: -- goes though a penetration, or if's a path that is needed --

MEMBER SIEBER: -- penetration in a safety to the isolation valves --

MR. DEAVER: -- those are then designed to a, you know, a higher classification in order to be consistent with the standards.

MS. CUBBAGE: And that's exactly the situation. Our reviewer for instrument air and service air was confirming that the service air -- it's the containment penetrations that elevate that portion of that system. Otherwise, they're consistently applied.

MEMBER STETKAR: And in fairness, I just did a little homework here, and I believe the -- if the drawings, the simplified drawings are reasonable cartoons, the things that I thought were probably instrument air containment penetrations, are probably included under the high pressure nitrogen system. Because the connections are outside the containment. So, it in fact may be consistent.

CHAIRMAN CORRADINI: Dennis.

MEMBER BLEY: Mr. Chairman, I hate to drag this out any further, but Tom put something on the table and it begs a question I'd like GEH to answer. Was the PRA and its importance measures in any way used to define these categories, what components within these categories?

MR. DEAVER: We don't have anybody representing PRA here. I know --

MR. RAJENDRA: We don't have anybody representing PRA.

MEMBER BLEY: Well, you have people who did the assignment. Did they use the PRA, or the importance measures? It was suggested that they might. I just want you to tell us.

MR. DEAVER: I would say that the process was that we initially established the categories based on our understanding on the functions of the systems and the equipment. PRA has been an evolving thing.

If there have been times when PRA has come back and said, well, these components have more significant, and we have actually have made changes, to be consistent. But PRA in the sequence of events wasn't necessarily the first item completed.

MEMBER BLEY: So it may have made things change as far as the class they were assigned to?

MR. DEAVER: Well, you know, they helped

established the RTNSS equipment and those sort of thing.

MEMBER BLEY: Okay, for RTNSS.

MR. DEAVER: For RTNSS, yes.

MS. CUBBAGE: For RTNSS, yes.

MEMBER BLEY: Okay.

MS. CUBBAGE: And RTNSS is more than just reliability and availability. It does impact the classification from a design perspective for some of the important RTNSS systems, they're Seismic Category II, correct?

MR. RAJENDRA: Yes.

MS. CUBBAGE: Rather than NS.

CHAIRMAN CORRADINI: So, just to make sure I understood the conversation. The RTNSS --

MS. CUBBAGE: They're different.

CHAIRMAN CORRADINI: The RTNSS categorization analysis may have elevated certain systems?

MR. RAJENDRA: That is correct. In fact a good point --

CHAIRMAN CORRADINI: Can you give me an example of that just so I can write it down and not forget something.

MR. RAJENDRA: The auxiliary diesel

building that you have not seen, it's in DCD revision five, that is not -- it is categorized as Seismic Category II to improve reliability. But it is not adjacent to any safety-related structure that its failure would compromise a safety-related function of a structure.

But it's simply called Seismic Category II to improve reliability. That's an example.

CHAIRMAN CORRADINI: Go ahead.

MS. CUBBAGE: I believe it's all the RTNSS B components.

CHAIRMAN CORRADINI: Thank you, Amy.

MR. RAJENDRA: This is --

MEMBER SHACK: I have my cheat sheet here so I know what you mean.

MS. CUBBAGE: Yes.

MR. RAJENDRA: This is Table 3.2-2, defines minimum Quality Group, Seismic, Electrical and QA requirements classifications for each safety class. As you can see here, this matrix provides according to the safety classification, the different quality group ASME code class, seismic category, the electrical classification and quality assurance.

And in Table 3.2-3, provides quality

group designations and corresponding codes and industry standards.

We also provide, in some cases, core classification boundaries of -- in two figures. Here's an example of the classification boundaries for power conversion systems. This slide is kind of busy. You can see here that the turbine building, this is the main steam system going from the reactor to the main steam condenser. It shows the break in quality seismic Category I break, happens at the pipe anchors indicated -- at the boundaries indicated.

On the left-hand side, is Seismic Category I. On the right-hand side, is Seismic Category II.

CHAIRMAN CORRADINI: So, just again, this is for my edification. Because I read this a couple of times, and I probably just still don't get it. So, Seismic Category II, comes down to the fact that it is not going to compromise a Seismic Category I function, but it itself is not going to necessarily going to be called upon to function during a seismic event. Do I have -- I have I said it approximately right?

MR. RAJENDRA: It doesn't support the

function of a safety-related system.

CHAIRMAN CORRADINI: Nor does it hamper it?

MR. RAJENDRA: Yes. Right.

CHAIRMAN CORRADINI: And that's essentially the cross-over point.

MR. RAJENDRA: Yes. Right, right. Right.

CHAIRMAN CORRADINI: Okay. And then you said something in the discussion of the busy picture that I want to understand. The designation between Category I and Category II in the cartoon --

MR. RAJENDRA: Yes.

CHAIRMAN CORRADINI: -- is what again? You said it relative to? I can't remember exactly how you phrased it. Is there a piping division? Because it appears to be in a building, which must mean there's some sort of anchoring difference.

MR. RAJENDRA: Yes. That's the anchor. That's the pipe anchor, is on the left-hand side is Seismic Category I, and the right-hand side is Seismic Category II.

CHAIRMAN CORRADINI: So, it's literally the design of the anchor changes as you cross that boundary?

MR. RAJENDRA: That's right.

CHAIRMAN CORRADINI: And assuming the isolation values, or the multiple isolation values shut down or close, everything can rip off and fall into the ocean for it matters, life is okay?

MR. RAJENDRA: That's right. Seismic Category I is protected.

CHAIRMAN CORRADINI: Okay.

MR. DEAVER: Typically, category changes happen at valves or restraints, which you know, you see physical features here, typically.

CHAIRMAN CORRADINI: Okay. But to go from cartoon to reality, the piping structure would be in the building. What's the building's categorization, Category I?

MR. RAJENDRA: The building, Seismic Category I, that's right.

CHAIRMAN CORRADINI: Okay. Thank you.

MR. RAJENDRA: And the next picture is a similar picture for the feed water system. We'll move on to Section 3.3, wind and tornado loadings. Seismic Category I and II structures are designed to withstand 150 miles an hour wind, measured as a 3-second gust.

MR. WALLIS: So, this is converted to a

pressure.

MR. RAJENDRA: Right.

MR. WALLIS: What's the density of the air then? What temperature does it have, and pressure?

MR. RAJENDRA: The rules we used to convert the wind velocity, which is a 3-second gust, to a velocity pressure, the rules we follow ASCE standard 7-02.

MR. WALLIS: Well, that doesn't tell me anything. Is it cold air, or high pressure? Is it some sort of maximum air density that's used? Does it have water in it? I mean, is this a wind which is full of hailstones, or raindrops, or is it just a benign, warm breeze, or a full wind, a warm air wind? I don't know. But it seems to me it might make a difference.

Do you question these things, or are you just sort of flying by a blind -- just routinely apply some standard?

CHAIRMAN CORRADINI: If I were on their side, I would say, I am following the reg guides as specified.

MR. WALLIS: You have to apply standards.

MR. RAJENDRA: Yes.

MR. WALLIS: But you have to also have some curiosity about the basis for the standard, it seems to me.

MR. RAJENDRA: There's plenty -- all the design standards that we use are already supported by another research.

MR. WALLIS: And they consider water in the air?

MR. RAJENDRA: Which is pretty much the state-of-the-air. That is the current state of knowledge of the day.

MR. WALLIS: But it may not be right. It may not be good. It may be, as we know, that some standards sometimes have lacunae in them, have faults or errors, or miss things. I just wondered if you have a curiosity about whether this wind had water in it, or hail. Does that make a difference?

CHAIRMAN CORRADINI: I suspect he follows Bechtel topic report BC Top 3(a), Revision 3, Tornado and Extreme Wind Design Criteria for Nuclear Power Plants, issued 1974.

MEMBER SIEBER: That's what I'd do.

(Laughter)

MR. WALLIS: I know that. But this sort

of -- without curiosity applying paperwork standards can sometimes lead to design errors.

MEMBER BROWN: That's a problem with the regulations. I mean, if out of the tons of stuff I ever built and had vendors delivered to me, I've never ever had a manufacturer or vendor sit down -- what we told him to build, that's what he built.

I mean, if didn't tell him there were hailstones in it, he didn't build -- he didn't have the wind with hailstones. That's a regulatory functions, design guidance function as opposed to asking these guys to -- just personal opinion by the way. You can shoot me if you want.

CHAIRMAN CORRADINI: Feel free. This is what we're here for.

MEMBER BROWN: Okay, all right.

MEMBER SIEBER: This is a free zone. This is a gun-free zone.

MEMBER BROWN: A gun-free zone, that's good. I like that.

(Laughter)

MR. WALLIS: I understand.

MEMBER BROWN: I'm trying to make a point. I think the line of questioning is not very useful. That's personal opinion again. It's not very useful for this venue under these circumstances. They're going to go take the reg guides and the other design guidance and ASME stuff, whatever it is, and they're going to apply that. They aren't going to say, well, this doesn't make sense.

Occasionally, a bright light alights somewhere and somebody says, you know, this is driving me to do some really dumb things, and it doesn't really apply to this plant design. Well, that's like -- that was a light bulb doing off, we really appreciated it when somebody did that.

And we'd say, oh, yes, you're really right, we don't want to spend the extra $4 million to get that done. We'll take that off the table, give us the money back, by the way, since we already paid you for it, and get on with the reduced, or more relaxed design.

MR. WALLIS: Well --

MEMBER BROWN: I throw that in. I just wouldn't --

MR. WALLIS: I just want to make a statement. I don't want to abandon this line of -- and walk. But, as I'm ACRS consult, not a member of the committee, I have done some work for utilities and manufacturers since I've retired. And I'm astonished at what I sometimes run into which seems to be, you said -- we look at it, let's not worry about what really happens. Let's just satisfy the regulations, you know, and then see if the NRC will accept it.

That to me, is not really what I expect as sort of the really -- an engineer of integrity to do. An engineer of integrity should say, I have designed this thing for what really happens and it's going to work for what really happens, not in some strange world of regulations. And I've said my piece now, and I'm going to be quiet.

But it does concern me, because now I've got on the other side, I have even more concern about the process. Thank you.

MEMBER ARMIJO: I think I saw something where, to GEH's credit, is on the tornado winds, velocities, over 330 miles an hour, which is in excess of reg guides and other requirements. And I was going to ask, why in the world did you go beyond the requirements. So somebody must be looking at that and saying, that's really not good enough.

And I think that's your point, is this -- are the requirements and regs really good enough.

MEMBER MAYNARD: Well, the ASME code requirements are more than just a paper set of requirements. The ASME code requirements put together with participation, input, industry, NRC, there's a lot of different inputs and checks and everything on that. So, I think that's a lot more than just a paper requirement that goes into ASME code requirements.

MEMBER SIEBER: Well, it is just a talk about tornados, you have to add the transitional velocity to the rotational velocity to get the wind loading. And that's what they did. I think that's what the code calls for. On one side of the tornado it's going to be less, on the other side it's going to be the sum of the two.

CHAIRMAN CORRADINI: Can we move on.

MR. RAJENDRA: Yes. The next slide is on the tornado loads. Seismic Category I and II buildings are designed for design basis tornado with maximum winds of 330 miles and hour.

A comment was made that this exceeds the current RG 1.76, that is correct. The current RG 1.76 says 216 miles an hour. But that reg guide was actually issued after we had submitted this design specification. The value we used was based on an interim design guide which was much higher.

Although the RG 1.76 value released, we did not go back and change it. We just kept the same value that we had.

The control building emergency filtration unit air intake openings are provided with tornado dampers. All the Seismic Category I buildings are essentially designed as unvented structures, that means there is no vent openings that would allow difference in internal pressures to double-up between the compartments.

The remainder of plant structures, designs do not adversely impact Seismic Category I structures or components.

The next is Section 3.4. We described the flood protection design basis. The methods deals with the external flood sources as well as internal flood sources. For the external flooding, the external flooding is protected number one by ensuring that the design plan grade is at least one foot above design flood level.

And that requirement that we design is reflected in Table 2.01 in Chapter 2. So, if a plant has -- when they are siting a plant, they have to make sure that that requirement is met.

If that requirement is not met, then the -- as on a site specific basis, they have to describe what additional protection measures they have to provide and that will be provided as part of the COL application. Or, they have to raise or artificially change the grading of the site to suit that condition.

Walls below flood level are designed for hydrostatic loads. We have provided -- water stops are installed in joints before flood and ground water levels.

External surfaces are waterproofed below grade. We provided by using waterproof membrane for the basement walls, and use a mud mat with a Zypex, it's a trade name, waterproofing material added to the concrete that's added to the mud mat. And that provides waterproofing at the basement, below the basement.

Water seals are installed at pipe penetrations below grade and the roofs are designed to prevent pooling.

CHAIRMAN CORRADINI: Can I ask a question?

MR. RAJENDRA: Yes.

CHAIRMAN CORRADINI: Since we had a lot

of flooding recently and it's now on my mind, does ESBWR design, in some sense is a bit underground. That is, the vessel sits low. That helps you with the water pools relative to seismic, but have you done an analysis, does it hurt you relative to flooding? Or, does it -- is there a compromise?

I guess what I'm trying to get at is, from the design of the system, was there a conscious decision to position the system relative to where it would be for flooding hazard versus seismic hazard? Or, are they looked at separately and independently?

Because as I saw, we're going to get to this tomorrow, so I don't -- don't answer about seismic. As I saw it, you weighed the water. You weighed the isolation condenser. You weighed the PCCS and you told us how high it was, and you jiggled them. But the jiggling and how they're impacted by the jiggling is how much I stick them inside the earth. But the more I stick them inside the earth, the more I'm prone to an external flooding issue.

So, can you give me some feeling as to how you thought this through, or was there an independent analysis of this?

MR. RAJENDRA: The two analysis are

independent. The flooding protection is independent. The flooding protection is provided by waterproofing the structure, and providing all of these protection. These are basically hardened protections, they're not active systems. They're hardened protections, passive protections.

MEMBER SHACK: Well, I think what Prof. Corradini was really asking is, why did you decide to locate it the way you did? Was that basically driven by the seismic considerations, or were there other considerations as to how you chose?

CHAIRMAN CORRADINI: Or, were there interaction in the considerations that said, no, don't go down ten meters because that's too low, go up five, and that gives us, you know, there is an optimal. I'm just trying to understand your design thinking in all of this.

MR. RAJENDRA: Jerry, do you have any?

MR. DEAVER: Well, some of the things that came to mind for me is like, in the fuel pool, or the storage pool, we put it at ground level. You know, I think that was more of a safeguards considerations. So, there's a lot of considerations given. But I think, mainly we embed our reactors for seismic purposes and containment and dynamic loadings and things like that. We want to dampen the structures such that we don't get amplification going up in the building.

So, I think -- flooding is just a different concern, you know. That's mainly an exterior building concern that we have to protect against.

MR. WALLIS: You mentioned fuel pool. Is that part of the discussion. I haven't really heard about it yet. It obviously is a concern and a seismic and are there other events?

MR. DEAVER: That was primarily a Chapter 9.

MR. WALLIS: Exception to our discussion today.

MR. DEAVER: Right.

MEMBER MAYNARD: I just had a question on your design levels. Just looking at your table 3.4-1, there's only one foot different between the design flood level and the designed groundwater level.

MR. RAJENDRA: Right.

MEMBER MAYNARD: That seemed a little narrow to me. It shouldn't make any difference, I mean, the site's going to have to show they meet both of those, but it seemed like that was a pretty small difference between the ground water level and the flood level, design level.

MR. RAJENDRA: These values actually come from utilities URD document. That's what the utilities got together, decided what new plants should use, their standard design parameters. And the ESBWR pretty much followed that guidance.

MEMBER MAYNARD: On what --

MR. RAJENDRA: Yes.

MEMBER MAYNARD: -- the site to show that they're design flood level, or their flood levels and groundwater levels are below that, but it just seemed like it's a pretty narrow band.

CHAIRMAN CORRADINI: Is this -- you're on 3.4-1.

MEMBER MAYNARD: Yes. 3.4-1.

CHAIRMAN CORRADINI: Where it's 14 point -- where the feet?

MEMBER MAYNARD: Yes.

CHAIRMAN CORRADINI: Okay. Fine.

MEMBER MAYNARD: Design flood levels 14.3 feet, design ground --

MR. RAJENDRA: The table.

MEMBER MAYNARD: -- water 13.3 feet.

CHAIRMAN CORRADINI: Right.

MEMBER MAYNARD: And the finish grade level's 14.8.

CHAIRMAN CORRADINI: Before we go ahead, I guess I want to understand the interaction. Because Prof. Wallis always educates me every time. So, let's say, they are going to build this somewhere in Illinois --

(Laughter)

CHAIRMAN CORRADINI: -- a place where, it's underwater, a lot of water right now. And the estimate is that, how would I change the design? I would waterproof, or would I change the elevation of the design relative to how much I inserted into the ground? Would I essentially just have to use the word, you didn't say waterproof, you had a nicer word for it.

But, I would essentially then have a sealing to a higher level, and the base design would stay the same? What would be an approach since the utility would come back to you, so their COL would pass muster?

MR. RAJENDRA: Well, the application would have to address the fact that now you have that high a water level. Which means, they would provide some sort of a dikes to prevent --

CHAIRMAN CORRADINI: A levee?

MR. RAJENDRA: Yes.

(Laughter)

MR. RAJENDRA: And first, that would have to be proven to work on a seismic event.

CHAIRMAN CORRADINI: Okay.

MR. RAJENDRA: You know. That's what I would guess that they would have to provide, some sort of a barrier.

CHAIRMAN CORRADINI: It would be something that would be a site specific change, not necessarily a plant change to that site.

MR. DEAVER: Our intent is to have standard plant designs. And so we're not going to change the elevation in the ground or anything like that.

MEMBER BROWN: Well, the ground's not a big issue. Here I've got a river that's flooded, and I've got -- look out over the towns you see in the pictures, and you see little parts of peaks of roof. That's 20, 30 feet up. I mean, they're buried. So I'm just sitting here thinking, all I see is a cooling tower from a plant sitting out there. That's --

(Laughter)

MEMBER BROWN: I guess so we build levees or dikes, or protective walls.

MEMBER SIEBER: Don't build your plant on a flood plain.

MEMBER BROWN: Well, we don't prohibit --

MS. CUBBAGE: That's if the site doesn't meet the proscribed site parameters.

CHAIRMAN CORRADINI: But Otto brought it up, so it's fault.

(Laughter)

MR. WALLIS: Well, the key question would seem to be, what's the design flood level.

CHAIRMAN CORRADINI: Well, I think their answer back is that it would be a site-specific parameter. That's if I understand --

MR. WALLIS: But again, I mean, there are floods now that are in your area which may be above the traditional design-specific.

CHAIRMAN CORRADINI: University of Iowa is dealing with that at the moment, but yes.

MEMBER MAYNARD: And I do think that's a serious issue for siting. And I know that Dr. Powers has brought this up several times, is how much can you rely on past data versus what's the -- I think it's going to be a challenge for somebody deciding what's the design flood levels and stuff for that site.

MEMBER BROWN: 500-year flood headline, that was an impressive.

CHAIRMAN CORRADINI: But it was the governor, so I don't know. Sorry.

(Laughter)

CHAIRMAN CORRADINI: Remove that from the record. Expunge that. I'm sorry, that was --

MEMBER SIEBER: Too late.

(Laughter)

CHAIRMAN CORRADINI: Go ahead.

MR. RAJENDRA: Next section addresses the internal flooding. The internal flooding sources are due to pipe breaks and cracks and piping of fire hose discharges. The protective features provided to mitigate or eliminate consequences of internal flooding includes, structural enclosures or barriers, curbs and sills, leak detection components, floor drainage systems. Although, we have not taken any credit for flood drainage systems in the flooding evaluation.

MR. WALLIS: This flooding is due to

something like a fire hose discharge. It's not due to something discharged from your big tanks of water which you have in this building?

MR. RAJENDRA: Right. There aren't considered to fail.

MR. WALLIS: They're never allowed to fail.

MR. RAJENDRA: Yes. They're not considered to --

MR. WALLIS: And that piping isn't allowed to fail?

MR. RAJENDRA: They are designed to Seismic Category I standards. They're not, we don't postulate a failure of those.

MR. DEAVER: Most of our pools are just gravity pools. And as such, there's not high pressure piping associated with them. So, generally, it's not a big design challenge.

CHAIRMAN CORRADINI: But, I guess I thought you were going to answer it differently since we have a reactor pool, and all reactor pools kind of leak. The monitored leakage rate has got to be known within some sort of tech specs. And then if not, you have to go in and fix it. So, I would assume these pools would be of the same sort of thing.

You have an open pool. You're always monitoring the level, and you always should know the leakage. And if it goes beyond some sort of acceptance level, you have to go in and fix it. The owner, or the licensee would have to go in and maintain it within specs.

MR. DEAVER: Exactly. We have -- we control all the water levels. We monitor leakage.

MEMBER SIEBER: You're actually controlling the level, though.

MR. DEAVER: Oh, yes. We're aware of water level at all times.

MEMBER SIEBER: Right.

MR. WALLIS: I guess therein the problem would be some inadvertent opening of a drain value or something, it wouldn't be a natural thing. It would be some human error, most likely cause a large internal flood.

MR. DEAVER: Typically, that would probably be the case.

MR. WALLIS: Or a water hammer, or something like that, a fire line, there have been water hammer in fire lines.

MR. DEAVER: Most of our pools are there

for safety purposes. So, typically, they're not operating. So, it shouldn't get into a lot of those problems.

MR. RAJENDRA: Next slide, section 3.5 is on missile protection, design basis. Seismic Category I structures are designed for missile protection. Systems requiring missile protections are safety-related systems and off gas charcoal bed absorbers.

The Seismic Category II structures are not designed against missile protection, because inside, we don't have any seismic category safety-related components.

MEMBER BROWN: Say that again?

MR. RAJENDRA: Seismic Category II structures are not designed for missile protection in general, except in the case of turbine building, we have the charcoal bed absorbers. That room is provided with missile protection. But other, the rest of the Seismic Category II structures are not designed to resist missiles.

That's the key difference between Seismic Category I and Seismic Category II.

MR. DEAVER: Is that external missile versus internal?

MR. RAJENDRA: External and internal.

MR. DEAVER: Okay.

MEMBER SHACK: Just to address Dr. Wallis's issues, you know, this is the deterministic chapter. You get another shot at all this stuff when you go to the PRA. We missed you during that meeting.

CHAIRMAN CORRADINI: We'll get a shot of that in the next slide.

MR. WALLIS: No, it's not entirely -- there's a turn to the minus seven per year screening criteria.

MEMBER SHACK: Well, yes, those, there are those.

MR. WALLIS: There is some --

MEMBER SHACK: But things like internal floods, I mean, you would come back to the PRA.

MR. WALLIS: Right.

MEMBER SHACK: And in fact, you know, if you found a vulnerability, you may do something about it.

MR. WALLIS: I was a bit surprised by your answer to the PRA. I thought this was a design in which the PRA was integrated from the beginning.

MEMBER SHACK: But he's looking at

meeting requirements now.

MEMBER SIEBER: He has to meet the rules.

MR. DEAVER: Well, it's been an interactive process. I'm not trying to say it wasn't part of the initial design, but it's been interactive.

MR. KRESS: It was implicit too. Because the design was such as to eliminate a lot of the severe accident issues, which were known from past PRAs. So, it's implicit in the design.

MR. RAJENDRA: Rotating equipment, examined for a possible source of credible and significant missiles. In the case of main turbine missiles, the turbine is located in a manner favorable to containment location.

In a subsequent slide, you'll see a picture of the turbine missile trajectory, and how the safety-related buildings are located away from it.

MEMBER STETKAR: Can I ask you a question?

MR. RAJENDRA: Yes.

MEMBER STETKAR: I got confused reading through the DCD and the SER. Is -- and you don't have numbers up here, or -- no you don't.

CHAIRMAN CORRADINI: You mean, pages, you mean?

MEMBER STETKAR: No, no, no, no. Numbers. Is the design basis turbine -- main turbine missile generation frequency for the ESBWR standard plant, is it designed to a 10^{-4}, per year turbine missile generation frequency, or a 10^{-5} per year?

MR. RAJENDRA: That's addressed more in Chapter 10, but it's my recollection that we committed to 10^{-5}. And that actual calculation will be submitted as part of the COL applicant commits to doing that as part of the COL application.

MEMBER STETKAR: I guess I need some clarification and there's a table 3.5-1 in the DCD that lists probabilities. And I looked at changes in the DCD.

MR. RAJENDRA: Yes.

MEMBER STETKAR: There were text changes that as the DCD evolved from Rev 3 to Rev 4, took out several references to that 10^{-5} and put in qualifiers that said, if the turbine were designed with a typical type, with an advanced type of rotor, then it could meet the 10^{-5}.

But it seemed like Section 3.5 focuses now on a 10^{-4} frequency. And since I come from the PRA background --

MR. RAJENDRA: Yes, yes.

MEMBER STETKAR: -- I'm going to have a follow-up on that on the PRA. But from just a strict design-basis criterion, because this is a design criterion that you're going to specify for your turbine vendor, is it 10^{-4}, or 10^{-5}?

Because the -- the reason I bring it up is, the SER consistently seems to assume that it's a 10^{-5}. It will be a question for the staff later. But something like 90 percent of the words and numbers that I can see in the DCD, focus on 10^{-4}.

So, I'm curious which it is. Because it's a number difference, but it is a design spec. Anybody have an answer to that?

MR. PATEL: My name is Chandi Patel. I guess I'm the culprit for SER.

MEMBER STETKAR: No, no, no, no.

(Laughter)

MEMBER STETKAR: You're GEH who is specifying the design.

MR. DEAVER: I'm not sure we have a knowledgeable person here to answer that.

MR. KINSEY: This is Jim Kinsey from GE Hitachi, our turbine expert isn't in the room, but we may be able to gather that information during the break and then --

MEMBER STETKAR: I'd appreciate it. Because I got really confused. The numbers -- you'll see when we get to the next slide here, I have a follow-up that's more of a PRA-related question, but I wanted to get the design down first before I asked the follow-up.

MR. KINSEY: We'll follow that up at the break.

MEMBER STETKAR: Thanks.

MR. RAJENDRA: The turbine missile issues are fully addressed in Section 10.2, we basically make a reference to that from Section 3.5.

The COL applicant's going to provide the turbine and inspection program, and turbine missile generation floor with the calculation to show that our commitments are met.

Missiles from pressurized component failures are evaluated. This is the picture I told about where the site is arranged in such a manner that the low trajectory turbine missile does not impact any of the safety-related buildings.

MEMBER STETKAR: Now I get to ask the PRA question. I noticed that -- and it relates back to this table 3.5-1 in the DCD where Table 3.5-1 says that the, "Under nominal conditions, the probability of a turbine missile generation should be less than $1E^{-4}$, 10^{-4} event per year."

"That if the probability raises to somewhere between 10^{-4} and 10^{-3}, you can continue operation until the next refueling outage. Between 10^{-3} and 10^{-2}, you can operate for 60 days. And if the probability increases to greater than 10^{-2}, you can still operate for six days."

So, there are criteria there, and obviously the licensee would have to do an evaluation to confirm those probabilities. I notice that essentially, all of the electrical building is within the target area from the low trajectory turbine missiles. And you mentioned earlier that Seismic Category II structures are not designed against missiles.

The PRA has absolutely no input to it from turbine missile initiating events. So, I was curious whether GE has looked at the risk from turbine missile damage to the electrical building, recognizing it's a non-safety structure, but it includes a heck of a lot of RTNSS equipment that's required for post-72 hour event response.

Have you looked at that issue at all, given the fact that I can operate for a rather extended period of time with allowable turbine missile generation frequencies that are fairly measurable?

MS. CUBBAGE: I believe the post-72 hour equipment has been relocated to the ancillary diesel building.

MR. RAJENDRA: well, there are now -- if I recall, there are no RTNSS C, B, equipment in the electrical building?

MEMBER STETKAR: Is that right? Okay.

MR. RAJENDRA: Yes.

MS. CUBBAGE: That's probably a change in Rev 5.

MR. RAJENDRA: Yes.

MEMBER STETKAR: Ah, geez, I thought I was so good, I went up and I read Rev 4. I have Rev 5.

MEMBER ARMIJO: You told us to read Rev 5.

MEMBER STETKAR: Yes, for the PRA that's true.

MEMBER ARMIJO: But this is a -- that's what this is?

MEMBER STETKAR: Well, but the SER and the DCD -- the SER seems to be on Rev 3 and-a-half or 4. So, I was trying to be fair for this meeting.

MEMBER SIEBER: Take an average.

MEMBER STETKAR: It's not clear. I wanted to ask the staff later on that. But in fact, the PRA, at least Rev 2 of the PRA, I did not look at Rev 3, of the PRA, makes no mention of turbine missile damage. But it might not be relevant if in fact everything's been relocated to a building that's not -- where is that other building, the new building on this picture?

MR. RAJENDRA: Yes. I can tell you where it is. The part machine shop that you see, indicated at HM, it's going to be moved to, well, it's west, right, not south. So, it's west. North is turbine building, reactor building -- turbine building is not the reactor building. So, hot machine shop moves west and the auxiliary diesel building is located between what the service building and the part machine shop.

MEMBER STETKAR: Oh, okay.

MEMBER BLEY: Can you point to it with

your pointer?

MR. RAJENDRA: Yes.

MR. DEAVER: Basically, this building is moving down and the auxiliary --

MEMBER BLEY: -- will be right in there somewhere, well outside the of the range of the turbine missiles.

MR. DEAVER: From the other side.

MEMBER STETKAR: Thank you. And that's going to contain not only the diesels, but all of the switch gear, all of the -- for connecting between the diesels and the safety-related battery charges, and so forth? All the medium voltages, I think 6.9 kV and medium voltage switch gear will be in that building?

MR. RAJENDRA: I know that it contains the diesels.

MEMBER STETKAR: Well, but I mean, the diesel's can generate power, but if the switch gear is destroyed, that's not so good.

MR. RAJENDRA: Right.

CHAIRMAN CORRADINI: I think they're going to have to take that under advice and get back to you.

MEMBER STETKAR: Okay. Thanks.

MR. SHAMS: I can answer that question. My name is Mohammed Shams. I reviewed the RTNSS stuff for GE. They created a new building altogether, with new diesel generators. They still have diesel generators in the electric buildings, however, they're not required to address the long term safety. They're there to address uncertainty with some of the performance of RTNSS systems.

So, by definition, they're not required for seismic response.

MEMBER STETKAR: Okay. I understand the diesels. But the switch gear that the, you know, there has to be bus work that the diesel's generate electricity using --

MR. SHAMS: That is included in that building also, the --

MEMBER STETKAR: In the new building?

MR. SHAMS: -- the required -- in the new building.

MEMBER STETKAR: Okay. Thanks.

CHAIRMAN CORRADINI: Go ahead.

MS. CUBBAGE: And I should say, I don't know whether this helps or confuses matters on the turbine missile probability, but the ITAAC requirement is to verify that the probability of turbine failure resulting in ejection of a turbine rotor is less than 10^{-4}. That's the ITAAC in DCD Rev 5.

MEMBER STETKAR: So it is Rev 5, DCD Rev 5.

MS. CUBBAGE: That's tier one.

MEMBER STETKAR: Okay.

MS. CUBBAGE: I will say that the text in Chapter 10 appears to be a little bit confusing. So I can understand where you're coming from.

CHAIRMAN CORRADINI: Thanks. Let's -- thanks.

MR. RAJENDRA: The section continues with Section 3.5 missile protection. Tornado generated missiles, other limiting natural phenomena hazard, Seismic Category I buildings are designed to resist tornado missiles.

The site proximity missiles for ESBWR standard plant is assumed to be statistically insignificant, meaning it's less than $1E^{-7}$. The site -- the COL applicant has to address site specific hazards because these are standard plants, that's about the best we can do is to make the assumption that there are no significant site-specific missiles.

And the same thing with the aircraft hazards. We consider them to be statistically insignificant, and the COL applicant for a particular site has to show that the aircraft hazard is less than $1E^{-7}$.

And Section 3.5 also provides barrier design procedures to prevent local and overall damage due to missiles.

MR. WALLIS: Is there a number on statistically insignificant?

MR. RAJENDRA: $1E^{-7}$.MR. WALLIS: $1E^{-7}$.

MEMBER STETKAR: Which is ten times, well, about four times higher than the total risk from everything else combined that's evaluated in the PRA.

CHAIRMAN CORRADINI: Except for seismic.

MEMBER STETKAR: Except for seismic. That's right. The seismic is not evaluated.

MR. RAJENDRA: That concludes my --

MR. WALLIS: 10^{-7} is the cutoff. The actual value is presumed to be less than that. Or, is that 10^{-7} -- where does 10^{-7} come from?

MR. RAJENDRA: It comes from the regulations.

MR. WALLIS: Oh, it comes from the

regulations.

CHAIRMAN CORRADINI: You asked.

(Laughter)

MR. RAJENDRA: That's the end of Sections 3.1 to 3.5.

MEMBER SHACK: If you have no further questions on 3.1 to 3.5, we'd like to proceed then with Sections 3.10, 3.11 and 3.13.

CHAIRMAN CORRADINI: Sure.

MR. WAAL: This is the continuation of discussion on Chapter 3. Right now, we would like to talk about sections 3.10, 3.11 and 3.13 DCD. With me are Jerry Deaver and Kevin Baucom who will be doing the presentation.

MR. BAUCOM: Overall, Section 3.10 provides the requirements for qualification of equipment to seismic conditions. It requires requirements for seismic and dynamic qualification of all the mechanical and electrical equipment. It outlines that qualification be performed by test, analysis, or a combination of the two, and also that mechanical and electrical equipment are designed to withstand earthquake and other dynamic loads with a sound basis.

The general criteria for qualification

is --

MEMBER BROWN: Can you wait a minute?

MR. BAUCOM: Yes.

MEMBER BROWN: You -- the idea of test or analysis, is there -- there's nothing in this, at least what I saw in the presentation, in the materials that defines how do you decide whether you're going to test or analyze. Is there a set of criteria that you've established to determine -- I mean, test is obviously --

MR. BAUCOM: Is the preferred method.

MEMBER BROWN: -- the preferred method. But if you're not going to test, what basis have you all said, hey look, we can't. I mean, other than huge -- I recognize --

MR. BAUCOM: Yes.

MEMBER BROWN: -- taking a turbine generator and going off and trying to run a seismic test is somewhat difficult.

MR. BAUCOM: Generally, that's a reasonable conclusion. That if it's practical to test it, the intention is to test it. But where that line is, because all the equipment is not you know, hasn't detail specified --

MEMBER BROWN: Is that laid out as a

metric somewhere? Is there some design standard or criteria that you've put out to the people that know that that's -- how do you know that's going to happen? I mean, from lots of experience, people just assume not test. They'll say, well, gee, we built this stuff before and it works just fine. So they just -- and we know how to do it.

MR. DEAVER: Well, typically, the passive components that don't have any active motion --

MEMBER BROWN: You mean, non-rotating equipment?

MR. DEAVER: Right, or valves, or you know, actuators and things like that. The passive components like that typically we do by analysis. And you know, reactor pressure valves --

MEMBER BROWN: You mean electrical cabinets? Your instrumentation and control, or your other control electrical control or hydraulic control functions, whatever they happen to be for in plant, in compartment type components, you would do those analytically? So, you just wouldn't test them? That's what I got out of your statement. I'm not trying to attack you. I'm just, that's what I got out of your statement.

MR. DEAVER: Well, I think, yes, it's very dependent on the components. I mean, like for valves and stuff, we have to do functional testing to make sure the valves can actuate. You know, so there's different considerations.

MEMBER BROWN: You going to do that under the seismic conditions to see that they work before -- obviously they worked before, that's your functional test? They work afterwards, after the thing's gone through it. And you test them again, or you just -- that's what I'm trying to get at. Whether it's valves, whether it's electric actuators, whether it's control cabinets --

MEMBER SIEBER: Diesel generator.

MEMBER BROWN: Yes, all those are huge. So, those won't fail --

MEMBER SIEBER: They won't test them.

MEMBER BROWN: They won't test those, I recognize that, and it will be done by analysis. But the rest of the control functions and all of that other type stuff that you have to use in order to make sure something's going to happen after the fact for your passive components, is you know, that the passive systems have operated, and now you need something else subsequent to that.

Or, is it supposed to continue operating anyway. I mean, the plant's not supposed to crumble under a seismic event. It's supposed to be useable after that.

MR. DEAVER: Right. Components need to be, remain functional, after an SSE, of course.

MEMBER BROWN: So, what I got out of it, you're not -- you're just going to kind of analyze these things, and not test them. That's what I got out of that.

MR. DEAVER: No, not necessarily. A good example of something we're doing, like the control rod blades. We actually do physical testing with offset components based on seismic motions, and you know, that we have bounded. And so, we will do physical testing insertion of blades, and drives, under scram conditions under a seismic event.

You know, we don't shake the building, but we offset the components and make sure the components can be inserted. So, you know, where it's important, we do testing. You know, particularly in more dynamic conditions like that.

MR. WAAL: You know, generally, what happens too, is you evaluate what the requirements are for the component, and let's say for example, you have something like the main control board, which is very large. It may be a combination of analysis and test. You analyze the structure to show that it meets that stress requirements and maybe frequency requirements --

MEMBER SIEBER: Test all the parts.

MR. WAAL: -- and then you test the parts so that they can withstand the seismic environment when they're installed in the structure.

Or, if you have a valve that has to operate during a seismic event, not an exceedingly large valve, you can do a shaker table test to show that it operates during a seismic event. And that's all in accordance with the industry standards, the IEEE standards for qualification of equipment.

MEMBER BROWN: Do they require the test to be done for -- for instance, a lot of the cabinets that you have for the instrumentation, reactor instrumentation, they've got to work before, they've got to work during, they've got to work after.

MR. WAAL: Right. Right.

MEMBER BROWN: What -- I would expect those to be tested, and I would have expected somebody to have a list that says, these items will be tested. And I didn't see any of that in this document at all. And it's the only place I would guess I would have expected to see it, since this is components, not the rest of cloud diagrams and stuff.

MR. BAUCOM: I think it depends on the requirements for the equipment. Seismic Category I and it needs to be -- it needs to operate before, during and after an event, that's included in the specification for the equipment.

MEMBER BROWN: But we're not going to know that when we determine whether the application of satisfactory, or what-have-you, when we give our Betty Crocker, Good Housekeeping Seal of Approval.

MR. BAUCOM: Section 3.11 contains a list of equipment subject to qualification. And in there, the EQ program does make reference to it, but it doesn't -- well, I'm going to be careful on the revision of the DCD that I'm speaking to. But, it does make reference that seismic and dynamic is part of an equipment qualification program in general.

So, there is a list of equipment in Section 3.11.

MR. DEAVER: But we don't specify whether it's test or analysis.

MR. BAUCOM: No, we don't. But we do itemize the equipment that requires it.

MEMBER BROWN: What I'm looking for is what's going to be tested and what's not and how that decision would be made, or at least see how the -- what the thought process would go. Some stuff, it seems to me, has to be tested.

CHAIRMAN CORRADINI: That wasn't -- we did -- I guess to put it differently, it wasn't obvious from the section to determine that. Is there somewhere we can look so we can understand it?

MR. BAUCOM: That's fine.

CHAIRMAN CORRADINI: That's what I think you're asking.

MEMBER BROWN: Well, I just -- my interest in this type of stuff is, you'd like to know going in are they going to test it? There's a lot of new equipment if they're -- that they're proposing. This entire plant is run off of computer-based systems, displays, controls, everything. And that's fine. Not a problem.

But how are you then going to take those designs, which have not been fundamentally tested in this environment before, how are you going to bring those forth and show that they meet the requirements or the criteria. And I can't think of any circumstances, other than the diesel generators or turbine generators, where I would be comfortable with not seeing a fully functional definition of what's going to be tested.

MEMBER MAYNARD: Especially for electrical cabinets and equipment.

CHAIRMAN CORRADINI: Absolutely.

MEMBER MAYNARD: Now the staff, I don't know if they're going to -- typically the staff does the seismic qualification review and I don't know if you guys are going to cover that, or is that part of the DCD stage, or is that part of the seismic?

MEMBER SIEBER: COL.

MR. PATEL: My name is Chandi Patel. Yes, there is a section 3.9.2 in that we do look at the, you know, seismic qualification of equipment and component and you know, metallurgy and other things, this afternoon.

MEMBER MAYNARD: And as part of that review, do you review whether they've done analysis or whether they do testing, and whether you accept their rationale for what they've chosen to do?

MR. PATEL: Well, I will have to get to the reviewer. I'm a project manager, so I don't get in that much detail. So, this afternoon, we should be able to answer that.

MEMBER BROWN: I didn't see that is 3.29, so I didn't do an exhaustive review. I went back to 3.10 where it paid attention to the electrical stuff. And I went after -- and that's what I went and looked at in more detail.

So I mean, the bottom line I take out of this, is right now, there's no -- correct me if I'm wrong, is that there's no definition of what will be tested or not. There's it will be tested or analyzed, there's a list of systems, but there has not been a definition of what falls into what falls into what category.

CHAIRMAN CORRADINI: What falls into what category. Are we hearing that right?

MR. BAUCOM: I think if you look, an explicit definition is not.

MEMBER BROWN: And that's really what I'm looking for.

MEMBER SIEBER: That's consistent with past practice. There would -- if you had an electrical cabinet, you may test relays on a shake table. The cabinet, you may analyze. And so there's often, or sometimes a mixture of both.

MEMBER BROWN: I mean, for example, there's a lot of -- people make relays for seismic qualification, they're rotary relays. Everybody thinks they're fine. And we use those in the Navy, but you go find -- run a shock test on those, and you'll find out that they'll close contacts for any where from 30 to about 70 milliseconds. Well, that can be disastrous if certain things happen under those circumstances.

And that's why even though they build the part, theoretically to meet a seismic or a shock requirement, whatever you want to call it, that doesn't mean it will perform that function satisfactorily inside of a larger component. It doesn't always work that way, based on orientations, et cetera, residences, whatever goes on. And it could be -- could cause problems.

So, there's small parts, there's big parts. And where you want electrical isolation or relays are used, and therefore, they become critical, contacts, you know, how connectors are done, how tightly are they locked in. You start to slide circuit cards in and out, it doesn't take much to dislodge them and all of a sudden, your displays or your protection function don't work right or don't work at all.

MR. DEAVER: Or do.

MEMBER BROWN: Or do, and so do unusual things. That's another way of phrasing it.

MR. DEAVER: Well, what you're talking about it, how -- you know, considerations that are required in the specification of how do you qualify.

MEMBER BROWN: That's -- I think that's -- personally that's what I'm interested in seeing. And I agree with John, that's what my understanding of past practice is, and that's what we'd like to see in these circumstances.

MR. DEAVER: And that's a level of detail that DCD doesn't get into.

CHAIRMAN CORRADINI: Where would we expect to see that level of detail?

MEMBER SIEBER: COL.

CHAIRMAN CORRADINI: Is it the COL stage?

MEMBER BROWN: I mean, these are components used --

MEMBER SIEBER: Yes, you're buying them. You're buying them. You have to -- you buy at the COL stage. And that's where you specify how you're going to achieve seismic qualification.

CHAIRMAN CORRADINI: So, can the staff help us there just so we understanding.

MS. CUBBAGE: I mean, I think we're relying on regulatory guides and IEEE standards, specifically IEEE 344 talks about seismic qualifications pursuant to equipment.

CHAIRMAN CORRADINI: But it would be at the COL stage where the equipment is specified that one would have to make the determination?

MR. ABID: Sir, I believe -- let me -- my name is Mohammed Abid. IEEE 344 1986 NRC noticed. that reg guide 1.100, revision 2. And that lays out pretty much how the testing and also the analysis be performed for the components.

We're talking about switch gears -- I mean, the relays and all those, I mean, they're tested pretty much. And the rest of them are like switch gears, they're analyzed by analysis.

There's a sequence in IEEE 3.23 where EQ is, and that request for the Class IE items, where you know, they go through the thermal aging, a lot of mechanical aging, and then it goes through the seismic analysis. If it qualifies good for functional requirements during and after the seismic event.

So, I think 344 has, I mean, it's pretty clear in that.

CHAIRMAN CORRADINI: Can you say it again?

MR. ABID: IEEE 344, 1986, has been endorsed by NRC.

MEMBER BROWN: 344, and I'm trying to remember, I can't quite. When you do shake testing on the electrical equipment --

MR. ABID: Right.

MEMBER BROWN: -- you have -- they do that under load, so you can see what actually happens?

MR. ABID: It has to be. It depends upon the classification of the component. If it's required for --

MEMBER BROWN: IE.

MR. ABID: -- the site's IE, then it has to.

MEMBER BROWN: Only required for IE, right?

MR. ABID: If it has -- it has, supposed to perform that function, yes.

CHAIRMAN CORRADINI: But does it provide criteria as to whether you do the test or analysis.

I guess that's been the question we've been trying to get at.

MR. ABID: I mean that, IE should answer that. We are still in the design stage. If it is required to test, it has to be tested, I think. I don't know, you have to help me out with that. But I know we can tell what standards are used to do the testing.

THE REPORTER: Your name please?

MR. ABID: Mohammed Abid.

MEMBER BROWN: Do you ever look at the submissions of analysis and say, we really think we need a test on this one, and go back? I don't recall any RAIs like that, but there might be some.

MR. ABID: I mean, testing is always better than analysis. Let's put it this way. But if it cannot be performed, if the test cannot be performed, analysis has to meet the requirements of the regulatory guidance and that should be. That's what we had in the industry standards so far, all the plants have gone through that for the qualification.

MS. CUBBAGE: And I know you guys don't like it when I put you off to another chapter, but this is part of the ITAAC verification. They're required to do test and/or analysis to demonstrate that they've -- the facilities were constructed to perform, da, da, da, da, da.

MEMBER BLEY: Infamous Chapter 14?

MS. CUBBAGE: Yes, Chapter 14. So I know there have been RAIs in Chapter 14 that speak to whether something's going to be a test, or an analysis, and whether we need to specify one or the other, or whether in some cases, it's appropriate to say, test or analysis in accordance with whatever the standard is.

So, you know, we can try to get some information to you over the course of the day here, or we can try and hit that when we talk about the ITAAC process.

MEMBER BLEY: Let me sneak in a question. I can wait for the ITAAC process if that's where it comes up. If they're doing analysis rather than testing, wouldn't that be done at this stage rather than at the ITAAC stage?

MS. CUBBAGE: Well, they have to actually procure equipment before they can qualify it.

MEMBER BLEY: Okay, fair enough.

MEMBER MAYNARD: I do know that for existing plants, there have been cases to where the

NRC staff did not agree with the analysis and that testing had to be done to finish the qualification, but that was existing plants.

MEMBER BLEY: At what stage was that decision made?

MEMBER MAYNARD: Well that --

MEMBER SIEBER: During construction.

MEMBER MAYNARD: -- during the licensing, that's when we were doing the licensing as we were building it and refusing everything. And it was before the plant got built, or finished, but it was, or licensed to operate. But it was in the final stages.

MEMBER BLEY: Before we did design service.

MEMBER MAYNARD: It was in the final stages of construction.

MEMBER BROWN: That's kind of late, isn't it?

MEMBER SIEBER: That's the way --

MEMBER BROWN: I know that's the way it used to be. I know that's the way it used to be. But the way it used to be is also fairly cumbersome from the licensee and others knowing what they have to do in keeping their costs under control. I mean, you don't want cost and time to bring a plant on line to start getting up into the 15-year time frame as opposed to you should go back and look in the '60s and stuff, it was a six-year time frame roughly from licensing to plant operation.

MS. CUBBAGE: Right. Well, certainly with the Part 52 process, the regulations that we need to resolve, safety issues prior to certifying a design. So, by confirming that these equipment will qualified to appropriate standards, that's the basis for our finding of reasonable assurance.

MEMBER BROWN: I'd still like to have some definition of what's going to be tested and what's not. I'm just skeptical.

CHAIRMAN CORRADINI: We're going to have to wait until Chapter 14 as well.

MEMBER BROWN: I could -- I mean, if --

MEMBER MAYNARD: Well, I think some of that's still going to be at the COL stage, because again, the equipment, until that is finalized, purchased, at that stage, I think some of it will be a COL.

MS. CUBBAGE: When you say COL --

MEMBER SIEBER: If you would do that now, you would have to buy the equipment to test it. By the time you installed it, it would be obsolete.

MEMBER BROWN: Yes, but why couldn't -- say that again?

MEMBER SIEBER: In the six or seven years it would take from the testing of a prototype until you actually install it, chances are the model number or a design change are pretty big.

MEMBER BROWN: I don't know. I mean, if you read through this thing, they talk about pieces that are, gee, we know how to use them, therefore, we've used them before and past data shows they're okay, so that we ought to get on to the business.

MEMBER SIEBER: Containment, penetrations fall into that.

MEMBER BROWN: If something changes over a seven or eight year period, then the test data is no good. So that seems kind of like a losing proposition. I don't mind waiting until ITAAC Chapter 14, now I know what ITAAC is.

CHAIRMAN CORRADINI: Well, that's the start of it. Amy was going to say something to finish off.

MS. CUBBAGE: I mean, yes, it's a two-edged sword here. I mean, there's the staff, needs to decide they have enough information on the design to reach a safety conclusion, and we also need to decide if we have enough ITAAC to verify that the facility's been constructed in conformance with the design we've certified. So, it's a two-part thing. And Chapter 3 is where we talk about the standards and the criteria.

MEMBER SIEBER: Right.

MR. DEAVER: Just one last statement. When we go out and actually procure equipment, in some cases, the equipment has been previously qualified either by test or whatever. And so it is somewhat dependent on the procurement process as to in come cases which way it goes. It could be a prior test, or they need a new test, or maybe analysis.

MEMBER BLEY: I have no problem with it, prior tested, but it better be, look exactly the same down to where the bolts are located, and how many cards are in the cabinet and where the switches are. It's very dependent upon location of components and their restraint. If somebody changes in between, then you have to --

MR. DEAVER: Yes. I'm talking more down to the basis component level.

MEMBER BLEY: As opposed to assemblies.

MR. DEAVER: Yes.

MEMBER BLEY: Well, I mean, but you can't qualify an assembly based on the qualification of five parts that go into the assembly. It doesn't work very well. Well, you know where I'm coming from.

MR. BAUCOM: I think we've beaten this one up. But, basically, just the --

CHAIRMAN CORRADINI: Okay. Turn the page. So you've answered the question there, didn't you?

MR. BAUCOM: Pardon?

CHAIRMAN CORRADINI: On the slide, you -- no, the one I just turn --

MEMBER SIEBER: The next slide.

CHAIRMAN CORRADINI: One slide next.

MR. BAUCOM: Well, this one was actually aimed at supports.

CHAIRMAN CORRADINI: Okay.

MR. BAUCOM: One more slide, Jerry.

MEMBER BROWN: You mean supports, by you mean pipe hangers or?

MR. BAUCOM: Brackets into the --

MEMBER BROWN: Mechanical stuff.

MR. BAUCOM: Yes, mechanical stuff.

CHAIRMAN CORRADINI: Oh, okay.

MEMBER SIEBER: Right.

MR. BAUCOM: But the intention's to test the supports with representative equipment installed so you've got the, you know, you don't have to try to simulate the dynamic load.

MEMBER BROWN: You made a statement about you don't rely on experience. You've said it again here. But yet, on page -- I'm looking at the SER GEH stated that it "follows the methods outlined in IEEE 344 when existing test data or experience data are available, the equipment database is reviewed to determine the previous testing experience meets or exceeds the new requirements."

And yet, earlier, you said you're not going to do that.

MR. BAUCOM: That was actually the subject of an RAI.

MEMBER BROWN: I know. That's what I'm reading. That's what I'm reading, but --

MR. BAUCOM: We responded to that by saying we will not use actual experience in some later revs of the DCD.

MEMBER BROWN: Okay. So I'm going to hope when I finish reading the rest of this that the staff, that that shows up. I saw it in one place, but I didn't see it in the other, so.

MR. PATEL: Again, my name is Chandu Patel. I know what you are talking about. We -- if you go a little later, in after all the discussion, we said GE has agreed not to use experience as a, you know, criteria.

MEMBER BROWN: I will go look for that.

MR. PATEL: It's like RAI 2, 3.10 to 3.40. You know, it's just, I know it's really long going this discussion back and forth. We have so many back and forth in this issue. You know, so it's a little long before you get to the conclusion.

MEMBER BROWN: Okay. All right. Thank you.

CHAIRMAN CORRADINI: Go ahead.

MR. BAUCOM: Start Section 3.11. Section 3.11 provides the requirements for the environmental qualification of the mechanical and electrical equipment. The conditions that are applied there are used to involve the most limiting design conditions that can be present.

We do specifically include all three categories of 50.49(b)(1), (b)(2) and (b)(3) equipment in the EQ program. And there is a table

3.11.1, does identify specific equipment that will be included in the EQ program. The fundamental requirement is that equipment in a harsh environment must be able to function properly during any design basis accident conditions.

We consider the range of --

MR. WALLIS: When you say function properly, is this some kind of probability of success in functioning, or is it --

MR. BAUCOM: No, it needs to meet its intended function.

MR. WALLIS: Yes. But you can never guarantee 100 percent probability that it will work. I mean, 100 percent probability 1 that it will work. What does function properly mean?

MEMBER SIEBER: It's deterministic.

MR. WAAL: I think it means that when they put it though the testing program --

MEMBER SIEBER: It passed.

MR. WAAL: -- it met the qualification, they show that how it operates before the test program, during and after and it meets the --

MR. WALLIS: Then you have a question of how many tests to you need in order to be statistically significant? Or do you just test it once?

MEMBER BROWN: No, it's a deterministic test. You go, you shake it --

MEMBER SIEBER: You do it once, it passes or fails.

MR. WALLIS: There's no such thing.

MEMBER BROWN: Well, that's the way it's done. I mean, you run a test, you shock it five or six times, and you make sure that it -- or a seismic test, or whatever the spectrum is --

MR. WALLIS: Testing one bolt is good enough to show --

MEMBER BROWN: I didn't say a bolt. I'm just -- I'm speaking of a larger assembly or when I look at protection equipment, for instance. They test it. You shake it in multiple plains and then you make sure it worked before, it doesn't shut anything down, or not work during, and then it provides its protection function afterwards.

If it does, then that's considered the gold standard. It's not done 500 times to come up with a statistical basis, or at least that's my past experience.

MEMBER BLEY: Mine too.

MEMBER BROWN: Is that anything

consistent -- inconsistent, oh, okay. Thank you.

MR. WAAL: And there is generally, you know, there is one test item to be tested for an instrument, but the testing parameters have some margin built in to take into account variations in the test and variations in operating conditions so that you have a high probability. It's not one, I know, that the equipment will operate as installed, or as intended when it's installed in the plant.

MR. WALLIS: There's a high probability.

MR. WAAL: When you look -- you cannot guarantee probability of one.

MR. DEAVER: I think along with that, there's a lot of redundancy in the equipment and functions, so it's all factored in on the big picture. Not to say it completely can't fail.

MEMBER BLEY: You guys just said something that bothers me a little. From what I've seen of these kind of tests, they aren't done enough by any means to establish a failure rate under this insult condition. They're done enough to show that it works and no a whole lot more, and sometimes that's not more than one time. So, to make a claim that there's a high probability of success, I really want to know what that's based on.

MR. WAAL: Well, like I said, because of the margin that's given in the test parameters, which is sufficiently larger than what the design parameters are. It shows that that test item can meet those design conditions. And the margin for example, I think it's ten percent margin on seismic, is supposed to cover variations in the design of manufacturing.

MEMBER BLEY: Has there been enough testing to convince anyone that that's the case? That in fact, you need one or two samples to gain confidence that it covers the manufacturing variable.

MR. WAAL: Well, I don't think that's the intent of these industry standards.

MEMBER BLEY: I don't think so either. But we're claiming that it's giving us this fairly high confidence, and I'm wondering what that's based on. It's based on the margin.

MR. WAAL: Right.

MEMBER BLEY: On the test, not any way sampling to see that you're covering manufacturing variability.

MR. WAAL: Right.

MEMBER BLEY: I thought I heard that

right. Okay.

MR. DEY: My name is Pijush Dey, GE --

CHAIRMAN CORRADINI: Microphone. Identify yourself please.

MR. DEY: This is Pijush Dey, General Electric Hitachi. On that topic of margin and the confidence limit like on the testing, my experience, I had that same. They do say, for example, required response spectra in the seismic test, and the test response spectra, TRS level, generally is very high, higher level than the RRS level.

And they do test multi-access. Some of the time you do not need multi-access test. They do three axial tests on the two axial tests. And that has a lot of, you know, high margin out of that test.

And they do the shake table tests --

MEMBER BLEY: I'm sorry. I didn't understand.

MR. DEY: Shake table tests, and they do in the, you know, 50(b) cases, or 3SSC cases, so they do test more than one or two, or sometimes as they write the different specification based on that they do the testing.

And I've seen tests in the Wiley Lab in

Alabama, the big structure, the valves and the cabinets, et cetera, that you know, has -- after testing, we inspect visually any damage. It's -- we put it in the bench and it was simulated as the, just like in the plant how it functions.

And they do apply the seismic spectra higher level in that. And after the testing, we're going to go back and look at the visual inspection basis any damage or anything happen and we see that it is still functionable they way it was intended. So that's done, actually.

CHAIRMAN CORRADINI: Go ahead.

MR. BAUCOM: Conditions for qualification do consider all the thermodynamic conditions present, temperature, pressure, humidity as well as radiation and chemical. And the qualification, I think we beat this one as well, is in accordance with IEEE-323 as it's been endorsed by the applicable reg guides for harsh environment and keep it duty safe.

Loss of HVAC is considered as a part of the design basis. Because there are no safety-related HVAC systems within the ESBWR.

MEMBER STETKAR: How did you determine your design qualification temperatures for equipment in the reactor building and control building for 72 hour response after -- with no HVAC? In particular, the rooms in the reactor building that have a DCIS cabinets and remote check amp panels and the invertors? I notice that the design temperatures tend to be 122 Fahrenheit, with the exception of the rooms that I guess have the invertors, those are 145.

I saw you had heat loads, I kind of read through Appendix 3.H, and I saw you had heat loads specified for those rooms. But since you don't have the equipment yet, are those just nominal heat loads for now, or design heat loads? Or, how do you know what the heat input to those areas are?

Because it's kind of a, you know, chicken and the egg sort of process, that you specify that the equipment has to meet 122 degrees Fahrenheit, the vendor will say, yes, indeed. It meets 122 degrees Fahrenheit. You go measure the temperature in the room, and it's, you know, 147 degrees Fahrenheit because the vendor's equipment put out more heat than you estimated that it would be put out. I was curious how that process works.

MR. DEAVER: Well, at this stage, what has to happen is that people have to estimate the heat loads based on the expected equipment and you know, the information available on equipment. So, those heat loads at this point, would be a process is, to bound those such that we understand them.

Then basically, understanding the heat load, then they can do a temperature analysis.

MEMBER STETKAR: But these are modest, relatively modest -- I mean, we design equipment for an existing power plants to higher temperatures than this. You say that we're bounding the heat loads, we're actually estimating pretty modest heat loads in these rooms.

And in fact, let me kind of follow-up on it. There are tables that show how the heat loads change as a function of time. And in one location, for example, 17-1/2 kilowatts, heat load for the first two hours drops to 2 kilowatts after two hours. In another location, 5.7 kilowatts for the first two hours drops to 4.7 from 2 to 24, and then it drops to 3 kilowatts after 24. What design features absolutely guarantee that those heat loads indeed will shut off and drop to those values at those times?

Because that's important. If they don't drop to those values, then the equipment qualification must be much different, should it?

MR. DEAVER: Well, what's bounding or limiting here is our battery power. In most cases, there's some functions that will operate up to 24 hours and there simply isn't enough power to operate those components any further.

So, to a large extent it's bounded by our ability to operate the equipment.

MEMBER STETKAR: It's bounded by the design assumption that you have to assume that the batteries do fail. If they don't --

MR. DEAVER: It's not necessarily a failure, it's --

MEMBER STETKAR: If indeed they last longer than that time, then the heat loads would be substantially longer, extended to longer durations, wouldn't they? In other words, if the design is based on the assumption that at 2.0 hours, the heat load drops catastrophically by a factor of oh, 8-1/2, something must be shutting off that heat load positively or your design should, I would think, account for the fact that indeed, that heat load might persist.

MR. DEAVER: Well, the basic philosophy is to be able to conserve battery powers. So, at certain stages, you know, after they've been monitoring a function, and it's no longer necessary to monitor, rather than just continue to operate it, they'll shut it down to conserve batteries.

MEMBER STETKAR: They being the operators?

MR. DEAVER: No, this is all automatic.

MEMBER STETKAR: Ah. The automatic system. That's what I was asking. What design features shut these things down. I guess we haven't seen -- is this all in Chapter 7 of the DCD, how this stuff works?

MR. DEAVER: That's principally where it's at, yes.

MEMBER STETKAR: I guess we'll wait until seven then.

CHAIRMAN CORRADINI: Go ahead.

MR. BAUCOM: Some equipment is affected by -- potentially affected by submergence and the qualifications for those programs do include the actual submergence water chemistry and the operability requirements that be met. And additionally, radiation sources from any conditions and the resulting integrated doses are included in the EQ program for equipment aging and various conditions.

The final section, 3.13, we do not explicitly have a Section 13 in the DCD.

MEMBER STETKAR: I was looking for it.

CHAIRMAN CORRADINI: Sorry about that, but I saw it was included and I just asked where it was.

MR. DEAVER: The material that is --

MEMBER SIEBER: -- just say, go some place else.

MR. DEAVER: The sequence was that --

CHAIRMAN CORRADINI: That's fine.

MR. DEAVER: Okay. You understand.

MR. BAUCOM: That material is covered in Section 3.9, so for this presentation, we elected to defer to 3.9.

CHAIRMAN CORRADINI: Good.

MR. BAUCOM: 3.10 and 3.11 do provide the basis for qualification of the equipment for seismic, dynamic and environmental conditions in accordance with the applicable reg guides.

CHAIRMAN CORRADINI: Any questions by the members?

Thank you very much. And we will take a break until 10:45.

(Off the record from 10:29 a.m. to 10:45 a.m.)

CHAIRMAN CORRADINI: Okay. Let's get started. Mr. Patel, are you the lead on this?

MR. PATEL: Yes, sir.

CHAIRMAN CORRADINI: Okay. It's all yours.

MR. PATEL: I guess it's still morning. Good morning. My name is Chandu Patel. I'm a lead project manager for the review of Chapter 3. What I will do in the beginning is just to give you an idea of what the broad picture of how we handle Chapter 3 here, because there are so many sections and so many reviews involved, so I'll just walk you through this general idea, and then we will go into specific sections.

This one just gives you the detail of each section and the title which is easy reference and by now you have an idea of most of the things we have followed here. So, I will not go much into detail with this thing.

These are the people. I thought it would be a good idea for the subcommittee to know who are the real players. I'm just a messenger. What I'm going to do is, I'll try to relay the message. And if there is any tough question which I cannot handle, I'll point to those guys.

This is the important slide, and this is just to set the stage for you guys. I know some of the members aren't here for the numbers, but this will give you some idea.

CHAIRMAN CORRADINI: We're really not engineers.

MR. PATEL: I would like to have, you know, if you guys are going to ask the questions, where would be the focus and what are the areas where we still have open questions. At least we have -- that was the intent of this slide.

Originally, we had about 583 RAI totals so far until about a week ago. Now, it's 588. Out of that --

(Laughter)

MR. PATEL: So far, now we have as of last week, we have 57 open RAIs. And out of that, you can see, in Section 3.8, we have 19. So, we did --

CHAIRMAN CORRADINI: That's seismic?

MR. PATEL: Yes. And that's where we had a lot of questions, of 125 RAIs just in 3.8.

The next one is 3.9. And also after 3.9

has gone, it goes from 3.1 to 3.96 -- 3.91 through 3.96. But, where I would appreciate, I guess, we will concentrate is most of the RAIs still open are in 3.95, you know, which is reactor internals and steam dry issues and flow operation. Those are the more, main in 3.9. Everything else is relatively clean.

In 3.6 is the next one, which we have -- Dr. Wallis and another, had some questions asking for previous ACRS. And we still have about seven of the issues still open. So, 3.6 is pipe breaking, or location and all that. So, that will be this afternoon.

And equipment qualification, 3.11. That one is relatively clean. The only area we have questions outstanding is in the area of the qualification for the radiation environment and the temperature. So, this is just general overview. Now, I'll go to --

MEMBER STETKAR: Can I ask?

MR. PATEL: Yes.

MEMBER STETKAR: This is really quick, I hope. Does this SER apply to Rev 3 or Rev 4 of the DCD?

MR. PATEL: Thank you, very much.

MEMBER STETKAR: You're welcome.

(Laughter)

MR. PATEL: No, that's a good thing. I should have said that, you know. The intent -- the way -- okay. The past trouble, this SER was being prepared from -- okay, I had input all the way from March 2007, okay? Or, May of 2007, let's say. Because March of 2007 was when we got Rev 3.

So, I had input from May of 2000 (sic) through all the way up to December, January of 2008. And by that time, you already had Rev 4 in house. So, when we started to write, it was supposed to be on Rev 3. And most of the concentrated reviews was on Rev 3.

But what I have done, if it makes it easier, instead of making item open and leaves it only Revision 4, we closed it based on because they have already changed something. Like, instead of making item, like confirmatory, we just said, this item is resolved because it's already included in Rev 4. Does that make sense?

MEMBER STETKAR: So the document that we received, then is -- pertains to Rev 4 of the DCD?

MR. PATEL: As you said, I think you are the one you said, it's three and a half.

MEMBER STETKAR: I did say it was three and a half.

MR. PATEL: No, no, no. What I did exactly, okay, let me just -- because I know every page of the safety variation.

(Laughter)

MR. PATEL: Believe me, I have spent quite a lot of time.

MEMBER STETKAR: Bless you for that.

MR. PATEL: The intent was like, as I said, like some of the RAIs had open, or like confirmatory. And if I could use Rev 4 to close it, I did it. But other than that, we did not discuss anything more detail in Rev 4. Okay. So, Rev 4 is not.

MEMBER STETKAR: So, let me -- I'm still trying to understand. Does that, because I was trying to go back and forth from the SER to the DCD and spot check things in the design. Does that mean that you have to now go through, formally go through Rev 4 of the DCD?

MR. PATEL: Yes. And give you the --

MEMBER STETKAR: For Chapter 3?

MR. PATEL: Yes.

MEMBER STETKAR: And you have not done

yet.

MR. PATEL: No.

MEMBER STETKAR: Okay. Thanks.

MS. CUBBAGE: We're on five. We're on Rev 5 now.

MR. PATEL: Let me give you --

MEMBER STETKAR: You're at five.

MS. CUBBAGE: We're not going to -- excuse me, Chandu. Let me just --

MR. PATEL: Yes.

MS. CUBBAGE: Basically, the SE is written to the design in Rev 3. And to the extent that we could close issues with material that was provided in Rev 4, we did that so that we could provide as much closure as we could in this document.

MR. PATEL: And for a fact, an example is this. Like turbine building. If you read safety regulation 4, Rev 3, it says everything is great, like they have Seismic Category II. But all everybody knows now, that in Rev 4, they have changed it and we did not address it.

Safety 4.1, we settled the issue.

MEMBER STETKAR: Great, thanks. That explains. But now, when you update the SER, it will be updated to Rev 5 of the DCD?

MR. PATEL: Yes.

MEMBER STETKAR: Okay, thanks.

CHAIRMAN CORRADINI: Which is the expectation is, the last Rev.

MS. CUBBAGE: We do anticipate there will be some cleanup necessary in a later Rev to address some of the RAIs that are still open. But the design will be as it is in Rev 5.

MEMBER STETKAR: Okay.

MS. CUBBAGE: Unless an RAI results in a design change.

CHAIRMAN CORRADINI: I understand.

MEMBER STETKAR: Before we continue, let me just get in one question, because --

CHAIRMAN CORRADINI: You already had your one question.

(Laughter)

MEMBER STETKAR: No, one question I -- another question. This is to Amy. I'm like a little terrier who grabs you, you know, by your calf, and never lets go.

Back when we reviewed the SER for DCD Chapter 5, I asked a question about why the SER did not contain a review of the main steam isolation valves. And I was told, well, it will be in Chapter 10. So, I waited and we got to Chapter 10, and it wasn't in Chapter 10, and you said it will be in Chapter 3.

I couldn't find a review of the main steam isolation valve design. I'm not talking about structural design, seismic response, but the design of the value itself, its operator, the design criteria for closure time, things like that. Similar to things like you've reviewed for squib valves and other parts of the plant.

That's not in Chapter 3. So, where are the main steam isolation valves, and for that matter, the main feed water isolation valves reviewed by the staff, since they are -- now I learned they are in fact the Class I, Class II seismic boundary. So, their operation and design should be worked out.

MS. CUBBAGE: And exactly which aspects of the design you talking about?

MEMBER STETKAR: The operator, the valve type.

MS. CUBBAGE: That's not a level of detail we have at this time.

MEMBER STETKAR: For the main steam

isolation valves? They're described in DCD Chapter 5, I think they are. That's why I was looking for it in Chapter 5 of the SER when we started this. And you said, well, no, they're probably in 10. And then we got to 10, well, no, they'll be in Chapter 3, and they're not.

MR. PATEL: And I do remember your question, believe me. When we were going through Chapter 5, and yes, we did say, we will look into Chapter 3 when we come to Chapter 3.

Now, I'm going to say one more thing that Tom Scarbrough's not here.

MS. CUBBAGE: He will be this afternoon.

MR. PATEL: This afternoon, we will be able to answer your question. Because I asked that question to the staff two or three times.

MEMBER STETKAR: Okay. Thanks. I'll wait.

MR. PATEL: Because I was fully aware of his question before.

MEMBER STETKAR: I'm not talking about the seismic design of the structure.

MR. PATEL: No.

MEMBER STETKAR: I'm talking about the design of the valve itself, how it works.

MR. PATEL: Yes. And Tom Scarbrough is the one person who can at least give a little bit. Because we don't really go into so much detail for the operator and you know, detailed reviews.

MEMBER STETKAR: Okay.

MR. PATEL: But at least he will be the most qualified person.

MEMBER STETKAR: Okay, thanks.

MS. CUBBAGE: And I think with respect tot he level of design detail that's currently been provided, I think GE would have to chime in on that.

MR. PATEL: Yes. But maybe we will do this afternoon.

MEMBER STETKAR: By the way, I didn't have any particular questions about the design.

MR. PATEL: No.

MEMBER STETKAR: I just want to make sure the staff actually looked at it somewhere and there was some record that you have.

MR. PATEL: All right. Now I'll go through specific sections.

MEMBER ARMIJO: Before you do that, I want to make sure I follow you. In the SER, you had a reference to an RAI 3.2-7 related to lack of detail on PNIDs. And is this -- in your list of open RAIs, there's no 3.2. Is 3.2-7, is that now resolved?

MR. PATEL: Yes.

MEMBER ARMIJO: So, you have adequate detail, or you're going to get adequate detail at some time so you can look at the PNIDs sufficiently to do your review?

MR. McNALLY: This is Rich McNally from engineering mechanics branch. And I believe GE has made a commitment that we can receive final PNIDs. We will also have the ability to audit, as part of DAC closure, to look at design specifications, which would actually include the basis for the design classification breaks.

This will be an on going change until the as-builts are complete. So, this is really part of detailed design, and will be subject to the future reviews during audits.

What we've done here, is a review of the simplified diagrams and --

MEMBER ARMIJO: And on the basis of those commitments, you've closed out RAI 3.2-7, you have enough that you can close that?

MR. McNALLY: Correct, correct.

MS. CUBBAGE: Well, I'll also say that GE

Hitachi did provide PNIDs for many, if not all of the systems on the docket. They're not part of the detail of the design certification, the DCD. But they have been submitted.

MEMBER ARMIJO: Okay, thank you.

MEMBER BLEY: While that issue was brought up, I have a comment about it. The RAI here was requesting something more than the simplified PNIDs to be able to do the classification. I don't recall a similar RAI to be able to do a thorough review of the system so that you could really identify possible problems at the detail level, which is where the problems tend to crop up.

MS. CUBBAGE: The reason the PNIDs were actually submitted was because of RAIs that were on Chapter 6 and I believe 9, where we wanted additional detail.

MEMBER BLEY: Oh, it was raised.

MS. CUBBAGE: Absolutely.

MEMBER BLEY: Okay, I hadn't found it.

MS. CUBBAGE: -- reactor systems, and balance of plant reviewers insisted on those PNIDs being submitted.

MEMBER BLEY: And there was just -- okay. So, they are submitted on the docket to address these issues.

MS. CUBBAGE: Yes. They're proprietary and they're not part of the DCD.

MEMBER BLEY: The previous comments of the sort, gee, all I had was a very simplified one, and I couldn't address those kinds of things should be cleared up in the future.

MS. CUBBAGE: I don't know that we would have, for example, you may be referring to instrument air.

MEMBER BLEY: It came up there, but the concern really was really across all the systems.

MS. CUBBAGE: Right. But the major balance of plant systems, we have PNIDs for those. We have GDCS, ICS, PCC.

MEMBER BLEY: And they have been reviewed now and it's detail given.

MS. CUBBAGE: -- SLC, yes.

MEMBER BLEY: For performance?

MS. CUBBAGE: Yes.

MEMBER BLEY: Okay, thanks.

MR. PATEL: For the classification, the systems and structures, I guess we have really discussed quite a bit already about -- there are a couple of issues. And I guess -- let me just, this is Patel talking.

I have been in the nuclear industry for almost like 35 years now. And I can go way back to 1978, about these safety classification, safety, you know, I and II and III. Now, this is my understanding, if I was a teacher in the class, I would tell -- this is how I will classify it.

Category I, is like reactor coolant pressure boundary, or anything required to protect the reactor. It's like defensing death. The first defense is reactor coolant pressure boundary. So, that's Category I.

The second one, comes like containment. That's the defense, and that's number II. Anything which requires any affluent to get, any release getting out, will be in Category II, Safety Category II.

Three, is anything which try to eliminate, I mean reduce, the exposure to the radiation level getting out, will be Category III.

And now, same thing type quality group, is just corresponding to pressure boundaries A, Safety Category II is B, and like that, okay. So, that's my understanding and it should be discussed in regularly guide if you go back and they do go in some details.

MS. CUBBAGE: Chandu, Rich would like to try that.

MR. McNALLY: Yes. I can elaborate on that. 10 CFR 50, really establishes the basis for quality Group A for the reactor coolant pressure boundary, establishes that anything that's small enough that its failure could be overcome by normal reactor coolant make up, would be excluded from the reactor coolant pressure boundary.

Anything that's Quality Group A, of course, would have the highest level of quality. It's equivalent to ASME Section III, Class I. It has fatigue analysis applied to it. It's got the highest design requirements imposed on it, the highest material requirements imposed. And so this coincides with the risk informed categorization process.

Quality Group B, is a little lower quality, as Chandu indicated. It's typically identified in RG 126. RG 126 really distinguishes between Quality Group B and Quality Group C. Anything that's Quality Group A, B, or C of course, is safety-related.

Quality Group B represents ECCS systems, containment boundary and anything that's required for safe shutdown of the reactor. Quality Group C, is any support system, or any system that would result in a radiation release in excess of 10 CFR 100. So those three quality groups are the highest. They're equivalent to ASME Section 3, Class I, II and III. They're all Seismic Category I.

And there's also, in terms of safety class, that GE has indicated, that's based on ANS 58.14, which the NRC does not currently endorse at this point. It was considered too broad to endorse, but I am on a committee that is working to get that standard updated to reflect the new reactor designs.

And of course, that gets into other components that are not pressure boundary. It should be emphasized that Quality Group A, B and C are really just pressure boundary components and their supports.

MR. WALLIS: You mentioned the word, risk informed. But you didn't mention anything about probabilities. So, we assume that somehow this high probability is understood that ASME when they defined these categories and they know what they mean by high probability?

MR. McNALLY: Well, I believe these were

developed before the PRAs were ever applied. And of course, there is a risk informed approach that has been used now for operating reactors. But we're using a deterministic approach primarily here for advanced reactors.

And the RTNSS approach is really more of an illustration of the PRA risk-informed approach. And that does distinguish between the relative importance of various components. And those are thrown into the Quality Group D category.

MR. WALLIS: It's never been clear to me. I mean, you get something like out force and you go to the pressure allowed by ASME and there's never been clear to me how that translates into probability of failure.

MR. McNALLY: Well, that's --

MR. WALLIS: Is that, I think, made at some stage by the staff?

MR. McNALLY: That's not my particular area, but I'd say that is handled by the RTNSS process.

MS. CUBBAGE: It's a service levels -- are you talking about for ATWS, where the that's service level C? So basically, so there could be -- this is Amy Cubbage. Sorry.

Yes, I guess I'm not a mechanical expert, but it's expected that there could be some deformation. They'd have to do inspections before they could start up.

MR. McNALLY: I know one issue was brought up related to the importance measures. You raised the question on that. And staff did have recognition of these importance measures. And an example of something that was added because of risk, were the vacuum breaker valves. These were not originally included, but was recognized based on their risk significance as an important safety item and was eventually brought into the program and was categorized appropriately.

You know, one major issue here that is really fundamental to what we look at in satisfying GDC 1 and GDC 2, is the importance to risk. The way the criteria reads now, is that it's anything that's important to safety needs to be considered for seismic and also for appropriate quality levels.

And industry has emphasized the importance on safety-related components, as they should. But it's also recognized that there's additional components that are important to safety that may not be safety-related. And those are the ones that are included in the RTNSS process.

MR. WALLIS: The importance to risk measure of something, the importance to safety is a vague term because you don't know what safety is.

MR. McNALLY: Correct. So that's a way of helping to quantify it. But as we know, numbers can be manipulated.

MR. PATEL: All right. I'll just quickly summarize what we mainly use the RG 1.26 and 1.29, just to assure ourselves that the classification for seismic requirement and also the quality assurance is consistent with the regulatory guide. And our findings was that in general, they are consistent with regulatory guide 1.29. When I say, in general, it's because this one, this ESBWR because of the RTNSS issues, there are some of the, you know, differences in the quality group.

And we have still some of the open items related to that. Because it depends on the risk factor. If the system is important for the -- if it is risk-dependent type of a system, then we have to consider, you know, for the quality assurance also. And that is one of the open item.

Also, we made sure that there are -- there should not be any non-safety building to --

adverse impact of the non-safety building on the safety building. Okay. So, just giving the example, say like we had issue with the turbine building earlier. Of course, it was Safety Category II, so there was no problem. But now if they are thinking of making it non-safety, then we will have some of those type of issues still going on.

In general, they are in compliance with GDC 1 and 2. Other than there are two, three open items, and I will discussed those few items. The first one is, I think we already discussed about the diesel. We have already discussed this quite a bit.

And the second one is the one I'm talking about, basically, RAI 3.2-6, if you look at the safety-relation 14.2, it's all over. Because it's really widespread of the quality assurance purpose. We all have to look at each component, make sure whatever is significant of that system overall, and then decide on the quality assurance purpose. But that's why that open item is there.

And the last one, we yearly opened it after we issued the safety-relation for Rev 3. We had no problem with Rev 3. Okay, so this is because of Rev 4 changes.

MEMBER STETKAR: I was thinking about

something else, but when you look at risk significance for RTNSS determination, is it on an absolute or relative basis? In other words, is it a significance of a system relative to an absolute risk target, for example, 10^{-6} for damage frequency?

Or, is it relative to the existing evaluated risk, in other words greater than a 20 percent contributor to the evaluated core damage frequency. You understand what I'm asking?

MR. PATEL: Richard, do you have?

MR. McNALLY: Well, you know, again, the quality groups are really deterministic approach. They're not aligned with a particular probability value. RTNSS is different for Quality Group D. Those are non-safety related components that do have a relative importance. And those are -- can be calculated with the probability of effects would be, should they fail on safety.

And the list of those components are designated in the DCD under Chapter 19. That's an evolving list the way I understand it. It's just preliminary at this point and will be added to as the expert panel takes further looks at it. But that's the best we've got now.

We've noted that these are primarily

just active components and they're being assessed in terms of what impact they would have on safety should they fail.

MEMBER BLEY: I have a follow-up question about the qualification process, the deterministic nature. And I admit, I'm not fully up-to-date with how things are done today. Is there any requirement or standard practice that when results of qualification testing are submitted for NRC review, that they see the history of the testing, maybe, if there were several failures, and then changes or something leading to finally a successful qualification, do you see that history, or you just see the certification that component passed the test?

MR. McNALLY: Well, seismic and environmental qualifications is not really my area. I'm more concerned with 3.2. I would think that those records would be subject to audit by the NRC staff. I'm not sure that they're really at that point yet, other than we have a list of components that are subject to either seismic or environmental qualification and that those should be comprehensive of all the safety-related components.

MEMBER BLEY: We'd be interested in that

if it's possible to learn about that.

MS. CUBBAGE: Right. Our EQ reviewers will be sitting in front of you this afternoon.

MEMBER BLEY: Oh, today.

MS. CUBBAGE: Or, yes, today.

MR. PATEL: He's here. I guess. Maybe when we get to his section.

(Laughter)

MEMBER BLEY: Okay. I'll try to remember to ask again.

MS. CUBBAGE: He's our EQ, I was thinking about --

MR. McNALLY: Seismic.

MS. CUBBAGE: Mr. Scarbrough as well.

MR. PATEL: Mr. Scarbrough, he's here.

MR. McNALLY: At the appropriate moment.

MR. PATEL: Yes.

MS. CUBBAGE: We'll get there.

MEMBER MAYNARD: I want to make sure I understood a statement you made just a little earlier. You said you didn't have a problem with Rev 3, but Rev 4, apparently introduced additional questions.

MR. PATEL: Turbine building?

MEMBER MAYNARD: Turbine building. Yes.

MR. PATEL: It was categorized as Seismic Category II as of Rev 3.

MEMBER MAYNARD: Yes.

MR. PATEL: But in Rev 4, they changed it.

MEMBER MAYNARD: Yes. Now, I started to ask a question earlier, it shows you are reviewing as the revs come out or something that has change the conclusion that you had drawn on an earlier revision.

MR. PATEL: Yes.

MS. CUBBAGE: Absolutely. We actually had RAI milestones in the fall and into January, where we, the staff, made a comprehensive look at Rev 4, and we asked any additional RAIs we felt we needed to, based on the content of Rev 4. And this is a good example. We do have RAIs we've asked on this topic.

MEMBER MAYNARD: Because economic -- just if you have two things, they can close issues out, or it can raise new issues that you've already closed. So, I'm glad to see --

MR. PATEL: If there is no more question on 3.2, we can move to 3.3.

CHAIRMAN CORRADINI: Yes.

MR. PATEL: I guess for the wind and --

MEMBER BLEY: I'm sorry.

MR. PATEL: Sorry.

MEMBER BLEY: You got way past me because I notice there wasn't a review of 3.1. And I had a simple question about it, because something there just kind of got under my skin. Mostly that's the requirements, but under each one, you have a criterion, and they give a criterion.

MR. PATEL: Right.

MEMBER BLEY: And then they say, here's our evaluation against the criterion.

MR. PATEL: Right.

MEMBER BLEY: For example, the instrument and control system meets all these criteria, but there is no such system, and I didn't see an RAI or anything that said, we got to look at this later on.

MR. PATEL: No. Let me -- I was the person responsible for 3.1, so I could tell you what I did. I looked at the description in 3.1, and if you see, everywhere they say, for this, they will be discussing particular section. So, and I went through all the criteria in 3.1 and I guess I didn't look at for instrument one. In general, we --

MEMBER BLEY: Instrument controls.

MR. PATEL: Instrument control. Now, I do remember there was one in GDC, I think, 5. I believe. Because there's the shared system, I think for, you know --

MS. CUBBAGE: And that's if you have a multi-unit site.

MR. PATEL: That's right.

MS. CUBBAGE: This is a certification for one unit.

MR. PATEL: And that criteria is not applicable here. But other than that, I quickly went through and I did not see any need for discussing here what, you know, if you have any particular question, that should be addressed in the particular, whichever design criteria is applicable, it should be discussed in that section.

MS. CUBBAGE: Let me try. We don't have a specific SRP that tasks us in this chapter to do this. All the other SRPs do it. The SRP for Chapter 7, you ensure that the appropriate, right in the SRP, it will say, GDCs X, Y, or Z are applicable here and we make a finding in Chapter 7 that they either have or having met those GDCs.

MEMBER BLEY: So, 3.1, really --

MS. CUBBAGE: It's a point. It's a

point.

MR. PATEL: It's just a --

MEMBER BLEY: It's a map.

MS. CUBBAGE: It's a map.

MR. PATEL: Yes.

MEMBER BLEY: So, there's no -- okay.

MR. PATEL: There's no excerpt, there's nothing.

MEMBER BLEY: There's no review of that directly.

MS. CUBBAGE: Right. But Chandu went ahead and did a sanity check on it to make sure that everything was being covered.

MEMBER BLEY: That was just my -- it doesn't say it will be this well, it says it is. But it's over in the other section where you chase that. Fair enough.

MR. PATEL: And just to make sure, what I did, I just looked at past evaluation safety-relation and I was consistent. Whatever they discussed, then I just made a very simple statement saying, this is what we're discussing in sections.

Okay. Ready to go next.

CHAIRMAN CORRADINI: Yes.

MR. PATEL: For wind and tunnel loadings, we have discussed this out. They have designed for, first of all, we did use the Regulatory Guide 1.76 and as it was pointed out, for tornado wind, they are exceeding the requirement of 1.76. So we did not have any significant problem with any of the issues in this area.

There was only one thing which we wanted to make sure and that was the open RAI which we asked them, because the Radwaste Building, it was not originally -- they were not intending to design for the same wind speed of 330 miles per hour, and we had to ask some follow-up questions, and finally they decided to qualify Radwaste Building for the tornado wind velocity whatever they have at (b)(2). And so they issue in Section 3.3, were all resolved.

Now there was a discussion earlier -- just let me make sure. Yes. There was discussion about ASME standard, and if there any more question, we can discuss more about tornado loadings. But that we also can do in 3.5.3. But is there any question about you were asking about -- stop to discuss about tornado loadings? Or, it looks we don't need to go.

CHAIRMAN CORRADINI: We're happy. We're happy.

MR. PATEL: Okay, good.

MR. WALLIS: I'll ask you about this wind pressure. What do you mean by wind pressure? The pressure varies around a structure when there's flow past it. And you have to know how to calculate the variation of pressure around the structure, not just some pressure somewhere. Do they know how to do that without testing?

MR. SHAMS: I'm sorry, what was the question, one more time?

MR. WALLIS: If I put a building in a strong wind, I get all kinds of different pressures in different places. I may get a lot of suction on certain places, for instances. Do they know how to calculate those things of any old building of any old shape. I'm not sure that they do without a test. Do they have to put it in a wind tunnel?

MR. PATEL: You want to answer, or do you want me to?

MR. SHAMS: You want to take a shot at it, go ahead.

MS. CUBBAGE: GE's stepping up.

MR. RAJENDRA: This is Clement Rajendra, GEH. ASC 702, provides additional factors for shape, height, et cetera, to adjust the direct velocity pressure to the actual forces on the building.

MR. WALLIS: So, there is a format for doing all this.

MR. RAJENDRA: That's correct. And similarly, we have for tornado loads. The BC topical report provides the associated factors to convert to -- from the velocity pressures, to convert that to the actual forces on the building.

MR. WALLIS: What is a velocity pressure now? That's not a technical term I'm familiar with.

MR. RAJENDRA: Velocity pressure is simply a conversion of the velocity to a pressure, a force. But then how that, the shape of the building, the exposure conditions, all of that factor into a total lateral load that is applied to the building. Those are additional factors that you take that into account.

MR. WALLIS: But does this include fluctuating pressures?

MR. RAJENDRA: If by fluctuation, you mean gas, that is included.

MR. WALLIS: Is this a question of where I should look at the standards and see if it's adequate?

MR. RAJENDRA: That is correct.

(Laughter)

CHAIRMAN CORRADINI: I think they'd be glad to get those for you.

MS. CUBBAGE: The question while GE was up about the standards in this area, and Mohammed Shams would like to address that.

MR. SHAMS: I would like to address Dr. Wallis's question about whether or not ASCE 7 process considers the density of the air, or you know, things of that nature. I just wanted to highlight, I'm not going to directly say yes or no. But I'd just would like to highlight that ASCE 7 standard has been around for over 30 years. And it's a consensus standard. It's the state of the air for wind calculations. They based a lot of their provisions on wind tunnel testing. A lot of their provisions also were calibrated based on results after storms.

So, they went and took all these considerations into account. So, it is a reliable standard to the most of our knowledge.

MR. WALLIS: Thank you.

MR. PATEL: So we go to the next slide. This is for external and internal flooding. We staff did look at the GDC, Section 3.4.11 for external flooding and internal flooding. The external flooding is from the resulting of natural phenomenon. And there's a statement, I guess, as they discuss in GDC, they have -- they are going to design for the maximum flood level plus one feet above the maximum flood level. So, it will be a kind of a site specific flood level. They have to decide on a plan specific, site specific, and then one feet above that.

For the external flooding, there is no concerning.

MR. WALLIS: Where does the one foot come from?

MR. PATEL: Well, that's what GE decided --

CHAIRMAN CORRADINI: It comes from the URB.

MR. WALLIS: But the television last night said that the Mississippi might get significantly above the highest flood that's ever recorded. It may be more than one foot. Is the magic number one foot adequate?

MR. RAJENDRA: This is Clement Rajendra, GEH, for the 3.5 design, it's not site specific. We have to set these flood levels and ground water level at some point. And for that, we use the URB as guidance. So these, the two -- the one foot for flood and the two foot for ground level comes from the URB specifications.

Now, each site then, has to then look at their flood level and make sure that their flood level is below this one foot. If it does not, it becomes a departure, and that has to be addressed as a departure.

MR. WALLIS: If you had a flood which is large, you have waves on that flood? Where the wind blows, I would think waves bigger than one foot are very common.

MR. RAJENDRA: Well, since the flood level is below -- the highest flood level is below the finished ground elevation, there is no issue of floods coming in -- waves coming up. If the flood waters are above the ground, then you would have waves.

MR. WALLIS: Where did the one foot come from?

CHAIRMAN CORRADINI: URB.

MR. RAJENDRA: URB. It's arbitrarily chosen for the standard design.

CHAIRMAN CORRADINI: Tell him what the

URB is, I apologize.

MR. RAJENDRA: Utility Resolution Document.

MR. WALLIS: -- is one meter?

MR. PATEL: No, one feet. One feet.

CHAIRMAN CORRADINI: Yes, one foot.

MR. WALLIS: It seems low to me as a margin. One foot is nothing to compare with the size of a big flood. That bothers me. It seems a very small margin.

MEMBER SHACK: You put all the margin in the design flood.

MR. RAJENDRA: Yes.

MR. WALLIS: I guess the staff has it all under control.

MR. PATEL: The only issue for internal, this external, internal flooding which we had open item, was -- one was the emergency operating procedure. If they had external floods, then they should have some type of operating procedure how they're going deal with, and that item is closed now.

And the other one is for the RTNSS, there was no discussion about how they were going to protect the RTNSS system. And that is, now we will be following, coordinating our review with RTNSS people you know, and that's area 22.5-5.

And the third one, open item was I guess this was the NRC, so I'll just tell something. We were not convinced completely we are to make sure ourselves that whatever calculation they made for internal flooding, that there was some good basis for it. So we asked them to prove up, review the calculations. Because we did not have any detail dimensions in everything. And after we showed the safety-relation, we have looked at the calculation and convinced all staff that it was okay. So, that item is closed.

MEMBER BROWN: So the third bullet is the internal. I mean, that's like pools of --

MR. PATEL: Yes.

MEMBER GROWN: Pools dumping down into the drywall, that type of stuff.

MR. PATEL: Internal floodings, right. In earlier version of DCD, we had no dimensions and other things, so we could not independently say, okay, what GDC is okay. So, we wanted to look at detailed calculations. And we ran, and we have confirmed that it's okay. So it is closed.

MR. WALLIS: I was concerned when I read

that GEH assumed a volume of water and found out high the level would be. Where does this assumption come from? It must come a design of some sort. You can't just assume an arbitrary volume of water. It must know something about the size of attack or something.

MR. PATEL: Yes.

MR. WALLIS: So, you can't just assume it. This bothered me, the word assume. You know, they must take the volume of water, which is actually designed, and then see what it does. Is that what they did, or did they just assume a volume?

MR. PATEL: Dave. Do you have -- he's the guy who looked at calculations. Dave Shum will answer.

MR. SHUM: My name is David Shum, I'm from pipe system branch. And we know that crack -- the size of break they're shown -- I mean the design pipe break area. So we know that --

MR. WALLIS: And you know the volume of water that could --

MR. SHUM: And you know water, how much water falling out of the crack at the pipe break.

MR. WALLIS: So you didn't assume

anything. You know these values.

MR. SHUM: We -- I mean --

MS. CUBBAGE: It's a postulated.

MR. SHUM: Right.

MEMBER BROWN: It's a postulated crack. They assume it gets there. They know the amount of water.

MR. SHUM: So, you kind of -- you know, you kind of say, for example, you've got a fire protection pipe --

MR. WALLIS: So the SER is wrong. You did not just assume a volume of water, you know how much volume of water you he.

MR. SHUM: You postulate.

MEMBER BROWN: Well, just hold it. If a fire pipe breaks, and you've got something pumping water in, you have to make an assumption as to when you turned the pump off, I guess.

MR. SHUM: Yes.

MEMBER BROWN: Other wise, because that's fire protection. So this is just going to keep pumping the water in there as long as the pipe breaks and there's nothing restraining it, if you're pumping water and you've got a giant tank. I mean, did you all include looking at the PCC and the GDCS water breaking and flooding down into the dry well area? Yes or No?

MS. CUBBAGE: Or, GE, would you like to?

MR. SHUM: No.

MR. RAJENDRA: This is Clement Rajendra. Those big GDCS pools, there is no postulation that those would break and the water will flood. They are designed to Seismic Category I standards, and they are not postulated to break.

MEMBER BROWN: So there is no, they will never fail.

MR. RAJENDRA: Well, they're not postulated to fail.

MR. SHUM: They should not fail by design.

MR. RAJENDRA: By design.

MEMBER BROWN: So if all the water came down in there, you didn't look at that?

CHAIRMAN CORRADINI: Not within the design basis space.

MR. RAJENDRA: Basis.

CHAIRMAN CORRADINI: But within the PRA, it better have been looked at.

MR. PATEL: This kind of, yes.

MR. WALLIS: But the fire protection

system, you assume that all the water in the tank flooded?

MR. RAJENDRA: No. There is an assumption that the break, the leak will be detected and isolated within a certain time period specific.

MEMBER BROWN: Okay, so that's how you determine the volume after that.

MR. RAJENDRA: Yes. Right. That's right.

MR. WALLIS: So, it's the time period.

MR. RAJENDRA: There's a time period.

CHAIRMAN CORRADINI: Thank you.

MR. WALLIS: So it's not an assumption.

MEMBER BROWN: They picked a time which is an assumption.

(Laughter)

MR. WALLIS: I just think that it should be clear that these are not just assumptions out of the blue, they have some basis.

MR. PATEL: I guess I should have made an earlier remark that some of the sections were very small, you know, and this would be one of the area which I would like to skip if there is a --

CHAIRMAN CORRADINI: No, skip it.

MR. PATEL: Exactly. Because there's not

much you know, in this. Again, for this internally generated missile, we have looked at -- I'll go both internally generated missile inside containment and outside containment. So, we'll make it faster.

Basically, we did look at the missile and what kind of missile there could be. They -- GE has categorized for outside data, categorized like two types of missile, rotating, and rotating component and also pressurized component.

We did look at what will be like possibility, if there's any possibility of real generation of missile. And our conclusion was there is no significant impact. And we had no issue other than RTNSS system again. The have not provided any protection, or at least, we were not clear about RTNSS system protection. So that was the only open item in that area, for both.

Only difference between inside and outside containment is inside containment, they included one more possible missile is gravitational missile. You know, if you have some hoist sitting around and then they forget to, you know, stabilize it and something happens. So that was the only difference.

But basically, you know, as we had

concluded for the outside of containment, there was no significant impact from this internal missile for the inside and outside containment. So, that takes care of SRP 3.5.11 and 3.5.12.

MR. WALLIS: No, I was a little concerned.

MR. PATEL: Yes.

MR. WALLIS: You said there was a 10^{-7} per year screening criteria.

MR. PATEL: That -- these are the probability of like, what kind of missiles can you have. You know, like, if you were to -- previous one. Select. Rotating equipment, what kind of impact they can have. And we looked at it, and there's 120 bolts. You know, you cannot penetrate, you would need repairs. It would not penetrate the casing.

MR. WALLIS: It just -- the thing that interested me is you had a probabilistic screening criteria 10^{-7} per year. But then your discussion of the ASCR was very qualitative about how robust things were and things like that, which doesn't give me any number. It just says they're robust.

MS. CUBBAGE: Are you looking at internal versus external?

MR. WALLIS: Is there a probabilistic basis somewhere for these claims that it's robust enough?

MS. CUBBAGE: I think the issue is internal versus external. I think you're getting them --

MR. PATEL: No, but he's asking is that for acceptance criteria 10^{-7}. And Dave, correct me, Dave this one does not have 10^{-7} criteria.

MR. SHUM: This --

MS. CUBBAGE: You've got to get to the microphone.

MR. PATEL: Yes, this one is just for qualitative purpose. The other one is later on, coming for, in the next section. What you're talking about, 10^{-7}, it comes later on.

MS. CUBBAGE: This is a deterministic --

MR. SHUM: All this data --

MR. PATEL: This is a deterministic approach here.

MR. SHUM: All this data from, you know, as stated in the SER 3.5.1 are from Reg Guide, I mean, the standards. Off hand, I don't remember exactly where, it's 1.76, or something like that. Because I didn't write this.

MR. PATEL: What, 3.5.11.

MR. SHUM: All this data, you see the rate of occurrence of missile, P sub(1), that's less than 10^{-7}, or P sub(2), blah, blah, blah.

MR. PATEL: Yes, okay.

MR. WALLIS: Well, I'm just saying, that when I read the section that you're, the page 342 to 350-something, there seemed to be a lot of qualitative statements about how the explosive squib valves were unlikely to produce missiles and all these components were very robust. There seemed to be such qualitative statements, I just wondered if that was good enough. And I just wondered how much of this conclusion is based on a sort of a sense that things are all right qualitatively, or is it based on some evidence which is more substantial.

MR. PATEL: I think this 5.1.1 was really on a qualitative analysis. Yes, I -- this discussion in 3.5.1 which was, it's not really 3.5.1, this was generally discussion which is applicable later on. If you go on to the on site missiles and all that thing, you know, because 3.5.1 has no -- there is no acceptance criteria like, there's no SRP which is 3.5.1, per se. So, this is a description was for general purpose which could be applicable to all 3.5 -- on all missiles. So, 3.5.1.1 which was really, this is only qualitative acceptance.

MR. WALLIS: Qualitative acceptance means staff judgment?

MR. PATEL: Yes. That's what we use.

MR. WALLIS: And there's no way I can quantify how good the staff's judgment is?

MR. PATEL: If you think about it, we do have some discussion about failure of the rotating equipment and what is the, you know, possibility for this to become a missile. And it's ending in judgment that says, it might penetrate the you know, pipe casing, but it will not damage anything. And that's a judgment call.

Now, 3.5.1.3, the turbine missiles. This is the issue here. As of Rev 3, we were okay. Everything was fine and we -- what you were talking about, that they will be providing the proof that it will be 10^{-5}, you know, probability and all that. And we had no problem.

And then they change, and now we are again, we have finally resolved and made it an ITAAC issue. They will be solved, they will be resolved with the ITAAC.

CHAIRMAN CORRADINI: What does that mean here?

MR. PATEL: That, okay, first of all --

CHAIRMAN CORRADINI: Let's take this one, which I think I kind of maybe understand.

(Laughter)

CHAIRMAN CORRADINI: Explain to me how you're going to resolve it at the ITAAC stage.

MR. PATEL: In the ITAAC it will say, well, first of all, let me just make sure everybody's up to speed.

CHAIRMAN CORRADINI: No, no, good. This is good. A tutorial is good. Go ahead.

MR. PATEL: Sub (1) orientation, okay. This is a very favorable turbine orientation. If you look at so many plants, operating plants, and I have been involved with, Vine, Redwood, all I don't -- I couldn't name some of the things.

CHAIRMAN CORRADINI: We didn't hear that.

MR. PATEL: Okay, good. I'm sorry. They are not favorably oriented. This is the best orientation. So, given this best orientation, the acceptance criteria is like 10^{-4}. If you can -- by looking at the material, when applicant receives the turbine, they will have to go through all of the missile generation, and they will have to prove it to us that it will be less than 10^{-4}.

And the confusion, and we looked at the DCD, it started, it says GE recommends that it should be less than 10^{-5}. But our acceptance criteria is 10^{-4}.

MR. KRESS: What's the basis of that acceptance criteria?

MR. PATEL: Well, okay. Now --

CHAIRMAN CORRADINI: Are you just asking how you actually determine it? That's what I'm still struggling with.

MR. PATEL: Yes. Yes.

MR. KRESS: No, I want to know why it's good to go.

MR. PATEL: No, no.

CHAIRMAN CORRADINI: Why is it good now?

MR. KRESS: Yes. Why is it a good number. How do you determine that's the number?

MR. PATEL: Well, first of all, I'm not responsible --

(Laughter)

MS. CUBBAGE: No, no, no, no.

MR. PATEL: George.

MR. GEORGIEV: My name is George

Georgiev. I'm with the division of engineering, the component integrity section. The question as I understand it, how these numbers get derived and accepted by the NRC.

We have guidance on the street, it's a regulatory guide, and standard review plans. And this was published and operating experience indicate that these numbers are good. But a little tutorial of how it works.

At this design stage, there is no turbine built. If GE would have done bounding analysis to postulate certain conditions and come up with numbers, a type of a report would have given you these numbers. At this time, we have no numbers.

But when the turbine is procured at the site, as a part of the turbine, the turbine manufacturers develop this report which include results of inspection, results of materials, properties such as impacts, strength of the material et cetera.

And the results of the pre-service inspection and the results of the material properties, you can use to calculate crack growth and postulate within how many years something bad will happen with the turbine. And that factors into the turbine maintenance program, which means how often you're going to open up the turbine case to look at it and inspect it. And that's why it's important that the better turbine material you have, the better the low probability, the less often you have to go and inspect the turbine. And that's --

CHAIRMAN CORRADINI: And then the second part of the question that Tom asked, is why is 10^{-4} acceptable, what's the basis for that?

MR. KRESS: In the first place, that's a probability, and is that over the lifetime of the reactor?

CHAIRMAN CORRADINI: Per year. It's per year.

MR. GEORGIEV: Per year. Yes. Per reactor. It is a frequency, yes.

MR. KRESS: The units didn't indicate that.

MR. GEORGIEV: And 10^{-4} is a number that the staff has determined is acceptable for favorably orientated turbine. If it's unfavorably oriented, then it goes by one, or the magnitude.

MR. KRESS: Yes, I understand a limit, my question is, why is it that.

MR. PATEL: Okay. Let me try. I'll take a shot. This just happened in my -- I just thought of something. Because you have favorable orientation, right? First of all, you've got P1, which is 10^{-4}. Now you have to figure out what is the probability that will hit the critical target. In this case, it's pretty low. And as long as total probability is less than 10^{-7} which is our acceptance criteria for any --

MR. KRESS: This is derived from the 10^{-7} value, you're saying?

MR. PATEL: Yes, yes. You know, there is very little probability that there's anything, it's going to be hit. So as long as you keep 10^{-4} you're okay. You know, this is my interpretation, okay. I have not seen any regulation, but this is what I would think that that's the logic, that there's no critical target. I used to do this thing in '74.

MR. KRESS: It's the starting point, is a 10^{-7} for critical data. And you can back it into the missile finding from there.

MR. PATEL: Yes.

MR. KRESS: That makes some sense.

MR. PATEL: Typically, this is Busch. I don't know how many guys remember Busch. These were the people in 1972, like for turbine missile. Most of the time, this failsafe failed between, most critical is like five degrees this way, that way. And as long as you avoid that angle, you are okay.

CHAIRMAN CORRADINI: And in your analysis, or your design -- not your design, sorry. GEH's design, the window was 25 degrees?

MR. PATEL: It's a big, you know. So you know, that's why it's really, this is the best design. I mean I'm not a salesman for GE.

CHAIRMAN CORRADINI: I understand.

(Laughter)

MR. KRESS: The probability of hitting that window --

MR. PATEL: Exactly.

MR. KRESS: -- is, you take the whole spherical volume around it, and you take a fraction of that spherical volume. And that's the --

MR. PATEL: It's a very, very -- there's no critical target in that area. You know, if you are really very conservative, not even --

MR. KRESS: It's a volume and not an area. Or is --

MR. PATEL: Well, I guess you can -- you have --

MR. KRESS: An area of sphere or something.

CHAIRMAN CORRADINI: No, it's a -- because it can go high. They look at all that.

MR. PATEL: It can go real high.

MEMBER STETKAR: You do high missiles and low missiles.

MR. PATEL: Yes.

CHAIRMAN CORRADINI: One last thing, and then we will stop bothering you.

MR. PATEL: Okay.

CHAIRMAN CORRADINI: So now I understand the 10^{-4} for the number. Now, you had grades that after, if it's 10^{-2} you have six days' operation. So this must be experiences occurring of the same turbine somewhere else in the population of those types that during that time, you experienced some other missile being thrown, I assume. Because it's not going to be that particular machine.

MEMBER STETKAR: High vibration indications.

CHAIRMAN CORRADINI: It's a high vibration.

MR. GEORGIEV: Well, this brings in the vibration, the over speed protection and various other factors.

CHAIRMAN CORRADINI: Okay. That's fine. That helps me a lot.

MEMBER STETKAR: I don't want to let him off the hook though.

CHAIRMAN CORRADINI: Thank you.

MEMBER STETKAR: Since I've established that the SER applies to DCD Rev 3 and a half, certainly 3 to 4, there are no open items this particular topic on turbine missiles.

MR. PATEL: Yes.

MEMBER STETKAR: My question is, and I recognize now that in Rev 5 of the DCD, we've moved diesels around, and we have a new building, but I'm going to play the game for this SER, which is 3 and a half, or 4. In Rev 4 of the DCD, the electrical building contained the diesel generators and the plant, whatever they are, PIPs, the busses, the PIP busses that provide power to the safety-related battery chargers and so forth.

So, my question is, why is there not a concern in this SER with respect to turbine missile damage to RTNSS equipment. Because there are concerns in the SER in other type, seismic damage to RTNSS equipment, environmental qualification of

RTNSS equipment --

MS. CUBBAGE: Yes, I'm going to take this one. The electrical equipment you're referring to was never B1. And we've gone away from B1, B2. If you were at the PRA meeting, and how it's gone. It was never B1. So, B1 was the stuff that needed to be protected.

MR. SHAMS: I can also try.

MEMBER STETKAR: Okay.

MR. SHAMS: Mohammed Shams. We actually approached the issue in a different route, which is, we were engaging GE to prove that whatever classification they have for this RTNSS equipment is sufficient. And we were going at it that way, knowing that there is missile issues, knowing that there is seismic issues. And that approach actually succeeded knowing that in Rev 5, they recognized that whatever they had is inadequate, and they moved things around and changed the design.

So, it's not like we ignored it, we just approached it in a different way.

MS. CUBBAGE: Right. You wouldn't have seen a chapter 3 RAI that the staff had chapter 22 RAIs on these two.

MR. SHAM: Right. We had in 22 RAIs --

MEMBER STETKAR: No, I get it.

MS. CUBBAGE: With classification and design.

MR. SHAM: We approached it --

MEMBER STETKAR: Okay.

MR. SHAM: -- can you prove that this equipment is actually, can be reliably available after an event, external event.

MEMBER STETKAR: Okay. Thank you.

CHAIRMAN CORRADINI: Keep on going.

MR. PATEL: 3.5.1.4, these are again, tornado generated missiles. And we reviewed and there was no, any open issue with this one. And I guess we have beat the tornado-thing quite a bit. Is there any question on this, in this area? It did comply with the regulatory guide 1.76 and 1.76, so. If not, then I'll go to the next.

Site proximity missiles, you know in the, I'll go to the next -- both slides at the same time, aircraft hazard. They are very much similar. And both of these, site proximity missiles, accept aircraft, and also the aircraft, they fall into the category of the site specifications and they are, you know, included in Chapter 2, table 2.0-1, and also they are supposed to be addressed by COL applicant. And they will, they should be able to prove it to us that the probability of missile is 10^{-7}.

MR. KRESS: If you have a site or you have multiple sources of external missiles, do you keep each one of them at less than 10^{-7}, or is it the summation of each one of them?

MR. TAMMARA: The total probability.

MR. KRESS: It's the total. You add them all up.

CHAIRMAN CORRADINI: Come to the mike, please.

MR. TAMMARA: My name is Rao Tammara. I reviewed the 3.5.1.5 and 1.6. This will be the total probability of all the --

MR. KRESS: All of them.

MR. TAMMARA: All incidents or accidents or whatever. So, it's accumulated effect.

MR. KRESS: That's what I wanted.

MR. TAMMARA: Total, yes.

MR. PATEL: 3.5.2, the critical components are protected by externally generated missiles. We have looked at all the critical component, and it showed that they are protected. They are located in, they call it, tornado registered building. You know, and that's why the protection. So in this section, we did not have any significant open item, other than, again, RTNSS. You know, we are -- we were not -- they did not address RTNSS-type of issues, okay.

3.5.3, that's the one which is, I think, we have no significant problem because they have designed all the thickness off up to 330 mile per speed, concrete thickness of the building. So they are much more conservative than what we would have required according to the RG 1.76. So, in this area, we have no concern. Is there any question on this. Okay.

I guess we're go next to Mohammed Abid will discuss about Chapters 3.10.

MR. ABID: I am Mohammed from the division of engineering dealing with mechanics branch of NRC. And I'm going to be discussing SRP Section 3.10 for the ESBWR design specification for seismic and dynamic qualification of mechanical and electrical equipment.

We reviewed the applicants matters of test and analysis employed to ensure the structural integrity and the ability of Seismic Category I. Mechanical electrical equipment including the I&C

components under the full range of normal and excellent loading, including seismic and the reactor building vibrations.

We have listed the reg guides that GE used in their design. And I don't have to go one-by-one, and also the industry standard, IEEE 344, 1987. 1987 was endorsed by NRC by Reg Guide 1.100, Revision 2, in 1988.

Next slide. We have SER items of interest. We had like three open items, three RAIs that remain open. And based on the Revision 5 of the ESBWR design certification, they're closed now. I can go details on these.

3.10-1, we requested -- this RAI requested General Electric Hitachi to revise the COL information to require COL applicant to provide a milestone for submitting and implementation schedule for seismic and dynamic qualification of ESBWR mechanical and electrical equipment.

In its response, GE stated that DCD tier 2, Section 3.10-4, would be revised accordingly in Revision 5. And we confirmed that; we looked at Revision 5, and they did that. And we consider this RAI closed.

RAI 3.10-6, requested GE Hitachi to

provide basis for the assumed number of SRV actuation events --

MEMBER BROWN: Before you go on, you talk -- you wanted a schedule, an implementation schedule. I'm just trying to understand what this is. It's a milestone for submitting an implementation schedule. So they've agreed to submit a schedule.

MR. ABID: They have provided a section that agreed, yes.

MEMBER BROWN: For seismic and dynamic qualification of all the mechanical and electrical equipment.

MR. ABID: Yes.

MEMBER BROWN: I would presume then they would then identify all the lists of equipment and when they would be qualified, or tested? Because, am I reading too much into this?

MS. CUBBAGE: This is a schedule that we've asked that a COL item, such that the COL applicants would commit to providing milestones at which time they'd be implementing these programs and the staff would have an opportunity to audit the implementation.

MEMBER BROWN: So, this provides a tag to go pull on --

MS. CUBBAGE: Right.

MEMBER BROWN: -- once a licensee is going to use the plant, is going to start his procurement design process, what-have-you. Am I -- and so now, you have this schedule that he then commits to to provide this information to you all?

MS. CUBBAGE: Right.

MEMBER BROWN: To NRC, to the staff.

MS. CUBBAGE: Not GE, but the combined licensed applicants.

MEMBER BROWN: The combined licensee.

MS. CUBBAGE: This is consistent with Commission policy in SECY 05-0197 on operational program reviews. And, yes, basically --

(Laughter)

MEMBER BROWN: I'm on top of that one.

MS. CUBBAGE: Yes.

CHAIRMAN CORRADINI: If it wasn't on the record, don't worry.

MEMBER BROWN: This part?

MS. CUBBAGE: Yes. The Commission has indicated for, in our policy, has said that the operational programs will be implemented after issuance of a license, and there will be licensed conditions that must be fulfilled so that these programs are implemented.

And so the Commission policy was that these programs would be described in the FSAR, and then we would have the licensed conditions for implementation.

MEMBER BROWN: Okay. Now, is it possible to have this thing that you get submitted tell you whether they're going to do this qualification by test or analysis --

MS. CUBBAGE: I think we'll have to defer --

MEMBER BROWN: -- so that the licensee identifies --

MS. CUBBAGE: I'd have to defer to --

MEMBER BROWN: Have him identify when you get this list, I mean, it --

MS. CUBBAGE: I'll need to defer to the technical staff as to whether they need to know at this stage whether it's going to be a test or analysis, or if it's sufficient that the equipment will be qualified.

MR. SHAMS: Can I try to answer that?

MEMBER BROWN: I'm not sure yet, because I'm not sure I got the question right.

MR. SHAMS: I think I got it. I've been hearing your question all day, and I'll just take a shot at it.

MEMBER BROWN: Yes, I love to repeat, so, it's an old habit.

MR. SHAMS: I think the process starts there. There's an IEEE that has several ways of qualifying an equipment, be it analysis, design, or testing. I'm sorry, be it analysis or testing. And your question was, when do I get that piece of information?

I think the staff is at the other end of that equation in the sense that, whatever the applicant gives to us, we have the ability to quantify, did the analysis actually, is it appropriate for an equipment like this? Can I analyze a cabinet, an electric cabinet with relays inside of it? That's not an analysis problem, that would have to be a test problem.

So, at this point, is where we say, no, analysis would not work, here, that would have to be a --

MEMBER BROWN: Okay. I'm not looking for it to say, what they would, but that they provide a basis for the decision as to whether they test or analyze. I mean, that's what you would need, I would think.

MR. SHAMS: I would imagine they would have to provide a basis. And if again, if the basis is not provided, the staff has the ability to say, is analysis an appropriate approach to qualify this piece of equipment.

If you're qualifying a pipe, I'd say analysis could be appropriate. If you're qualifying an electric cabinet, I'd say analysis is not appropriate.

MEMBER BROWN: Okay. But shouldn't when they submit that, why wouldn't they automatically, if they're going to say analysis, why wouldn't they have to say what the basis was at the same time as opposed to you coming back and saying, gee, what's the basis, you didn't give it to us.

MR. SHAMS: Right. I think the answer for that is because the detail is not at this level of the design, and --

MEMBER BROWN: No, no. I understand that. I'm saying, when they submit the paper saying what they're going to do, that they don't omit the basis at the time they come to you, at the appropriate time when they're doing the design procurement testing decision process.

MR. SHAMS: I would imagine that --

MEMBER BROWN: Not that they know before. I'm not trying to get to --

MS. CUBBAGE: To fulfill the ITAAC, the licensees will have to have all the documentation to support their conclusion that they have qualified the equipment appropriately. And then the NRC will be able to inspect that.

MR. ABID: The functional requirement of the component will drive testing on the design.

MEMBER BROWN: Say that again?

MR. ABID: I think the component -- it depends on what kind of classification component has.

MEMBER BROWN: Oh, I understand that.

MR. ABID: What kind of safety content is going to provide, you know, Class IE will be tested, definitely. Non-Class IE, you can go by training of the type of equipment, you know. Sensors, their strength, there's two different things. Sensors will be tested, some will be analysis, you know. We discussed that before with G.

MEMBER MAYNARD: I think some of this will come down to a commercial risk for the licensee. The sooner they provide it, the more -- the less likely of a delay of having to redo it. If they wait until the end and it's not acceptable, then they may have a delay in their --

MEMBER BROWN: Your point is the one I'm trying to make. When they submit this, and say, we're going to, here's the list, we're going to test, analyze, test, analyze, that now the staff has got that, and they say, why is analysis okay? But it's now four years, or three years into the process, and now it's a little bit late. Because it's a risk. It's a risk.

MS. CUBBAGE: The operational program review, you know, we can go out and look at their program before they implement it. And then, after they implement it, we can verify by ITAAC. So there's an opportunity --

MEMBER BROWN: All I'm really interested in, Amy, is when they send you the list, it says what's going to be tested, what's going to be analyzed, they provide a basis at that time for why they're going to do an analysis as opposed to --

MS. CUBBAGE: I personally can't answer that question as to when we'll know --

MEMBER BROWN: No, not when you will

know, that they will tell you why they're going to use -- is this -- am I that hard?

MS. CUBBAGE: I understand what you're saying. I just can't answer you.

CHAIRMAN CORRADINI: They just won't get it approved.

MEMBER BROWN: I quit. Go on. I've thrown in the towel here. I've just been beaten into submission.

MS. CUBBAGE: No, I understand what you're asking and we'll try to get you an answer.

MR. PATEL: As for 3.10-6, I guess if you have anything.

MR. ABID: Any questions on 3.10?

(Laughter)

MR. ABID: All right. 3.10-6. Requested GEH to provide basis for the assumed number of SRV actuation events and the total SRV durations stated in the DCD. In its response, GEH stated that ESBWR design with isolation condenser system and its large steam volume results in zero SRV openings. During design, this is anticipated operational equivalencies.

Because ICS is sized to prevent SRV actuations with 3 or 4 trains in operation, Section

5.4.6.3 is the reference in the DCD for that, GEH concluded that the number of SRV actuation events and the total SRV test durations as stated in the DCD is conservative.

The staff finds GEH response satisfactory for the assumed SRV actuation events and test durations. And we consider the RAI as closed.

MEMBER BROWN: The design basis anticipated operational occurrences, it's just normal operation, or is this a design-basis earthquake, or? I have no idea what it is.

MR. ABID: Anticipated -- operational, sorry.

MR. PATEL: Anticipated operational.

MEMBER BROWN: That's an earthquake?

CHAIRMAN CORRADINI: Yes, that's an earthquake.

MEMBER BROWN: So it won't activate during the design-basis earthquake.

MR. ABID: That's correct.

MEMBER BROWN: Okay, thank you.

MR. PATEL: Let me just make the record, I think, clear. I believe AOO, Anticipated Operational Occurrences, is also considered like the first level of a transient. It happens.

MEMBER BROWN: You mean a power transient.

MR. PATEL: Yes. Yes.

MEMBER BROWN: A big power demand, or a turbine generator, a valve trip.

MEMBER STETKAR: There's some definitions in there.

MR. PATEL: Yes. That's the lowest level of --

MEMBER BROWN: Okay. So, it's operation --

MEMBER STETKAR: No frequently than roughly one in --

MR. PATEL: I just want to make sure everybody --

MEMBER BROWN: So it's not just for the -- I doesn't happen an earthquake, but during major plant transients as well.

MR. PATEL: Yes. It's no --

MEMBER BROWN: Okay. That's fine. Thank you.

MR. ABID: Can we go to RAI 3.10-8, requested GEH to address the adequacy of the seismic qualification of ESBWR mechanical and electrical equipment for plant site and High-Frequency seismic excitation.

In its response, GEH stated that ESBWR certified seismic design response spectra uses a single envelope ground motion containing both low frequency and high frequency ground motions to generate in-structure response spectra for use in seismic qualification of mechanical and electrical equipment. The seismic qualification of ESBWR mechanical and electrical equipment meets the IEEE 344 1987 requirements.

The concludes that ESBWR design is adequate for plant site with high frequency seismic excitation. RAI 3.10-8 is considered closed.

MR. PATEL: Is there any question? Can we go to 3.11?

CHAIRMAN CORRADINI: We're going to come back to this one a lot of times. So I understand it in this context.

MR. PATEL: All right. Amar Pal will be discussing our evaluation for 3.11.

MR. PAL: Good afternoon. I'm Amar Pal. I'm with the NRO/DE/EEB. I'm going to talk about the environmental qualification of the ESBWR design.

The regulations and the regulatory

guide, next slide, applicable for this section are 10 CFR 50.49, 10 CFR 52.47 (b)(1) for ITAAC and the several GDCs, 1, 2, 4 and 23 of Appendix A and III, XI, XVII of appendix B. The important Regulatory Guides are 1.89, 1.97, 1.209, 1.180. And industry standards are IEEE. Other guidance, SECY 05-0197. And one item is missing, is the SRP, and the SRP one there.

The technical summary, the equipment covered under the EQ programs are safety-related mechanical equipment in the harsh environment, and this mechanical equipment includes the lubricants, the grease, the fluid, et cetera, which has significant aging.

Electrical equipment important to safety and harsh environment includes safety-related electrical equipment, non-safety-related electrical equipment whose failure could prevent satisfactory operation of the safety-related function and certain post-accident and monitoring equipment. These are called B1, B2 and B3 in this order.

Then safety-related digital and non-digital, meaning analog, I&E equipment in the mild environment.

MEMBER BROWN: What's a mild environment?

MR. PAL: Where the temperature is not going to change with accident conditions.

MEMBER BROWN: What about the maximum conditions under which it has to operate, is that considered?

MR. PAL: It will have a maximum temperature, whatever the temperature is.

MEMBER BROWN: I mean, just from normal operations.

MR. PAL: Normal operation.

MEMBER BROWN: Forget the accident.

MR. PAL: And it is not going to change substantially, or significantly for the accident environment.

MEMBER BROWN: Is that mild environment defined in a spec somewhere, an industry spec, an IEEE standard, or is that in, somebody keeps quoting 344, or whatever. Is that for 1E equipment, is that --

MR. ABID: I could give you an example of what we used in the industry way back for the environmental qualification. Certain companies for like the reason three areas, consider like 10 to 4 for rads, 10 rads to 4 radiations as equal to or less than is mild; 104 degrees Fahrenheit equal to, or less than is mild. Anything above that is considered harsh and they evaluate that based on the equipment qualifications.

MEMBER STETKAR: Let's get specific for this design. Is 122 degrees Fahrenheit --

MR. ABID: It's for the containment, yes.

MEMBER STETKAR: Well, no, let me finish.

MR. ABID: Yes, go ahead.

MEMBER STETKAR: Is 122 degrees Fahrenheit considered a mild environment or not?

MR. PAL: It could be mild environment if the temperature in that area does not change dealing in accident condition.

MEMBER STETKAR: If an increase from --

MR. PAL: Exactly. If it normally operated at that temperature, then, and it doesn't change during an accident situation, then that is a mild environment.

MEMBER STETKAR: Okay. If it changes from, I'm sorry, if it changes from 85 degrees Fahrenheit to 122 degrees Fahrenheit, it that --

MR. PAL: It's not a mild environment.

MEMBER BROWN: During, that's during an accident.

MR. PAL: Yes.

MEMBER BROWN: Is that, that's what I heard you say a minute ago.

MEMBER STETKAR: So, we do have locations in the ESBWR reactor building that contains safety-related digital I&C equipment that are not considered a mild environment, is that correct?

MEMBER BROWN: In the reactor building?

MEMBER STETKAR: Yes. Yes.

MEMBER BROWN: Digital I&C is inside the reactor building?

MEMBER STETKAR: Yes. Just, yes. The reactor building is not the containment. The reactor building is the reactor building. So, I'm looking at specific rooms here that have a normal operating temperature of 85 degrees maximum during normal power operation, and have an accident temperature of 122 degrees Fahrenheit.

MEMBER ARMIJO: And there is digital I&C equipment in that?

MEMBER STETKAR: There are safety-related digital I&C in the reactor building. There are four corner rooms or quadrants, or whatever you want to call them, on this plan, that contain all of the safety-related digital I&C, except for the stuff that's in the control building, that also changes in temperature.

So, that is not a mild environment, is that correct?

MR. PAL: That's my understanding, yes.

MEMBER STETKAR: Because there's a footnote to the tables in the DCD that seems to tell me that GEH considers that to be a mild environment. So that's, it's important. That actually is an important distinction, but it's important to get to specific examples.

MR. ARMIJO: But that equipment would be then qualified to the harsh environment.

MEMBER STETKAR: Well, it should be qualified to 122 degrees Fahrenheit, which is my earlier question about how do you know the temperature will actually be that.

MEMBER BLEY: Well, that's in contrast though, to the mild environment. It seems to me it goes to the point of, it ought to be what the expected temperature may be in that room under even non-accident conditions, as well as accident conditions. I mean, it is a temperature-controlled, air conditioned --

MEMBER STETKAR: Under normal conditions, it is. Under accident conditions, it's not. That's the whole point.

MEMBER BLEY: Don't you have to -- I'm not familiar with this. Wouldn't you have to consider a loss of air condition as -- it's not an accident in terms of a reactor accident, but it's a loss of some plant support.

CHAIRMAN CORRADINI: I think John is, well --

MEMBER STETKAR: I'm pursuing it.

MEMBER SIEBER: It takes three days to get there.

MEMBER STETKAR: A long-lived topic here, so.

MS. CUBBAGE: The staff is pursuing the issues of the reactor building environment as well.

MEMBER STETKAR: Let me ask, we've gone over this a few times with temperature. I had another question though, that I wanted to ask. And I didn't ask GEH, but I wanted to get your opinion.

In those reactor building rooms that contain the DCIS, and the safety-related electrical equipment, the invertors, I notice that the humidity is not controlled. They specify a maximum design temperature to qualify the equipment against, but during accident conditions, there's no control over humidity in those locations. Is that a concern?

MR. PAL: Qualification will consider 100 percent humidity.

MEMBER STETKAR: Okay. That was -- okay. That was -- thanks.

MS. CUBBAGE: And we're going to try to get back to you on the --

MEMBER STETKAR: That's pretty difficult with solid state digital equipment.

MS. CUBBAGE: This is Amy on the -- oh, do you want -- on the mild environment we were going to try to get back to you. But if --

MR. WAAL: Actually, we have an answer for that.

CHAIRMAN CORRADINI: You have to identify yourself.

MR. WAAL: This is Jeff Waal, GEH. And table 3H.13, in Appendix H -- in Appendix 3H. We have a definition of the mild environment, which is 122 degrees Fahrenheit.

MEMBER BLEY: What about a humidity requirement?

MR. WAAL: There's a humidity 30 to 65 percent for typical conditions, and less than 95 percent for abnormal conditions.

MEMBER STETKAR: Okay. That's a different definition. Thank you, by the way. I'm looking at the table right now.

That's a different definition from what I heard earlier. Because you're defining a mild environment, although the notes in the table say normal, I don't care whether it's normal or abnormal. You're defining the mild environment as a temperature, not a change in temperature condition.

MR. WAAL: That's correct.

MEMBER BLEY: That's what I would have --

MEMBER STETKAR: That's a little bit different from what I heard earlier. Because what I heard earlier seemed to say that mild versus harsh was a change in temperature condition, not an absolute. You're defining it as an absolute.

Because this table is consistent with the notes that I had read in the DCD as far as stating that these are considered to be mild conditions. But it seemed to be different from what I heard earlier.

MEMBER BLEY: That's what I would have expected it to be.

MEMBER STETKAR: Okay.

MR. PAL: Maybe Paul can share something.

Mild environment.

MEMBER STETKAR: Thanks, by the way. I missed that table. I didn't get that far.

MR. SHEMANSKI: Paul Shemanski, division of engineering, electrical engineering branch.

Basically, the definition of a mild environment is one that does not change significantly during the course of an accident. And I guess GE has chosen a specific number of 122 degrees, which is fine. But, in reality, whatever the environment is, that is what the equipment has to be qualified for.

In other words, I've been in a number of plants where the temperature has been as high as 160 degrees, and that basically is their mild environment. That particular room never changes during an accident condition.

So, the bottom line is, the equipment then would have to be qualified for that number, 160 degrees Fahrenheit.

MS. CUBBAGE: And our HVAC reviewer's not here, but I know he has questions about the cooling in the reactor building, the justification of this equipment being in a mild environment is based on normal conditions. They have HVAC, but it's non-safety. And if the diesel's are available, they can use the non-safety cooling. And when no active cooling's available, they're relying on passive cooling in the reactor building, and we have some open RAIs on that as to what the conditions will be in those areas, and to justify the passive cooling will be effective.

MEMBER STETKAR: I don't know --

MS. CUBBAGE: And then, whatever the conditions are, the equipment will have to be qualified for those conditions.

MEMBER BROWN: During a reactor accident circumstances based on your --

MS. CUBBAGE: Yes.

MEMBER BROWN: Okay.

MEMBER STETKAR: Because according to the tables in the DCD, the normal expected temperature under active ventilation in those rooms would be 85 degrees Fahrenheit for most of the areas that I'm looking at. But -- and it, according to these tables, is expected to increase to 122 degrees Fahrenheit, which GE has defined as a "mild" environment.

And I don't particularly care personally what constitutes a mild environment, unless that word means something in terms of qualification and licensing space. If that word doesn't mean anything --

MR. SHEMANSKI: Where it does have significance from the standpoint that equipment in the mild environment is typically not expected to be exposed to aging parameters.

In other words, and as such, it is not required to have a qualified life. So, there is some significance to the --

MEMBER STETKAR: There's no qualified life to the safety-related digital instrumentation installed?

MR. SHEMANSKI: Well, its qualified life would be in this case 60 years. It would be the licensing period of the plant itself.

MEMBER SIEBER: It is active, so you replace it --

MEMBER BLEY: You mean, you really expect to put a cabinet of electronic equipment in, and it's going to last for 60 years?

MR. SHEMANSKI: Yes, if it's not exposed to significant, if it's not exposed to significant aging stressors, that would be the expectation.

MEMBER BLEY: It's going to be

interesting.

MR. SHEMANSKI: I mean, we have plants out there now with --

MEMBER BLEY: I mean, you can't get a television to last that long, with all the latest digital technology involved.

MEMBER SIEBER: It's not safety-related.

(Laughter)

MR. PAL: Aging program summary, the equipment is designed to have the capability to perform its design safety function under all anticipated operational occurrences in normal excited and post-excited environment and for the length of time for which its functions are required.

The environmental capability of the equipment is demonstrated by approved testing and analysis. A QA program meeting the requirements of Appendix B to 10 CFR Part 50, is established and implemented to provide assurance that all requirements have been satisfactorily accomplished.

EQ of mechanical and electrical reliance equipment must meet the requirements of 10 CFR part 50.49, GECs 1, 2, 4, 23 of Appendix A and 10 CFR 50 criteria Bs 11 and 17 of Appendix B. The qualified life is verified using methods and procedures of qualification and documentation as stated in IEEE 323 1974.

The EQ program, region operation program part SECY 05-0197, and this is for the revision 5 of the DCD. GH has proposed an ITAAC to verify EQ equipment has been qualified for the regulations. This item also discussion in Revision 5, not in Revision 3.

EQ records will be maintained in an auditable from the entire period during which the EQ equipment is installed.

MR. WALLIS: I just wonder if the 1974 method is appropriate since there's been all kinds of changes in technology in over 30 years. Is it still --

MR. PAL: The latest revision is 2003.

MR. WALLIS: So there is a new addition.

MR. PAL: Yes. But the NRC did not endorse the 2003 portion yet, so we cannot use that at this time.

MEMBER ARMIJO: Even if it's better? Why not?

MR. SIEBER: It's not endorsed.

MR. PAL: But it's not endorsed. We don't know what is --

MEMBER ARMIJO: Has NRC reviewed it in the process of endorsing it?

MR. PAL: It's in the works right now. The next slide talks about that. I can't -- it's in the process. We've not finished that part yet.

MR. WALLIS: It's still being reviewed whether or not you should replace it after 30 years?

MS. CUBBAGE: The review on going is with respect to our RAI.

MR. WALLIS: Why don't you just do it instantaneously without any review. Presumably it's better.

CHAIRMAN CORRADINI: Just a minute ago, didn't you say how did I trust the codes and standards? I just want to make sure we'll all on the same page here.

(Laughter)

CHAIRMAN CORRADINI: Got you there.

MS. CUBBAGE: There have been cases where a new standards would relax --

MEMBER ARMIJO: Sure, I understand that.

MS. CUBBAGE: -- have a relaxation in the area, and the staff may not find that acceptable.

MEMBER ARMIJO: Right. But that should

be pretty quick to find that.

MEMBER SIEBER: Nothing with codes and standards are quick.

MS. CUBBAGE: Or reg guides, or regulations.

MEMBER BLEY: I asked a question earlier that I thought you said we'd get to. And these codes and standards might answer it if I read them. But, do these require documentation of the whole test program when tests are required, including failures as well as successes?

MR. PAL: I don't think the EQ -- I do not contain the failures. It only will contain the successes.

MEMBER BLEY: That's what I thought. Okay, so that hasn't changed.

MR. WALLIS: That's very strange.

MEMBER STETKAR: You pass -- fail four, pass the fifth, turn in --

MR. SHEMANSKI: Paul Shemanski. Let me try and answer your question again.

MEMBER BLEY: Thank you.

MR. SHEMANSKI: First of all, let me just back up with the IEEE standard. I was on the working group from NRC that developed the IEEE 323

2003 version. Overall, it's a pretty good document. The reason the staff has not yet accepted it, or endorsed it, because there, it does have a few shortcomings as Amy mentioned. There are some technical relaxations in there. So, the expectation is that the staff, right now, we're in the process of endorsing, of revising Reg Guide 1.89, and when we revise -- when we complete the revision of 1.89, we are likely to accept this new 2003 version of IEEE. But we will accept it with some exceptions.

It's a fairly decent document. It is. But right now, the standard of record is the 1974 version. So, we're still locked into the 1974 version.

MEMBER BLEY: Since you worked on the new one --

MR. SHEMANSKI: Yes.

MEMBER BLEY: Are we missing anything important by using the old standard instead of the new? Did it pick up some things we really ought to be paying attention to, and if that's true, are you actually --

MR. SHEMANSKI: Well, it actually did pick up a few items. It introduced the inclusion of EMI, RFI and power surge testing, particularly for the new breed of microelectronics coming out, the computer-based electronics. So, from that standpoint, it was an enhancement. The 1974 version did not really have EMI, RFI or power surge. So there are some --

MEMBER BLEY: Are those things covered in any way in this -- in our current review?

MR. PAL: Yes. Yes. The digital I&C components are going to follow the latest revision of the IEEE 323, which is endorsed by the guide 1.209.

CHAIRMAN CORRADINI: Did you follow that?

MEMBER BLEY: I'm a little confused. If it's endorsed for one reg guide why --

MR. PAL: It's only because of that EMI, RFI.

MS. CUBBAGE: For the digital I&C.

CHAIRMAN CORRADINI: Is that another way --

MEMBER BLEY: Especially for digital I&C.

MR. PAL: By in the environment.

CHAIRMAN CORRADINI: So it is approved another way.

MR. PAL: It's only for mild environment digital I&C requirements.

MR. SHEMANSKI: Yes. That's correct.

MEMBER BLEY: It's not like it just came out last year. It's been on the streets for a while.

MR. SHEMANSKI: In answer to your question about how does the staff review qualification test results, and I'm speaking primarily of 3.11 now, environmental qualification of electrical and mechanical equipment. At this stage of the game, we're basically reviewing the methodology that GE is using to actually do the qualification testing.

That has not been done yet. That will be done later down the line. EQ has been identified as an operational program, subject to an ITAAC. It's one of 15 or 20 operational programs. And the intent is that prior to fuel load, and probably pretty close to fuel load, the staff will conduct a very in depth EQ inspection.

I've done 20 of these in the past over the years. Typically it's a team of about ten people. I go out, and we spend one week at the site, usually, that's where the documentation is. And we do a very thorough inspection of the EQ test reports.

And the people that are looking at the reports are knowledgeable in this area. They know what they're looking for. And basically we look at the EQ test reports to make sure that the individual pieces of equipment have been properly qualified to the pressure temperature profiles that result from the accidents, to make sure they've incorporated aging, temperature and radiation aging, make sure that any anomalies that occurred, or failures during the qualification program, were documented in the test report.

So, there is some information there with regard to your previous question about how do we look at failures. But the bottom line is --

MEMBER BLEY: Their record has to include the whole program.

MR. SHEMANSKI: Their record has to include the whole program. And then we follow that up with a walk-down to make sure that the equipment is installed in the orientation it was tested.

If it was tested vertically, it better be installed vertically. So, it's a verification right at the end. There is a high risk, though, involved. Because if problems are developed at that point, it could be a delay in licensing, and that has happened in the past.

But typically, it takes a long time to develop this information, and that's why EQ is one of the last things looked prior, just prior to fuel load. So that is where we get the confirmation of the EQ program. That's a very important aspect of EQ.

CHAIRMAN CORRADINI: Go ahead.

MR. PAL: We did not receive the RAI response for the environmental parameter questions. There were several questions on those sides, so that's still an open item.

And the COL item is, COL applicant will provide a full description and milestone of program implementation of the EQ program that includes completion of the plant-specific equipment qualification documentation. And that's specified in Revision 5 of the DCD.

CHAIRMAN CORRADINI: Okay.

MR. PATEL: Okay, the last one is really, we know there's nothing to be said anymore. I guess we accepted the ASME requirement and everything is clean. We're going fairly fast now. There should not be, there is no open issue, nothing.

CHAIRMAN CORRADINI: Okay.

MR. PATEL: It's pretty straightforward. Thank you.

CHAIRMAN CORRADINI: Some of the members had questions, I saw. No? Okay. In that case, then we'll just take a break for lunch. We'll be back here at 1:30.

(Off the record for lunch break, 12:30 p.m. to 1:30 p.m.)

CHAIRMAN CORRADINI: We're back in session. Mr. Waal.

MR. WAAL: Good afternoon, everybody. This is continuation of review of Chapter 3 of the ESBWR DCD. In this session, we're going to talk about Sections 3.6 and 3.9. But in keeping with doing things out of order, we're going to start with 3.9.

MR. KRESS: We like it this way.

MR. WAAL: Which is mechanical systems and components. We have Dave Keck, Jerry Deaver, and Pijush Day, from the ESBWR engineering who will do the presentation.

MR. KECK: My name is David Keck. I'm with GE Hitachi nuclear energy. And I am responsible for the reactor internals. I'll be going through most of section 3.9.

This first slide simply lists the different subsections within 3.9 that we'll be going over. Special topics, the first area special topics covers is design transients. Normal and thermal transients event and dynamic loads are defined. And this section basically just points to different areas within 3.9 that defines the transients used, tables and things like that.

This section also lists computer programs used in the design, and it also discusses experimental stress analysis consistent with Appendix 2 of the code, basically snubbers, pipe load restraints.

And then a section on faulted condition, evaluation considerations, each of the Seismic I Category equipment, well, selected Seismic I equipment, is individually discussed with respect to code requirements. Tables contain your requirements, analysis or testing, and if analysis is elastic or inelastic.

3.9.2 dynamic testing and analysis of systems, components and equipment, the first section it talks about piping vibration, thermal expansion, dynamic effects. You know, the program's divided in two phases, which is pre-operational and initial startup. And this just discusses the general requirements. The measurement techniques, monitoring requirements, test evaluation, acceptance criteria, and any reconciliation and corrective actions.

The seismic qualification of safety-related mechanical equipment, whether it is testing, and/or analysis, basically lists criteria then goes through components and each component's approach to analysis and testing.

Then the dynamic response of reactor internals under transient and normal operating conditions our, the GEH vibration prediction methods and how this applies to components and discusses allowables and touches on the steam dryer and separator.

MR. WALLIS: This has a steam dryer, being a BWR.

MR. KECK: Yes.

MR. WALLIS: Of course, you know all about steam dryer FIV and that sort of thing.

MR. KECK: There's been some issues lately.

MR. WALLIS: What method do you use to protect the behavior of the steam dryer and that sort of vibration and so on. Or, are these evolving with the other methods that are evolving.

MR. KECK: We did submit, and there are three LTRs involved with the steam dryer that we have submitted. And there is one LTR specifically for the load, developing the loads for the steam dryer. And this was submitted at the end of February. Jeff, I don't know if you want to talk more.

MR. WAAL: That particular topical report had to do with a new evaluation method called PBLE, Plant-based Load Evaluation, for developing loads to be applied to the dryers. And then we also, once we develop the loads, we use a computer program to run transient analysis and load combinations in order to determine and ensure that the allowable stress criteria in that --

MR. WALLIS: This captures the forcing function from the steam line and all that sort of thing?

MR. WAAL: Yes.

MR. KECK: Acoustic loads.

MR. WAAL: Yes.

CHAIRMAN CORRADINI: So, let me just ask a general question. This is, everything you're going through is the type of analysis one would go through whether it be ESBWR or any BWR for putting in for a new certification.

So, what's unique about this design in terms of the reactor internals that makes this analysis different, either as Professor Wallis was asking relative to a new analytical procedure, or because the design is different? Can you give me a kind of a summary there?

MR. DEAVER: Specific to the steam dryers, or during internal?

CHAIRMAN CORRADINI: The reactor internals and the jet cells. Not just the dryers.

MR. DEAVER: Well, I think we've gone through the configuration of reactor internals before. What we've done in our evaluation program is, we look for similarities to past reactors and we've identified, you know, whether we need a vibration program or those or not.

Then, we have the chimney, which is a new component and the partitions that are in it. So, part of our, what's different in our DCD is addressing these new components particularly and how we're treating those.

We have the Appendix 3L which deals with vibration for reactor internals, and there we concentrate on the chimney partitions, the -- we have select injection line that comes into the vessel, which is different.

So, we've focused testing and so forth on these newer components. And with the steam dryer program, you know, we're following basically the industry program of addressing the vibration issues that have occurred in the past with dryers.

MEMBER ARMIJO: To that point, does the existence the chimney make the loads on the dryers milder or more severe or no different?

MR. DEAVER: Really, it's not going to make any real difference. What we've done, we've kept the volumes above where the chimney partitions end. Mixing volume is very representative of past BWRs. So, the space as comes -- the steam comes out, until it gets into the separators. That's very representative, and we should get typical mixing.

Then likewise is, we come up out of the separators, there's a similar relationship between the separators and the dryers. So that volume is very equivalent or the same as past reactors.

So, we're not expecting any difference in dynamics between those volumes coming up through the reactor.

MEMBER SHACK: But are you looking at scale model testing for this particular configuration?

MR. DEAVER: As a complete reactor internal component?

MEMBER SHACK: Well, at least as complete as you do for the current operating reactors. I mean, you know, you talk about an ANSIS thing, well ANSIS is fine, once I know the loads on the dryer. I'm perfectly willing to believe you can analyze the dry with ANSIS. What I want to know is, how you get the loads on the dryer. That's the tough part of this problem. And you know, we haven't seen a GE acoustic model yet, even for the up rate, so maybe your LTR covers that.

MR. WAAL: That's GLTR that was talking about --

CHAIRMAN CORRADINI: And that was submitted when, I'm sorry?

MR. WAAL: At the end of February.

CHAIRMAN CORRADINI: Oh, the end of February. So, staff is still reviewing it, I assume?

MS. CUBBAGE: That's right. We're going

to be issuing our RAIs on that in July. And we do have a presentation prepared today at a high level, and then the details will need to follow when we're further along with that review.

MEMBER SHACK: But you've benched marked this against data is it Quad Cities again?

MR. DEAVER: No. Well, they benchmarked it against several plants, including Susquehanna and others. Typically what we found is, that the ABWR was a dryer that was instrumented on startup. It had very low stresses and strains involved in that startup test program. So, we're adopting the ABWR design as far as the steam dryer is concerned.

MR. KECK: Same setback from the main steam nozzle, similar bank configuration.

MR. DEAVER: So, we recognize we have 15 percent more flow in our ESBWR as compared to ABWR, but we're trying to, as much as possible, duplicate that geometry which seems to be a good geometry.

Plus, I might mention that we've got some programs going to mitigate loads, these acoustic loads as a means to reduce any loadings on the dryer.

MR. WALLIS: How many steam lines are there?

MR. DEAVER: There's four.

MR. WALLIS: There are four.

MR. DEAVER: Typical for a BWR.

MR. WALLIS: So, this is a misleading figure?

MR. KECK: It's a -- well, it's a 2-D figure. I wouldn't use the word misleading.

(Laughter)

MR. KECK: It's a cross section cut on two plains.

MR. DEAVER: There's only one steam nozzle shown in this figure, and that's the extended long one at the top. There are four of those.

CHAIRMAN CORRADINI: So, I guess I'm, to get back to it, I kind of started this. Just so let you guys going here, so what you're saying is, in terms of volumes, the, what I'll call the plenum volume coming into the dryers is the same here, except for you've interposed now the chimney.

And it's your -- the design, your analysis seems to indicate that the presence of the chimney does not change anything coming into the dryer relative to, well, maybe saying nothing, modest -- it doesn't have a large effect on what the loads would be coming into the dryer?

So, whether I had the chimney there or not, it seems not to have a big effect on dryer loads? What about vibrations within the chimney? Are you going to eventually get to that?

MR. KECK: We'll have sensors on the chimney.

MR. DEAVER: Well, what we've done is, we've gone through a test program. I think I described that in one other meeting. Where we went through a --

CHAIRMAN CORRADINI: Yes, can you remind me since I have a bad memory. I'm sorry.

MR. DEAVER: Well, we had a 12-scale, a 6-scale and then essentially a full-scale single cell that we monitored. We sent a steam water mixture. This was a Hitachi test done in Japan. So, we had sensors along the length of the chimney, and we monitored pressures going up the chimney.

CHAIRMAN CORRADINI: At full pressure temperature?

MR. DEAVER: No. These were not at full pressure temperature. This was an air-water mixture.

CHAIRMAN CORRADINI: Oh, I thought you said steam water. I'm sorry. I misheard you.

Excuse me.

MR. DEAVER: And so from that data, then they've been able to extrapolate that data to determine what the stresses are and you know, there were a couple of different kind of tests where they -- they're basically assuming non-coherence between the two cells, you know, adjacent cells in the chimney, such that it basically creates the worst case as far as the loading condition.

CHAIRMAN CORRADINI: These were two chimneys, excuse me, again? I remember the three scales that you just said, but these were two adjacent chimneys with different flow characteristics?

MR. DEAVER: Well, what we did is, one cell where we monitored flow through a cell, but they also changed the configuration to be more like a cruciform shape, where they could identify interaction effects across the different partitions.

CHAIRMAN CORRADINI: Oh, I see. In terms of what was injected into that one chimney, into that one chimney.

MR. DEAVER: Right.

CHAIRMAN CORRADINI: So, you hd a full 4x4, but in three different scales?

MR. DEAVER: No. I wouldn't say it's a 4x4. It's one cell, but then it -- within that same cell configuration, they had a configuration that was basically four quadrants.

CHAIRMAN CORRADINI: Okay. I see.

MR. SIEBER: Just so they could get flow on both sides of the pin.

CHAIRMAN CORRADINI: I understand. All right. Thank you.

MR. DEAVER: And I guess what I'm saying is that between the coming up from the chimney which is you know, kind of the equivalent of flow coming out of the core --

CHAIRMAN CORRADINI: Right.

MR. DEAVER: -- that that gets mixed, and then it goes through the separator, that gets mixed, goes into the steam dryer at that point. And we've got more DP's coming through the core, so a lot of the drivers in that --

MR. WALLIS: That mixing region above the chimney is fairly shallow isn't it? So --

MR. DEAVER: It's two meters.

MR. WALLIS: Yes, have your cell figure right then?

MR. KENT: I think it is.

MR. DEAVER: Yes.

MR. WALLIS: That's two meters up there? It's very broad. You're not going to mix from side to side. You're going to mix a few channels, but you're not going to mix everything together.

CHAIRMAN CORRADINI: You have to be at a microphone, I'm sorry to say.

MR. WALLIS: It will do some mixing, but it won't volumize.

MR. DEAVER: I guess what I'm saying is, in prior BWR geometries, if you could basically eliminate the chimney --

MR. WALLIS: You get the same thing.

MR. DEAVER: -- you have the same thing. You have the same amount of volume above. And so when it came out of the core, it had, it's the same ability to mix.

CHAIRMAN CORRADINI: And there is a gap at the core level between the chimney and the core, yes?

MR. DEAVER: Here, no. No. The partitions fit directly on top of the core plate.

CHAIRMAN CORRADINI: Top guide.

MR. DEAVER: Because at that point, they really don't want cross flow. They want to keep the flow confined to the cells.

CHAIRMAN CORRADINI: Okay. So my memory's wrong. I remember some sort of -- we were told there was some sort of gap between the core and the chimney. Maybe I'm just misremembering.

MR. DEAVER: We'll never be able to make it perfect.

CHAIRMAN CORRADINI: So within tolerances, it's no gap.

MR. DEAVER: Right.

CHAIRMAN CORRADINI: Got it. Fine. Thank you.

MR. WALLIS: How do you get performance out of the separator if it's 15 percent more slow, but yet the same size separator?

MR. DEAVER: Well, what we've done to the separators is, the normal pitch between separators has been 12 inches. We've changed that pitch to 11 and a half inches now. And so we have proportionately quite a few more separators.

CHAIRMAN CORRADINI: You added separators.

MR. DEAVER: Than we've had in the past.

CHAIRMAN CORRADINI: But they're smaller.

MR. DEAVER: No, the separators are the same design, except that the spacing between them have been condensed.

CHAIRMAN CORRADINI: Okay, all right.

MR. DEAVER: So we have like 379 separators, I don't know what the equivalent number would have been if we had just the 12-inch pitch. It would have been, you know, 30 or 40 less separators, I believe. So that way we can get more performance out of --

MEMBER BROWN: -- pressure drops or anything of that nature.

MR. KECK: And also the steam dryer, the face area has increased to accommodate the --

MEMBER BROWN: Okay. So you did change the design proportionately.

MR. DEAVER: But what we have is a little bigger diameter of -- ABWR and ESBWR have the basic same inside diameter, but the flanges are a little different at the top. We're able to expand the dryer a little bit because of the wider flange configuration which allows --

MR. KECK: Larger diameter, but yet, we maintain the same distance, annular distance, annular space between the dryer and the vessel wall.

MEMBER ARMIJO: But you've sized it for the 15 percent more steam flow.

MR. KECK: As far as the face area in the dryer, yes.

MR. DEAVER: We were able to expand the width of the banks a little bit, and then we went a little higher.

MR. KECK: There's three sections in here that are closely tied together, the dynamic response of reactor internals under transient and normal operating conditions, the initial startup FIV testing of reactor internals, and then the last one listed, correlation of test and analysis results. They're pretty closely tied.

And going on to the initial startup FIV testing of reactor internals, and the purpose of that was to verify the effect of the single and two-face flow on the vibration response of internals. And then we --

MR. WALLIS: Are you going to instrument the reactor for all this FIV.

MR. KECK: Yes. And there's an Appendix 3.L where we discuss our instrumentation, and then also, there's a table. There's a table within 3.9 where we list the sensors and their locations. And

I think the typical locations that we've had in the past, and then the additional for the three components side of the evaluation program, which is the dryer, the chimney and the SLC, the SLC internal piping.

And this section also talks about compliance to Reg Guide 1.20.

MR. DEAVER: I might also mention we have a topical report also that we prepared and submitted last November which goes into all the details regarding the analysis for reactor vessel vibration.

MEMBER BROWN: So you're going to determine -- your instrumentation is to determine what is the fluence vibration response, I take it. Is that the intention of the instrumentation? You said, you're going to instrument it, so I presume there was a basis for --

MR. DEAVER: Well, we have Reg Guide 1.20, which really requires that any first-of-a-kind-type plant, that we instrument it as a means of, to confirm our analysis results.

So, we set up a criteria, and we instrument, and then we basically have to confirm that the vibration results are less than our criteria, then the plant's acceptable to operate.

MEMBER BROWN: I think you've just answered my question.

MR. DEAVER: And also, what's going to be a little different here is that --

MEMBER BROWN: Could have said yes, it would have been a lot --

(Laughter)

MEMBER BROWN: No, that, there was nothing wrong with that. It's just you could have blown it right past me if you'd have said yes.

MR. DEAVER: Also what we'll be doing is, we'll be making correlation. We'll be instrumenting the steam line and correlating the response on the dryer as a means to better understand the dryer vibration. So, that's part of our program also, which hasn't been typical of past programs.

MEMBER BLEY: Can I ask you a naive question? Why do we need the channels up in the chimney region above the core?

MR. DEAVER: Okay. Well, that's basically to keep the steam focused in a straight line coming up above the core. We need the --

MEMBER BLEY: To simplify your calculations, or you really need the uni-direction?

MR. DEAVER: Well, what will happen, if

you don't have it, it will start vortexing.

MEMBER BLEY: Up above. Okay.

MR. KECK: Up above.

MEMBER BLEY: Instead of going around. Okay.

MR. DEAVER: Yes. And you'll get a whole different dynamics going in with the steam that we don't want.

MEMBER BLEY: Okay.

CHAIRMAN CORRADINI: Based on what? What tells you you don't want it?

MEMBER ARMIJO: Well, there would be more flow going through some of the channels, some of the fuel assemblies.

MR. WALLIS: So it's a general fear of vortexing isn't it? It's not that you know it's going to happen.

MEMBER SHACK: The original design didn't have those channels, right?

MR. DEAVER: The prior natural circ plants did have partitions, okay. The Dodowaard plant, had partitions that were about ten foot high. These are more like 20 foot. But you know, so that was a small plant.

CHAIRMAN CORRADINI: So the worry is a

sloshing problem?

MR. DEAVER: Well, it's really --

CHAIRMAN CORRADINI: Sloshing --

MEMBER BROWN: Steam sloshing?

MR. DEAVER: Steam water, you know, what enters into the separators will be very inhomogeneous, all right. And the performance of the dryer, I mean, of the separators would probably suffer. You know, you'd be, wrong quality water possibly and those sorts of things.

CHAIRMAN CORRADINI: Thank you.

MEMBER BROWN: I have one other, how do -- this is an education. How do you ensure that you get balanced flow up through all of the partitions, is it? Are they focused on particular channels in the core itself, and those are where the heating is not totally symmetrical?

MR. DEAVER: Well, if we were to show you a plan view --

MEMBER BROWN: Loading across those partitions.

MR. DEAVER: -- the top guide typically has four fuel bundles, and a control blade in it. But a chimney partition cell has actually got 16 bundles with four control blades in it. So, this is an attempt to channel a larger flow stream up above the top guide. But that's a convenient geometry to focus the flow through.

MEMBER BROWN: Okay. This time you didn't really answer.

MR. DEAVER: What, what -- maybe you need to reiterate it.

MEMBER BROWN: I was just trying to -- now, I was just looking at uniformity of generation of steam --

MR. DEAVER: Oh, okay.

MEMBER BROWN: -- across the entire cross section.

MR. DEAVER: Okay.

MEMBER BROWN: And how do you get that normally if you get asymmetry is, you like it to mix up somewhere as you head up into the upper part of the cell.

MR. DEAVER: Well, a lot of this is tied to core dynamics and how you're generating steam and the core performance side.

CHAIRMAN CORRADINI: But given a loading pattern, I guess I thought you were going to tell him, given a loading pattern, you already should have the inlets orificed so that given a certain pattern, they've orificed it so to --

MEMBER BROWN: So that they get balanced steam coming from across the board.

MS. CUBBAGE: I think the thermal. hydraulic -- I mean, as far as that's like more of a chapter --

CHAIRMAN CORRADINI: Yes, yes.

MS. CUBBAGE: Different chapter, different --

CHAIRMAN CORRADINI: We're taking you where you don't want to go, but that's --

MEMBER BROWN: I'd like to find out what --

MEMBER ARMIJO: We're taking you where we're interested.

CHAIRMAN CORRADINI: Go ahead.

MR. DEAVER: The design tries to balance the steam flow throughout there to flatten it. But you know, it's not a perfect world either.

MR. KECK: Okay. And then the last section is a dynamic analysis of reactor internals under faulted conditions. And here, just load combination as a result of faulted conditions, RPV line break, earthquake, or SRV, or DBV discharge.

Then we start to discuss the structural

integrity of the pressure retaining components, their supports, and of course, the core structures in 3.9.3.

The first section, the load combinations design transients and stress limits also covers the methods. We see some details where we find info within the DCD. Okay, this is again, it points to a lot of locations within the DCD where you're going to find the information. It also discusses the 60-year lifetime. And you know, all components except the vessel, are designed to be replaced.

Plant conditions, normal, upset, emergency and fault are explained in this section, and those event probabilities for each of those occurrences. Safety-related functional criteria, where normal and upset flow permanent deformation to deteriorate the component's ability to perform its safety function, or emergency unfolded where capability of a safety-related component may be, may have to be repaired.

Then we go over to component information, related ASME code requirements, RPV, piping, basically just, you know, other components accumulators, valves, heat exchangers, and discusses designs, the design of the component, an analysis approach and acceptance criteria.

Then we go into the value operability assurance, including actuators, your major active valves, such as your MSIV, SRV or SLC injection, your DPVs and your other active valves. And some unique functional qualification for dynamic events are covered for each one of those valves.

And the design installation of pressure relief devices, your SRVs and your DPVs. And then your ASME component support design, basically subsection NF for piping, that would be your piping supports, your spring hangers, your snubbers and also your support for your RPV, your sliding support, your floor mounted major equipment support.

And then finally the discussion on the ASME threaded fastener design continuing material related to SRP 3.13.

MEMBER BROWN: You said that the RPV components were designed to be replaced.

MR. KECK: Designed to be replaced, except for the vessel.

MEMBER BROWN: Is there -- except for the vessel.

MR. KECK: But the intent is 60 years.

MEMBER BROWN: Is there some -- do you

have to then inspect them periodically during refueling operations to determine that you don't have to replace them? Is there some criteria?

MR. DEAVER: There will be a regular inspection program for reactor internals. That's been an ongoing program, you know, for operating plants, that there's a --

MEMBER BROWN: For your existing DWRs?

MR. DEAVER: Yes. There's a VIP program, vessels internal program, that they follow. And so, there will have to be a separate committee, you know, an owner's group that will look at the ESBWR. We will be doing things quite differently as far as the manufacture and installation of internals such that we'll have a lot more resistence to cracking and corrosion problems. And so they're have to set appropriate inspection guidelines.

MEMBER BROWN: And who sets the standard for those?

MR. DEAVER: Well, the owner's group typically.

MEMBER BROWN: You guys, I mean you all designed it.

MR. DEAVER: Well, we're involved, but typically it's the owner's group presents the program to the NRC for approval in that area. So there will be a regular program for visual inspections and as needed, volumetric inspections.

Some of the components, the dryer, separator, and so forth, they actually come out of the vessel. And so there's opportunities to go in the pools and look at those on a routine basis.

MEMBER ARMIJO: Now the chimney doesn't come out during refuelings? Or, is that your plan?

MR. DEAVER: That's our plan now, is to make it removable.

MR. KECK: That the partitions will be removable. The barrel will stay.

MEMBER ARMIJO: Oh, okay.

CHAIRMAN CORRADINI: The what, I'm sorry? Excuse me?

MEMBER ARMIJO: The chimney is going to come out during the refueling, is your current plan?

MR. DEAVER: It has the capability to come out every refueling outage and to make it more accessible to do the refuel.

MEMBER ARMIJO: During refuel?

MR. DEAVER: Yes. The barrel part, the outside part, will remain. But the partitions, that's the difficulty that the customer saw, was being able to get into the cells for core verification and you know, moving up out of the cell into another cell to do shuffles and so forth. So we've done studies where we believe refueling can be done much shorter without the partitions.

MEMBER ARMIJO: What's a likely time period?

MR. DEAVER: A shorter time period. A shorter time period, yes.

CHAIRMAN CORRADINI: Did you -- when you say studies, curiosity, is it, do you have, like full size mocks where you -- mockups where you --

MR. DEAVER: No, this was more of an experience, you know, factor of how long it takes to move a bundle. So it's mainly a time and distance kind of study.

CHAIRMAN CORRADINI: I see.

MEMBER SHACK: But how would the partition be located within the core barrel then, it just slides in?

MR. DEAVER: No, it will have to be accurately positioned at the base. We haven't done all the detail design work. But I envision it being locating pins that accurately place it with respect to the top guide.

And then, we're going to need particular lateral support at the top to prevent vibration, you know, motion at the top.

MEMBER SHACK: I just think it's going to be pretty wiggly, actually. I mean, it's --

MR. KENT: The chimney barrel has lateral restraints similar to the vessel itself. So, I mean, this is a taller structure piled up on top of, you know, it's our experience --

CHAIRMAN CORRADINI: It's seven meters, isn't it?

MR. KENT: And before, we didn't have the lateral restraints at the top. So, the chimney will have the lateral restraints.

MEMBER SHACK: And how thick is that barrel?

MR. DEAVER: It's like two inches. It's similar to the shroud construction. But the partitions themselves, we'll have to stabilize those.

MR. KENT: Control rods, the CRD system, you know, this is primarily discussed in 4.6.1. But this section will discuss the applicable regulations. Some of the components such as this FM CRD mechanism, ATU assemblies, interconnecting piping, instrumentation, things like that. And then it also defines the design loads and stress limits.

The CRD performance assurance program tests are described also in DCD Section 4.6, the factory quality tests, functional tests, operational tests and then the surveillance tests.

Yes, this is an eye chart. This is typically each one of these sections start out with you know, defining the loads, where the loads come from, the events. And this chart itself is broken up into the thermal hydraulic, transients, daily and weekly reduction of 50 percent power, and then also has your dynamic loading events, your faulted level conditions. And from this, we derive our load combinations.

MEMBER STETKAR: Dave, I'm curious. I passed the eye test, 8A, things that I would call a general transient-type scram, turbine trips, reactor trips, reactor scrams, those types of things, nonloss of heat water scrams, I notice you have 60 in there for a 60-year plant life, which if I do the division correctly is one per year. Notice how I can do that. I still do that in my head.

All of the other -- I did it on the -- I have it written down here. All of the other transients that you have in there seem, the numbers seem quite conservative with respect to actual operating experience in terms of numbers of events per year.

MR. KECK: Yes.

MEMBER STETKAR: Even the loss of heat water transients, given recent experience, except for this one. This one is, might be numerically conservative, but it's only one per year. So, if I have three this year, I better not have any more trips for the next two more years, or I might be violating some design analysis input. Is that the correct way to interpret this?

And if so, what's the basis for you know, why did you use such a thin margin on that particular transient?

MR. KECK: Well, we basically picked the numbers based on experience. I think typical of prior BWRs, in the early startup phase, there were more transients and situations. But as time went on, plants have tended to level out. Their operation is more consistent. They don't have a lot of these transients.

MEMBER STETKAR: They don't have a lot, but one per year is not many.

MEMBER ARMIJO: And this will be a new plant.

MEMBER STETKAR: I happen to be pretty familiar with the Leibstadt plant, and they tend to come down roughly once a year. Sometimes, a couple of times.

MR. KECK: They tend to have annual ones.

MEMBER STETKAR: No, no, no. I mean trip. Actual trips. They're getting better, but they still, you know, they have a wonderfully high availability factor, but they still tend to trip, turbine trips and things like that.

It's the only number that was so close to experience out of this whole table, that I was curious about why it was that close, or whether it makes a big difference whether you double that number in terms of --

MR. KECK: Well, we do have the A and B.

MEMBER STETKAR: You do, yes. And B in fact, if I add the to together, you get two trips per year.

MR. KECK: Right, yes.

MEMBER STETKAR: One feed water related, which is probably a little more severe. And that's probability a little bit on the high end. But it was just more of a personal curiosity that that the only number in this table that seemed pretty doggone close to real operating experience. And that if it's -- and doesn't leave much margin to going back and analyzing things if you have, you know, three trips in one year, it could be a problem.

MR. DEAVER: Well, yes, obviously in plant operation, you're going to have to take track of cycles of events.

MEMBER STETKAR: Yes, that's right. I mean, if you get 30 years out and you've already hd 40 trips, for example.

MR. DEAVER: There would be a need to go back in and re-evaluate.

MEMBER STETKAR: And re-evaluate because the term -- would it make a big difference to your analysis if that number were doubled to 120? I don't do design analysis work, so I have no idea what the implications of these numbers like that, that one in particular.

MR. DEAVER: Well, actually, item 7 also has 60 cycles.

MEMBER STETKAR: Well, that's right. A lot of the other ones -- and that's a very conservative number compared to what you see.

MR. DEAVER: See, what I'm --

MEMBER STETKAR: My only curiosity is, why that one and everything else that I looked at said well, this is quite a conservative design margin, except for this one.

MR. DEAVER: Yes. Well, what my memory is that, see all those happen to be, B service limit items.

MEMBER STETKAR: Yes, right.

MR. DEAVER: And they're all associated with scrams, typically.

MEMBER STETKAR: Right.

MR. DEAVER: So it was the collective number that we were looking at, more than just the individual numbers.

MEMBER STETKAR: So the collective numbers.

MR. KECK: The collective number incorporate --

MR. DEAVER: Right, 180, and those transients are quite similar when you look at actually the loss feed water heaters is probably the more limiting of the three.

MEMBER STETKAR: That's right. Yes, in terms of the thermal. Okay. Thanks. That's probably enough.

MR. KECK: Okay. So, Section 3.9.6 is in-service testing of certain pumps and valves performed in accordance with the ASME code. Since ESBWR does not include any safety-related pumps, none are included in the IST program.

It provides a full description of the IST program for valves, including plan testing and inspections. There is a rather large table at the back that includes, the back of this Section 3.9, that lists the valves that were part of the IST program, including valve positions, test parameters, test frequencies.

MR. DEAVER: Basically, what we've done there is, we've expanded that table to include a lot more material than we typically have in past certifications, mainly to accommodate the COL process. The idea being, to put as much as possible into this program now to avoid further definition later on where things are generic.

So, we think we've more than covered the needs on the DCD basis for the IST program.

MR. KECK: That was Section 3.12. I could just skip to 3.9.5.

MR. DEAVER: Well, we can talk about 3.12

though.

MR. DEAVER: Okay. Basically this is the section that we don't have a 3.12.

CHAIRMAN CORRADINI: Yes, I noticed that too.

MR. DEAVER: And it's because the SRP, you know, came out in March of 2007. So, in the course of the DCD review, we were getting 3.12 questions, and which I guess the NRC was anticipating the SRP.

MS. CUBBAGE: Right. Well, we had always planned on writing an SE Section 3.12. So, that's how we numbered the RAIs.

MR. DEAVER: so, basically all those RAIs, there were 38 of them, they basically all were answered through either 3.7.3, or 3.9. So, all of those were related to piping and their supports. And those topics were fundamentally covered already in those other sections. And so any adjustments or changes to the DCD we made back in 3.7 or 3.9. And we're pretty well resolved on most of those issues at this point.

MR. KECK: Okay. And we were asked to -- or I was asked to present 3.9.5 last. This is the RPV internals. And this -- there's an initial section, provides a description of the support and other internal components. The supports being the shroud, the shroud support, the core plate, top guide, fuel supports, control rod guide tubes and then the internals, which is your chimney, your steam separator assembly, dryer, spargers, SLC and core guide tubes.

Your low conditions, including RPV line break, accidents, earthquakes and internal pressure differences, discuss the events evaluated and the reactor internal pressure differences are also evaluated.

And then the design basis related to safety and power generation, safety-related functions, power generation, internal arrangement for coolant distribution and refueling, and then the loadings for plant events and stress deformation and fatigue limits. For deformation limits, we have tables. For your deformation limits, your primary stress limit, your buckling stability, your fatigue limits, and the criteria was established based on codes for similar equipment or established based on field experience and testing.

MR. DEAVER: You need any more discussion on the vessel?

MR. WALLIS: What is this vessel stabilizer?

MR. KECK: We have a -- as far as the vessel, the entire vessel sits as far as its support?

MR. WALLIS: Well, it seems, it sits down below doesn't it? It sits on the --

MR. KECK: About a third of the way up, you'll see some supports. They're sliding type supports.

MR. WALLIS: One of the supports seems to have a hole through it. What is that?

MR. KECK: Okay. That's the GDCS equalizing line.

MR. WALLIS: The GC line is supported, it supports the reactor?

MR. KECK: No. There's an integral forging and again, this is the way this cross section is made. There's eight supports, and in between some of the supports, we have this equalizing line.

CHAIRMAN CORRADINI: But that's the flow in for the GDCS?

MR. KECK: Yes.

MR. WALLIS: But that's not supported the way its shown.

MR. KECK: No, no.

CHAIRMAN CORRADINI: No. No, no. It's two things drawn on top of each other.

MR. KECK: It's to the left. The left support is more -- the left is support is more representative.

MR. WALLIS: Now the stabilizer at the top, what is that doing?

MR. DEAVER: That's the typical stabilizer we've had on all prior product lines, except BWR-VI. This is just an upper support.

MR. WALLIS: Does it have seismic purposes?

MR. DEAVER: Yes. For seismic only.

MR. WALLIS: It's just in one place, or is it all the way around?

MR. DEAVER: No, there's eight.

MR. WALLIS: It's all the way around, there's eight of them.

MR. DEAVER: Yes.

MR. WALLIS: Well, it would be nice if you'd put something like, eight of, or something. So we -- it looks funny just to see one. You really should see it with the other view.

MEMBER SIEBER: When you cut it in half, that's all you can see.

CHAIRMAN CORRADINI: So the weight of the vessel sits on those eight pedestals.

MR. KECK: Yes.

CHAIRMAN CORRADINI: And those eight pedestals fit into blocks which sit on a concrete pad as the upper dry well narrows to the lower dry well. Do I have -- is that correct in my memory?

MR. KECK: Well, there's a --

CHAIRMAN CORRADINI: The upper dry well, it kind of narrows down with a concrete shelf, and then it goes this, and these guys sit on abutments that are sitting on that shelf.

MR. DEAVER: I think the later figure will help.

CHAIRMAN CORRADINI: Okay, fine. Never mind then.

MR. DEAVER: Well, we could look at it now.

CHAIRMAN CORRADINI: Just point to it when you're there.

MR. KECK: Okay, all right. Here's the geometry.

MR. DEAVER: What you're referring to is

this lower area down here.

CHAIRMAN CORRADINI: Yes, it narrows.

MR. WALLIS: You're in the way, can't see. You're standing in the way.

CHAIRMAN CORRADINI: He's fine for me, Graham.

MR. DEAVER: The area we're talking about is this --

CHAIRMAN CORRADINI: No, you're up a little bit.

MR. DEAVER: Yes. This area right here is the sliding support. And below it is basically the pedestal arrangement. It does go towards the vessel, and then you know, ultimately becomes the lower dry well area down here.

CHAIRMAN CORRADINI: Those are like steel girders that then sit on the concrete pad?

MR. DEAVER: Yes. This is basically a steel structure. It's mainly steel as opposed to any concrete.

CHAIRMAN CORRADINI: Right. But the concrete is the wall it's sitting on below. Right there, that shelf?

MR. DEAVER: Usually there's a composite of steel and concrete, make up the pedestal construction.

CHAIRMAN CORRADINI: Oh. Okay. Thank you.

MR. DEAVER: Yes, there's all this structure down here.

MR. WALLIS: there's a BiMAC underneath this whole thing?

(Laughter)

CHAIRMAN CORRADINI: You had your chance. You missed it.

MR. WALLIS: Understand the designer wasn't there either.

MEMBER SIEBER: There is an imitation of it.

CHAIRMAN CORRADINI: But yes, I think it's down there, Graham. Right on the bottom.

MR. WAAL: All right. Any other questions on 3.9?

CHAIRMAN CORRADINI: Keep on going.

MR. WAAL: Okay. Then Mr. P.K. Dey will give us -- will talk about Section 3.6.

MR. DEY: Good afternoon. My name is Pijush K. Dey. I'm GEH engineer. And I'll be talking on the Section 3.6.

This section, the title is protection

against dynamic effects associated with a postulated rupture of piping. And --

MEMBER SHACK: One surprising think I found was no mention of anything like leak-before-break to eliminate some postulated line breaks.

MR. WAAL: That's correct.

MEMBER SIEBER: They're not using it. They've said that.

MR. WAAL: We're not taking any credit for leak-before-break.

MEMBER SHACK: And why is that? Just you don't want to debate with the staff?

MR. DEAVER: We chose -- we know that that's a very involved, complicated technology that you know, we just chose not to pursue that just because of the complexity and the review time that would be required.

MEMBER ARMIJO: But if you'd be using better materials, the arguments have been thrashed over and resolved. Couldn't you align with that.

MR. WAAL: I mean, we're not talking about it for ECCS.

MEMBER ARMIJO: Yes.

MR. WAAL: I mean, we're just talking about it for just dynamic loads here. But you --

okay, that's your decision.

MEMBER ARMIJO: I just didn't understand why.

MR. DEY: In this section, we will, Section 3.6, we'll talk about the, how we determine the break locations and the mitigation for these breaks and also finally, we do the as-built inspection on the high-energy pipe break as part of the mitigation features.

Section 3.6.1, plant design for protection against postulated piping failures in fluid systems inside and outside containment. This section provides a description of the design bases, criteria, objectives and the assumptions. And we identify the piping which are the high energy and the moderate energy lines inside and outside containment.

Then design evaluation of pipe break events and the features of, to provide the protection against the effects of pipe break events. The section also gives the protection methods include physical separation, like barriers, barriers, shields and enclosures and pipe whip restraints.

The next section, Section 3.6.2, it

gives the pipe break locations and dynamic effects with the postulated rupture of piping. And we determine the pipe rupture, are postulated in accordance with the BTP 3-4 branch technical position, which was formally EME 3-1.

Then of course, for fatigue usage of .40 is used when we analyze for the environmental fatigue, that is in accordance with Reg Guide 1.207.

ESBWR, our design intends to use, you know, we're going to use BTP 3-4 limits and going to maintain pipe stress locations, I mean the terminal stress points, we want to do stress points in such a way that we can avoid those intermediate break locations. Therefore, we will end up having only terminal end breaks.

MEMBER ARMIJO: I guess I don't understand what that means, terminal end breaks means, let's say attached to a vessel, or --

MR. DEY: Terminal end breaks is a pipe that connects to the nozzle's, reactor nozzles, or the treatment nozzles, like tank, heat exchangers, the pipe terminus and --

MR. WALLIS: So you deliberately make it weaker at its ends?

MR. DEY: No.

MR. DEAVER: Let me speak to the vessel side.

MR. WALLIS: No, it's only going to break there.

MR. DEAVER: On the vessel, the nozzle and what we call the safe end that attaches to it, is intentionally thicker and stronger than detached piping.

MR. WALLIS: Usually that's stronger there. Yes.

MR. DEAVER: But the piping you know, isn't intentionally made weaker at that connection. I think it's a recognition that typically the high stress points occur at these rigid ends where the piping is attached. So, the expectation is, that the highest stresses will be at those locations.

MR. WALLIS: Because of the weld, some residual stresses or something?

MR. DEAVER: No.

MR. DEY: It's the discontinuity.

MR. WALLIS: Oh, it's because that's where the bending is?

MR. DEY: Bending and highest load comes through the anchor location, axle and forces at moments of you know, at anchor locations.

MR. WALLIS: But at a big valve, the weld's attached to a big valve, those would not be considered terminal ends?

MR. DEAVER: No. No.

MR. DEY: Because that valve is modeled with the piping, we analyze them and the stress levels at all locations from anchor to anchor, nozzle from the tank, these are the terminal ends that actually at the moment the forces that we have.

MR. DEAVER: It's a recognition of where the rigid end points are, as opposed to in-line components.

MR. WALLIS: But from the residual stress, attaching a pipe to a big heavy valve might bring some extra --

MEMBER SHACK: Residual stresses never appear in these tolerances.

MR. WALLIS: Well --

MEMBER MAYNARD: If the valves that were anchored, that would be an end point, though, right?

MEMBER SIEBER: Yes.

MEMBER MAYNARD: If a valve is well within line, well then it's analyzed as part of the line.

MR. DEAVER: Yes.

MEMBER MAYNARD: But if it was anchored, then that would be it.

MR. DEY: That would be it.

MR. DEAVER: Right. So it would have to be considered a terminal end.

MR. WALLIS: Well, this is, I guess it's okay, but there are a lot of places where you have thermal stresses and things which could make a pipe break somewhere else other than its end.

MR. DEAVER: Well, that's why the criteria, what we have to design to is, 80 percent of the stress levels. So all these intermediate locations have to be below 80 percent of the stress limit, and we have to keep the fatigue usage lower. You know, the normal limit is 1. So, we --

MR. WALLIS: So, not weaker at the end, but you're ensuring that the loads are bigger at the end, which is kind of the same thing.

MR. DEY: We will perform the stress analysis, model the piping, and we will support it in such a fashion that stresses on the piping in between, I mean between the anchor and actual location of the piping will remain less than the threshold stress limit that is given in the BTP3-4. And that is 80 percent for Class II and III type of piping, 80 percent of the hot model by the stress range, normal stress range.

And once you put that below are the IV Class one, is less than .1 fatigue limit, then we do not then to postulate the breaks.

MR. DEAVER: Now, the stress at these terminal ends may not be any higher than the 80 percent criteria or anything, but that's the standard we're required to.

MR. DEY: Yes. We are required to postulate a break at the terminal end, regardless of the stress level.

MR. WALLIS: What does BTP stand for?

MR. DEY: Branch Technical Position.

MS. CUBBAGE: Those are basically --

MR. DEY: Branch Technical Position.

MS. CUBBAGE: They're basically --

MR. WALLIS: Oh, so it's NRC.

MS. CUBBAGE: Yes. Those are like appendices to the SRP.

MR. DEY: And then farther on this section, it also provides the analytical methods to define the blowdown forces that will be accounted for in our analysis and will determine the, you know, the jet impingement and pipe break loads onto the structures on which it will impinge on and provide the adequate protection where safety-related structure is being interacted by jets.

MR. WALLIS: This is the standard that is criticized by the ACRS, is that the one?

MR. WAAL: Yes.

MR. DEAVER: Yes.

MEMBER SHACK: Now see, if you had leak-before-break, you wouldn't have to answer Ransom Wallis.

MR. WALLIS: Did you say handsome Wallis?

CHAIRMAN CORRADINI: I think that's what he said, yes.

(Laughter)

MR. DEAVER: I guess on that slide, we did indicate that you know, a recognition of those issues. So, one of our plans is to do CFD analysis to account for those effects that are not particularly accounted for by the NC standard.

MR. DEY: And the, you know, we will analyze the jet forces and jet impingement on the --

MR. WALLIS: When you say CFD analysis, this is CFD analysis of what? The jet? Or what?

MR. DEY: Yes. CFD analysis will do the jet modeling, at the vibrate location and we'll analyze to determine effects of jet and at a distance of pressure compliance and delta P and on an object on which it impinges on.

MR. WALLIS: So you can use CFD analysis for two-phase flow?

MR. DEY: That is one question we have, we're looking at it. But we -- our -- what we have done, is we have selected our break locations in our ESBWR piping. And we need to see exactly which particular break would require a two-phase flow in a modeling or not. And in that determination, we have one mainstay that we do not need it. It's only steam condition that will require only single flow.

MR. WALLIS: Well, safety analysis of this sort of thing is not really state-of-the-art. So you really need a verifying experiment or something like that?

MR. DEY: We have got an analysis in house right now that actually was modeled on the main steam line break.

MR. WALLIS: It needs some validation, doesn't it? You can't do just analysis alone with two phase flow.

MR. DEAVER: What we'd like to do a little later is show you the actual break locations and the conditions that we have. I think that has a bearing on the amount of analysis that's needed.

MR. DEY: And also, we recognize that, you know, rupture, pipe rupture will also need to address the blast rate on separated structures and components on the rate. And we also perform the calculation that shows the extent of the blast rate and up to which distance that we need to analyze the effect of the blast rates. Based on that calculation, we will look for any sector items that are located in those.

MR. WALLIS: Are we supposed to decide that this is going to work?

CHAIRMAN CORRADINI: Of course it will work.

MR. WALLIS: Or this is a preliminary statement until we actually see what you do. It's a statement of intent really.

MR. DEY: Here I'm showing the elevation view of the, our containment, inside containment. What I describe in the pipe rupture I that section 3.6.1 through 6.2, that our terminal end are located between the reactor vessel wall and the dry shield wall. All the nozzles are between in this confined space. All the high-energy line, except for the main steam line, the nozzles would be outside of the shield wall. So, as a result --

MR. DEAVER: Back up, P.K. so they can see it here.

MR. DEY: As a result, what I said that this piping at the terminal end break, as soon as it breaks here, all the jet flows and jet actually going to impinge on this shield wall here. The shield wall is a six-inch thick stainless steel, surrounding the entire reactor vessels.

And the distance is very short between the two from the break nozzle to the shield wall is around 2.5 feet only. So, jet is not going to develop enough to have the reflection wave, or feedback amplifications, et cetera.

And on top of that here, we do not have any safety-related items. In the top right. The majority of the breaks are this side. For the reverse flow direction, the piping that connects to these nozzles, piping will be restrained and we will model those piping in the CFD analysis, if needed.

For most of the part, piping attached to the reactor here, except down here, there is a two-inch SLC line, standby liquid control, which I don't think you need to have any CFD modeling.

Other than that, all large flow piping like main steam line, and the DPVIC and feed water or the VCU, this will be modeled.

MEMBER ARMIJO: What are the sizes of those lines? Main steam, and the largest?

MR. DEY: Main steam has the largest diameter, 30-inches. But we have in the nozzles, we have the venturi, which actually reduces the cross section.

MEMBER ARMIJO: Yes.

CHAIRMAN CORRADINI: To what?

MR. DEAVER: It's roughly about 14-inches diameter. So it --

CHAIRMAN CORRADINI: And that comes right -- those orifices or venturi are right at the outlet of the vessel, right?

MR. DEAVER: Right, built into the nozzle in the vessel itself.

CHAIRMAN CORRADINI: Thank you.

MR. DEY: Okay. So, for the -- I know that -- therefore from the nozzle side, from the reactor side, we are -- our interactions to any safety-related items almost none.

But from the reverse flows direction, piping that attaches, it penetrates through the shield wall, and when we're supporting this piping, rupture strength will be provided and the analysis will show the piping separates from the nozzles, but it does not completely disperse in a lateral direction. So it will end up having flow -- I mean the jetting on the reactor's surface.

So, from this type of, this break inside dry well, except the main steam line, is pretty all limited that there's no -- there will be no interactions.

MR. DEAVER: Why don't we go down the sizes of the nozzles.

MEMBER ARMIJO: Yes. What's your largest diameter stainless steel pipe?

MR. DEY: Okay. The main steam nozzle is 30-inch diameter. And the depressurization valve and IC, oscillation condenser, that the nozzle connection is 18-inches, and then that's line connects to this at the T, the 40-inch line.

Then we have feed water line, which is 12-inch diameter. And our WCU connects from both sides, which is 12-inches diameter too. Then GDCS, gravity driven cooling systems, that's two lines coming. One is, the line goes, connects to and goes to the tank, and from the tank, which is from a suppression pool, comes to the equalizer line, which are both six inches at the nozzle location.

And then there is a two-inch standby liquid control, there are two nozzle's from both ends at 180 degrees apart that are two-inch diameter piping.

MEMBER ARMIJO: What is your largest diameter stainless steel pipe? Or do you have any?

MR. DEY: With respect to pipe break?

MEMBER ARMIJO: Yes.

MR. DEAVER: Eight inch.

MEMBER ARMIJO: Eight inch, and which one is that?

MR. DEY: No.

MR. DEAVER: You didn't point out the IC return line. That is an eight-inch line right below you, right there. The IC return line, all the piping returning is stainless steel piping, and it's an eight-inch pipe.

MEMBER SHACK: And the line to the IC is?

MR. DEAVER: Is carbon steel. It's a steam line.

MEMBER SHACK: Water -- the water feed lines are carbon or?

MR. WALLIS: So I think what you said was all the pipes except the main steam line are in that annular space?

MR. DEAVER: No, I --

MR. DEY: Right. Meaning the nozzles --

MR. WALLIS: They're all in that space.

MR. DEY: The main steam --

MR. WALLIS: Have you analyzed what happens in that space?

MR. DEY: As soon as a pipe breaks, we postulate the pipe break, the jets, you know, the water from the reactor will jet onto the shield wall.

And the distance between the nozzle to the shield wall are approximately 2.5 feet. So, therefore, you know, conditions, some of those feedback amplification, resonance, et cetera, are not important for these type of breaks, for breaks from this side, from forward flow, if I say forward flow from reactor to the pipe.

MR. DEAVER: I'd like to also point out that beyond the shield wall, there's a vent wall. The vent wall, you know, is the -- right in there. That's another solid structure now. And when you get out into that annular space between the shield wall and the vent wall, there we have some squib valves with GDCS, but we have a very limited amount of safety-related equipment in that zone. But you know, so there isn't much concern as far as breaks, particularly for those nozzles that are below the -- you know, opposite the shield, the vent wall area.

MR. DEY: Then we have another pipe here, the six-inch RWCU drain, that comes out in an angle right here. And there are four piping like that at 19, 0918270 and two nozzles have a cone piping, that pipe these out of these bottom, and it goes to the heat exchangers.

So, those terminal in here, you know, because of its own geometry, and there's a sharp lane, it's so stiff, that piping, one nozzle breaks, and it stays intact right there. It does not rebound or anything.

So, this jet impingement here is very limited. And also, there are no other safety-related items. These are the --

MR. WALLIS: But how does it break if it stays intact? I'm not quite sure. It cracks and moves a little bit?

MR. DEY: Yes. It just opens up, of course, but there is so steep piping there because it's in a curvature also, too nozzles connect one piping like that, as a result, its very steep piping, and piping will not displace after the rupture. That's what I'm saying.

MR. WALLIS: What's the shape of the break when it breaks at the end? Does it break up -- does it burst on one side of the pipe, or

MR. DEY: No we consider the total guillotine break, meaning it's a full separation from the nozzle.

MR. WALLIS: But that's not necessarily how it will break.

MEMBER SHACK: Probably not, but that's the most conservative.

MR. SIEBER: No, but that's what gives you maximum --

MR. DEY: That is the assumption.

MR. WALLIS: Well, I'm not sure that it is. If it opens up on the side of the pipe --

MEMBER ARMIJO: And it doesn't whip.

MR. WALLIS: Breaks off a -- I don't know if I'm doing it right, but here's the pipe attached here, and it breaks off the top, it peals off the top of the plant, can it not do that besides just breaking off the end of the pipe? Once it starts to break, can't it progress down the pipe and break off?

MR. DEAVER: I think in examples where there's been failures, it's usually once -- say, axial --

MR. WALLIS: Well, say it fails because it has axial cramps, now presumably they can grow and break off a piece of pipe rather than --

MR. DEAVER: Well, I think the experience is, it doesn't usually break off a piece, it just opens up.

MR. WALLIS: Yes.

MR. DEAVER: But typically, that's less limiting, is you know, that --

MR. KEY: It's more conservative in the analysis in jet impingement.

MR. WALLIS: If it breaks off a side, then it won't impinge on the shield wall, it will squirt up the gap, won't it.

MR. DEAVER: Exactly.

MR. WALLIS: So I'm not quite sure, convinced about the shape of the break. Double-ended guillotine is a kind of regulatory break.

MR. DEAVER: Yes, exactly.

MR. WALLIS: The real breaks don't necessarily look like that.

MR. DEAVER: Well, yes, I think this is all pretty highly theoretical all right.

MR. DEY: So, we have the, you know, at the bottom, the reactor drain here, four nozzles, two nozzles are connected to the carbon piping then the pipe gets out of the -- from inside the containment and finally connects with the heat exchanger outside the containment.

So, we address all the terminal end breaks for the high energy and the moderate-energy lines inside and outside containment. Here is the main steam line where our break will not be confined inside the, between the RBB and the shield wall.

So, from the composite drawings that we've reviewed so far, we don't see that this jet, after breaking here, again, assuming the guillotine break, the whole jet is you know, we plotted it, and it tracks with the GDCS pool, which is a stainless steel structure here. And don't see any -- don't have any safety-related items.

But during install or relocate any safety-related items here, we are going to design an adequate protection and protective devices to have known interaction of the jet.

MR. WALLIS: What's the other pipe we see below the steam line there, what's that?

MR. DEAVER: Feed water.

MR. WALLIS: That's feed water there.

MR. DEAVER: But it's physically much lower. It's not in the direct path..

CHAIRMAN CORRADINI: It's meters lower.

MR. DEAVER: Yes.

MR. DEY: But this is how the inside containment will be addressed. And there will be a separate report for rupture for inside containment as well for the outside containment.

And outside containment, the same criteria applies, break, you know, in the terminal ends and the intermediate break, if there is one, we will have to postulate that and there will be a separate report and all the interactions from those breaks we'll have to look into.

MR. WALLIS: The main steam line would break at the isolation valve, or where is it going to break?

MR. DEY: The main steam line will break in the terminal building, another terminal end at the TSV, terminal stop wall

MR. WALLIS: Stop wall.

MR. DEY: Right. And for the feed water,

it would be at the feed water heaters. And again, the feed water heaters are located in their own separate compartments. And there again, we have very limited interactions and there is none absolutely, actually.

And so is the heat exchangers, RWCU, they are located, and if I just assume, it's off of here, right here outside in the compartments. And the nozzles are very low towards the floor, a little elevated over, just about a foot over the floor level. And there shouldn't be any interactions there also.

So, likewise, the moderate-energy piping will be addressed for moderate-energy piping that is 200 degree or less in temperature, 275 psig or less. And those piping, we do not postulate the guillotine break, but crack will be postulation. And again, the crack postulation stress fracture is also given in Branch Technical Position 3-4. And based on that stress limit, and by stress analysis results, we have to see what are those breaks locations and that will be addressed.

MR. WALLIS: So, you say you're going to use CFD, but it looks as if you won't need it anyway.

MR. DEAVER: Well, we think we have a very favorable geometry you know, with the pipes in the annular space where there is no safety-related equipment. The only thing we need to do is look at the blast wave with respect to an adjacent piping or nozzle, which we've got a pretty decent spacing between nozzles.

And then it's mainly the steam line, you just have to keep the area clear between the, where the end of the nozzle is to the GDCS pool wall. We either have to put shields if we have any piping in the area, or you know --

MR. WALLIS: So when the main steam line breaks, do pieces of the dryer come out as well?

MR. DEAVER: No.

MR. WALLIS: The dryer doesn't break when the steam line breaks? The forces on the dryer are not enough to break it?

MR. DEAVER: I'm not familiar with -- well, part of the dryer design, in addition to the supports, we have restraints at the top of the dryer hood. So, if there's any tipping or forcing of the dryer, typically, that helps provide support to the dryer. And helps maintain its structural integrity.

MEMBER MAYNARD: Part of the reason for

the nozzle in the main steam line is to limit the flow out of any one of those to where it also --

MEMBER SIEBER: Yes.

MR. DEAVER: Yes, it is. See, it's an effectively, a 14-inch break, even though it's a 30-inch pipe. So, that helps limit the forces that --

MR. WALLIS: Well, I guess when the pipe breaks, there's some waves that go back into the dryer which are fairly intense?

MR. DEAVER: Well, under these circumstances, our design objective is just to be able to shut down. We're not trying to maintain structural integrity necessarily of the dryer under these circumstances.

MR. WALLIS: I was wondering. Maybe pieces of dryer come out the break.

MR. DEAVER: I don't think so.

MR. WALLIS: You don't think so. Well, I don't know. You don't think so. You have a basis for thinking, I have no basis for thinking. I just suppose it might. So, anyway.

CHAIRMAN CORRADINI: How would -- I guess to answer Graham's question differently, how is this any different than current DWR?

MR. DEAVER: It's not. As a matter of

fact, most reactors have -- don't have the venturi in the line. And so, they effectively have a 22 or 26-inch pipe that is you know, allows much more flow and pressure grout to occur. So, it is no different in that respect.

MR. DEY: And then Section 3.6.1.4, that illustrates the as-built inspection of the high-energy pipe break mitigation pictures. In this, what we will do is, prior to plant's startup, an as-built inspection will be done. And in the as-built inspection, and as-designed condition will be looked at, evaluate the differences.

If that forces us to re-analyze the system again, based on the as-built condition, we'll do it. And 99.9 percent that I have in my experience is that vibrate locations do not change. But should there be any change in the vibrate location, and that requires us to re-evaluate, and region analysis is not limiting, in that case, we'll have to re-analyze that.

And if there is a new location of the vibrate, we have to re-evaluate that. And that -- from the as-built analysis.

And during that inspection also, we will include the inspection for the vibrate restraints and jet shield installations for the design. And we'll look into the physical separation distances between the rupture location and the, all the equipment that it was for the safe shutdown and all the mitigation features can be planned.

MR. DEAVER: We're just on the summary page.

MR. DEY: And in summary, Section 3.6 in DCD tier II, it describes the complete pipe rupture, how to perform the pipe rupture analysis on the mitigation and the effects of pipe breaks in the ESBWR standard plant. And Section 3.9 provides a solid basis for the design of the safety-related equipment, and you know, it fully complies with the requirements of the ASME code.

CHAIRMAN CORRADINI: Questions.

MEMBER SHACK: Almost unrelated, but that shield wall that you have, that's a couple of inches of stainless steel?

MR. DEAVER: It's six inches thick.

MR. DEY: Six-inch.

MR. DEAVER: And it's carbon steel.

MEMBER SHACK: Carbon.

MR. DEAVER: I think stainless -- P.K. said it was stainless, but it's carbon. In the past, we had a composite structure there. There was a concrete steel. But in this design, we've gone to a six-inch plate.

MEMBER SHACK: And there's -- there's then insulation between that and the vessel?

MR. DEAVER: Yes, there is.

MEMBER SHACK: But that's removable so you can expect the vessel.

MR. DEAVER: Right. Well, what we do is, we hang the insulation off the shield wall such that it leaves adequate space for remote inspection equipment.

MEMBER SHACK: Inspection, okay.

CHAIRMAN CORRADINI: And this is in that top part of the dry well? Or, I'm sorry, not the -- I said the word dry well, I shouldn't have said it. It's in that, above the supports.

MR. WALLIS: It's in the annulus, but it's not shown.

MEMBER SIEBER: Well, go put the picture back up.

MR. DEAVER: The insulation?

MEMBER SIEBER: The shield wall.

MR. WALLIS: The shield wall.

CHAIRMAN CORRADINI: the shield wall is

there.

MR. WALLIS: It's not shown. No, that's the concrete wall that's shown.

MR. DEAVER: No, this is the shield wall there.

MR. WALLIS: That's the access to the --

MEMBER MAYNARD: It's real hard to tell on that. It's a little, very thin.

CHAIRMAN CORRADINI: This is shown as being quite thin. But it's six inches thick. That's the shield wall goes up nearly to the top of the containment area.

MR. WALLIS: You're right.

MEMBER BROWN: That's your radiation shielding?

MR. DEAVER: Yes, it is.

CHAIRMAN CORRADINI: And so you hang the insulation off of that.

MR. DEAVER: Yes. It lines the inside of the shield wall. It has brackets that support it.

CHAIRMAN CORRADINI: That's fine. So, that lane scale between the shield wall and the vessel is what?

MR. DEAVER: The distance between the two?

CHAIRMAN CORRADINI: Yes.

MR. DEAVER: It's like two and a half, three feet.

CHAIRMAN CORRADINI: Okay.

MEMBER ARMIJO: What's the primary reason why the shield wall has to be so thick? Is it just to mitigate this pipe whip, or the --

CHAIRMAN CORRADINI: No, no, radiation. It's just radiation.

MR. DEAVER: Well, to a large extent, the pipe break annulus pressurization are the primary loads that seize, and so -- but it does act as a shield for radiation during outages. So, that's the -- you know, that was its initial design intent.

MEMBER ARMIJO: But other than the insulation, it does support much, any other structures, heavy structures?

MR. DEAVER: No. Here it shows the stabilizer again. This is the upper support for the vessel. That's the only other support structure.

MR. WALLIS: So, this jet comes out and dislodges a lot of insulation when it comes out?

MR. DEAVER: Say again?

MR. WALLIS: The broken pipe, impinges on the insulation?

MR. DEAVER: Yes. The insulation is in close proximity to that break location. So --

MR. WALLIS: This is reflective metal or something?

MR. DEAVER: Yes, it is.

MR. WALLIS: But it will be broken, presumably, some of it?

MR. DEAVER: Typically, around nozzles, we have shield wall openings, and that's where we get access for inspections of the nozzles and vessel seams. That's typically removable insulation that has buckles and so forth. So, the expectation I would have is that as soon as there's a pressure wave from a break, it would tend to open up the buckles.

MR. WALLIS: Well, I'm thinking you open it then release pieces of insulation into this two-phase mixture, which might be available to clog something down stream.

CHAIRMAN CORRADINI: All stainless steel insulation.

MR. WALLIS: Just a little piece of edge stainless steel insulation in a vacuum breaker is not desirable.

MR. DEAVER: Well, the vacuum breaker,

which is up at --

MR. WALLIS: Well to get there --

MR. DEAVER: It's up on this floor here.

MR. WALLIS: All right.

MR. DEAVER: It has shields also in it. It has four openings laterally and it has shields, screens and stuff so you can adjust --

MR. WALLIS: Anyway, you're going to analyze the effects on insulation of these jets?

MR. DEAVER: Yes. Well --

MR. WALLIS: What happens to the insulation?

MR. DEAVER: Well, typically, you know, the insulation doesn't have any structural support. It's going to be torn loose in the vicinity of the break.

MR. WALLIS: And the question is, where does it go, what does it do?

CHAIRMAN CORRADINI: That is an interesting question.

MR. DEAVER: Well, typically, like this morning, we were talking about, these were the vent walls were, let's say we have a break and it's a steam break. This is where we're going to have protection over this vent wall to prevent debris, maybe insulation pieces, from actually getting down into the suppression pool. But -- so the main concerns would be clogging -- getting material into the suppression pool, or what we have up here, this is the GDCS pool.

We have a screen that limits the amount of debris that could potentially get into the GDCS pool.

MR. WALLIS: Now these breaks are supposed to mix containment, but they wouldn't mix containment if they're contained inside this box, would they? They'd just go up like a chimney out of this shield wall, and then the steam would spread around the top of the dry well, presumably.

MR. DEAVER: Well, these openings in the shield wall, you'll get a little escape of pressure through the shield wall, but not --

MR. WALLIS: But the steam is going to then flow up between the vessel and the shield wall.

MR. DEAVER: Yes.

MR. WALLIS: Like a chimney.

MR. DEAVER: Well, it will transition around circumferentially. It will go up and down. It --

MR. WALLIS: It will spread, it will be

directed up into the top of the dry well, the dome there, presumably.

MR. SIEBER: The pressure is so high, it will go everywhere.

MR. DEAVER: This is a relief point at the top here.

MR. WALLIS: This is a course model contained in your contained analysis?

MR. DEAVER: Right. The analysis, the annulus pressurization all that, accounts for that.

MR. WALLIS: Well it raises some new questions for the -- for me, for the analysis of mixing and containment.

MR. DEAVER: Well, if you have a steam break, it's not going to be directed into that annulus. It's going to --

MR. WALLIS: No, not the steam line. The other breaks.

MR. DEAVER: Well, the other breaks --

MR. WALLIS: DGCS line break.

MR. DEAVER: These will be predominantly contained within the shield wall.

MR. WALLIS: But then the question is, what happens to the flow pattern in the containment when it comes out of the shield wall space.

CHAIRMAN CORRADINI: Other questions? We don't have the right people from GEH to answer some of the things you're asking. We need a different subcommittee meeting for that, I would say.

Is your worry the air steam mixing, Graham? Is it the uniformity of the mixture.

MR. WALLIS: We had a lot of questions about where do the noncondensibles go, where does the steam go. And it's not as if we have a jet issuing into containment. We have a confined jet inside this shield wall which presumably tends to fill that space with steam.

CHAIRMAN CORRADINI: That's one break, right. There's a lot of breaks --

MR. WALLIS: And then it comes out in an orderly fashion from there.

MR. DEAVER: Well, that's if you have a break at the nozzle.

MR. WALLIS: Yes. That's where it's supposed to be.

MS. CUBBAGE: I could be completely off base, this is getting late, but I mean, are they not going conservative in not assuming things are mixing? I thought, wasn't that the issue? They were assuming things not held up.

CHAIRMAN CORRADINI: I think the issue was, well, let's just back up a step. But the calculation you saw, Graham, with TRACG, and the audit calculations with MELCOR are a bit different.

MELCOR took, I think, one node, for all of that.

MR. WALLIS: Which is very unrealistic.

CHAIRMAN CORRADINI: Right, but it then mixes the noncondensibles, and it pushes into the wet well, which essentially pumps up the overall pressure.

MEMBER SIEBER: And that's the worst case.

MR. WALLIS: Well, that's another subcommittee, now, isn't it?

CHAIRMAN CORRADINI: It's another subcommittee.

MR. WALLIS: Okay.

CHAIRMAN CORRADINI: Not these guys.

MS. CUBBAGE: I guess my --

CHAIRMAN CORRADINI: We don't want to torture them just yet on that.

MS. CUBBAGE: I guess my point was that because they weren't really able to model all this, they went with a conservative approach, so we don't really need to get into all of that right here right now.

CHAIRMAN CORRADINI: For the DBA, I would think that was the -- that was the audit calculation in the staff's point, is that they were probably on the high side.

MR. WALLIS: And the question was, while you're conservative at one period in the accident, are you then conservative later on.

MS. CUBBAGE: And these guys will not be able to help you with that. No offense.

(Laughter)

MS. CUBBAGE: But that's not what they're here for.

CHAIRMAN CORRADINI: Okay.

MS. CUBBAGE: They're here for jet impingement.

CHAIRMAN CORRADINI: On the loading, structural side, structural loading side, is there any other questions for this team? None. Okay. Let's take a break until 3:15.

(Off the record for break from 2:58 p.m. until 3:15 p.m.)

MEMBER STETKAR: We'd like to get back into session.

MR. PATEL: Thank you very much. My name is Chandu Patel. I'm a lead project manager again, for Chapter 3. I'm going to make a presentation for some easy section in the beginning, and then we'll turn to the other people.

First of all, I apologize for all this shuffling. I'll go to slide number 7. We had some personnel issues, so we had to shuffle around people. But I think finally we have everybody together. Please go to slide 7. Just after 3.9.1.

And I was comparing my slide, against the GE slide, and I don't know who stole whose slide, okay. They're essentially, but it is exactly the same thing. So, I do not -- I guess we do not need to repeat.

The basic issue is, in this section, we do not have any open item. You know, I can repeat the same thing, what they repeated, basically. It's exactly, we're on the same, like you know. They gave us the transients and number of cycles in the table, and they gave component programs, and the methodology. But, long and short of it, this section was literally easy and we have no open items. So, if there are no more questions, I can go to the next.

Now, I'm going to go 3.9.2.2, which is slide number 11. This is related to safety analysis and qualification of mechanical equipment. Basically, we looked at the DCD information provided in 3.9.2.2, and 3.7.2, 3.7.3 and B10, which was related to the seismic analysis and qualification of mechanical equipment and components.

What we, the area we reviewed was, seismic analysis methodology, for equipment and components, modeling of major component, number of earthquake cycles, particular evaluation, a combination of the model responses, damping values, qualification of large mechanical component, effects of rigidity of support anchorage and torque effects of eccentric masses.

And in general, most of the areas that were discussed are here. We had only two RAIs in this section. The first open RAI was related to the rigidity of the support anchorage to the building and particularly for the heavy component. And this item is closed. So, after we showed the safety-relation, it is closed.

The second open item was related to the CRD housing, and implementing the computer codes and industry standard, which was kind of a you know, all a type of an issue, and it wasn't significant. And that issue is also closed.

So, basically in 3.9.2.2, also, we have no open issue any more. And that's the end of 3.9.2.2, unless anybody has questions.

So now we are going to go to section 3.9.2.1, which has previous -- and Jay Rajan will take it from there. That's slide number nine.

MR. RAJAN: I am Jay Rajan, and I'll be discussing the piping vibration, thermal expansion and dynamic pipes testing.

The staff reviewed the vibration and dynamic effect testing, which included measurement techniques, monitoring requirements, test evaluation acceptance criteria, reconciliation and corrective actions.

The staff also reviewed the methods for determining the acceptability of steady state and transient vibration for the effected systems. This included wave observation, local measurements and remotely monitored and recorded measurements.

Generally, the specifications which the staff have accepted in the past, are identified in ASME operation and maintenance standard, subgroup 3, part 3, and the applicant has -- GEH has generally complied with those -- with that standard. So the staff finds it acceptable.

As for the requirements for thermal expansion testing, the -- they have also complied with the ASME OM standard part 7, which detail specifications for this -- for such a program, and in general, the staff asked a number of questions, but they were responded to in a satisfactory manner, so we do not have any open items in this section 3.9.2.1 (sic).

In 3.9.2.3, of the DCD, the staff reviewed the major reactor internal components within the vessel, which are subjected to extensive testing, coupled with dynamic system analysis to properly evaluate the resulting flow induced vibration phenomena during --

MEMBER BROWN: Can I ask you a question about, the other one first? You said they generally compiled.

MR. RAJAN: Yes, sir.

MEMBER BROWN: That implies that they didn't comply someplace, but yet, everything was okay. Were your --

MR. RAJAN: Well, we asked a number of questions, and the responses --

MEMBER BROWN: Were they on their areas of noncompliance?

MR. RAJAN: No, we found -- we found their responses satisfactory and acceptable.

MEMBER BROWN: Let me go back to square one. You said they were generally compliant with the standards, which --

CHAIRMAN CORRADINI: Did you mean to say that?

MEMBER BROWN: Did you mean to use the word generally, or they do comply with the standards and that you had some questions which they then resolved.

MR. RAJAN: Based on the response of that question, they did comply.

MEMBER BROWN: Okay.

MR. RAJAN: In the initial --

MEMBER BROWN: I quit.

(Laughter)

MR. RAJAN: The -- as I said, the detailed analysis for and testing information is for these -- for the reactor internal components, except for the steam dryer, is provided in the licensing technical report, NEDE-33259P Rev 1. And this will be discussed later in 3.9.2.3.

The major open items identified here all in 3.9.2.3, all relate to the steam dryer load definition. The current GE approach to steam dryer load definition is defined as a plant-based load evaluation method, or the PBLE method. And this methodology is contained in LTR NEDC-33408B, which is currently being reviewed under Section 3.9.5.

The review status and additional details will be discussed in Section 3.9.5. At this point, the ESBWR steam dryer load definition and the design itself has not been finalized.

GE has, however, stated that it will be similar to the ABWR steam dryer design. A detailed, finite element model analysis will be used to predict the steam dryer susceptibility to fatigue under flowing boost vibration loadings. The open items related to the prediction of stresses at potential high-stress locations on the dryer, and the stress limit curve, to be used during the initial power ascension test can only be evaluated and resolved when the steam dryer load definition from the PBLE methodology and detailed finite element analysis become available.

MEMBER ARMIJO: What is PBLE?

MR. RAJAN: That's the Plant-based Load

Evaluation methodology. It is discussed in a technical report, 33408P, and is being currently reviewed by the contractors and the staff under Section 3.9.5.

MEMBER MAYNARD: That basically means, once it gets installed, is that the test methodology, to come up with the loads?

MEMBER BLEY: Is it a computer code.

MR. RAJAN: Very briefly, I can say that it's based on --

MEMBER MAYNARD: I think somebody wants to help you.

MS. CUBBAGE: Well, actually, I was going to say, we have our contractors here. Yes, we'll wait until 3.9.5.

MEMBER MAYNARD: Well, did GE -- GE never mentioned this.

MEMBER STETKAR: Sure they did.

MS. CUBBAGE: Yes, they did.

MEMBER ARMIJO: Then I was asleep.

MEMBER SHACK: They didn't tell --

(Laughter)

MEMBER SHACK: They didn't use those words. They had three topical reports.

MR. WAAL: This is Jeff Waal. I

mentioned PBLE in the presentation.

MEMBER ARMIJO: Okay, Jeff. I stand corrected.

MS. CUBBAGE: And when the staff's presenting 3.9.5, we'll elaborate.

MEMBER BLEY: But that has replaced what the open items were here. They're covered in that. That's the way I read this. These open items are closed because they're superceded by these.

MEMBER BROWN: And you won't be able to get an answer until you get the new stuff.

MEMBER SIEBER: Well, it's going to be a different answer.

MEMBER SHACK: Well, they're not closed until you accept the topical reports.

MS. CUBBAGE: That's right. GE's addressing a number of RAIs by providing these topic reports, which staff's reviewing and will generate more RAIs.

MEMBER ARMIJO: So the only open items aren't really closed.

MEMBER SHACK: Say that out loud.

MEMBER ARMIJO: The open items aren't really closed then. They're just being addressed by another methodology.

MR. RAJAN: They may or may not be addressed, because if the PBLE methodology provides the adequate response to the questions we have raised, then they may or may not be raised there. And they have sort of, they have asked prematurely before the PBLE methodology was made available for us to review.

MEMBER SHACK: I'm waiting for 3.9.5.

MR. RAJAN: In Section 3.9.4, the staff review focused on the major reactor internal components within the vessel, which are subjected to extensive testing, coupled with dynamic system analysis and evaluation of the resulting flow induced vibration phenomenon.

These components include the chimney head steam dryer assembly, shroud chimney assembly, top guide, core plates, the standby liquid control piping, et cetera.

The first open item that we have in this relates to the classification of the ESBWR reactor internals as a non-prototype Category II. In accordance with the definition on reg guide 120, non-prototype Category II reactor internals are those which are the same as in the reference prototype plan, in terms of design, size and operating conditions, but, not necessarily the same arrangement or configuration.

The ABWR is considered to be a prototype reference plan for the ESBWR reactor internals, based on the similarity of design, size and operating conditions of the reactor internals. Three ABWR plants are currently in operation in Japan and the first plan completed a flow induced vibration test program in accordance with reg guide, NRC reg guide 120 Rev 2.

Extensive analysis, testing and full inspection were conducted during the first plant startup. A total of 46 sensors of different types were used to obtain vibration data on 11 different internal components.

The ABWR components monitored during the startup, including the steam dryer, control lab guide tubes, internal monitoring guide tubes and housing and the top guide, and the shroud.

For the ESBWR, extensive instrumentation of the chimney and the standby liquid control lines, both of which are new components, is planned in addition to the stream guide and a number of other components.

Prior to the startup testing, extensive

analysis of these two components that are the chimney and the standby liquid control lines, were made to establish the acceptance criteria. The acceptance criteria were set such that the maximum stress anywhere on the structure was limited to 68.9 megaPascals. If the FIV response amplitudes were at less than the acceptances criteria, damage to the components is not likely to occur. Thus the startup program will ensure that these non-prototype components will not be subjected to unacceptable flow induced vibration stresses during operation.

The staff determined that it needed more information because the applicant response evaluated only these new components which it considers as non-prototypical. But the applicant was requested to justify the non-prototype Category II Classification for the ESBWR on a component by component basis. And this they have done. They have provided an item-by-item discussion of why each component was considered to be prototypical and selected for further analysis and testing, or why it was considered adequate without further analysis or testing and this is provided in revision 1 of this license topical report.

This -- the revised LTR contains

detailed analytic methods used to determine the FIV response of each item requiring further evaluation. The results of the evaluation and comparison to allowable stresses were testing and determined to be required for a particular component. The revised LCL also includes the types and locations of sensors.

The remaining internal components that are not specifically identified in their Appendix 3L of the DCD or in this LTR, are basically proven by best trouble-free BWR experience and have designs and flow conditions that are similar to trial --

MEMBER SHACK: I think you've got your papers on the microphone. It's driving him crazy.

MR. RAJAN: -- I'm sorry -- prior operating BWR plants. The staff finds the applicant response acceptable with respect to the issues discussed above. But the review of the, this revised LTR is still on-going, and further -- and therefore, currently the review is being -- additional RAIs are being formulated as necessary. And the classification issue of the ESBWR reactor internals as a whole is still being kept as an open item.

The other open item identified in this

section relates to the flow induced vibration analysis of the ESBWR top guide based on the test data obtained form the ABWR top guide.

In RAI 3.9-77, the staff requested that the applicant describe the modifications made to the vibration analysis at the ABWR top guide assembly, the predicted response of the ESBWR top guide.

In its response, the applicant discussed the overall -- stated that the overall thickness of the top guide is the same as the ESBWR design and also provided analytical results for the top guide.

To calculate the five year response of the ESBWR shrouds and chimney separator structure, measure time histories in the ABWR shroud, we have to measure shrouds annulus, was suitable scaled to define the pressure time histories in the ESBWR shroud in the annulus.

The scale factors were computed as the square of the reissue of the ESBWR annulus flow velocity to the corresponding value in ABWR. And as based on the results of this determination, the highest to zero to peak stress intensity was calculated and for the shroud chimney structure and the top guide, both were determined to be well below the allowable value of 68.9 megaPascals.

The staff is primarily concerned not just with the lateral stresses on the tope guide, but rather the fact that the ESBWR, because the ESBWR guide plate has more cut-outs and may create greater stress concentration factors and stress patterns related to the differences between the ABWR and the ESBWR top guide, both of them need to be very similar in order for the extrapolation from the ABWR to the ESBWR to remain valid.

And so this remains an open item at this point.

CHAIRMAN CORRADINI: And how would that -- so the resolution of that would be test data, by startup testing? I'm still trying to understand -- I listened to how you're describing all this. I'm trying to understand.

MR. RAJAN: The ESBWR top guide supports a very long structure that is the chimney --

CHAIRMAN CORRADINI: Right.

MR. RAJAN: -- which of course, the ABWR does not have.

CHAIRMAN CORRADINI: right.

MR. RAJAN: And as a result of that, the staff concern is that it supports it in a sort of a cantilevered fashion. And the staff is concerned that because of the differences in the stress patter, the cut-outs, and it may create concentration, stress concentration effects on the plate itself. Which --

CHAIRMAN CORRADINI: On the bottom support foot.

MR. RAJAN: On the top guide.

CHAIRMAN CORRADINI: Oh, the top guide.

MR. RAJAN: The top guide itself. So, unless that's -- I believe unless the design of the top guide progresses to the point where they can model the exact cut-outs, this RAI cannot be resolved. So, which has not been apparently, their design activity has not apparently proceeded to that level yet. So this remains an open item.

MEMBER BROWN: And the concern is it could crash and block the passages of all the stuff coming up and cooling the core? Is that the safety concern on that thing, if you get cracks in it? A crack is a crack. You worried about it coming apart?

MR. RAJAN: Well, it -- we have not gone into the consequences aspect of it. But it certainly should be a -- we would certainly not like that -- something like that to happen, a cracking or anything. So, we would like that to be a structurally sound structure. Integrity -- structural integrity should be verified in some fashion.

CHAIRMAN CORRADINI: But can I just say it back to you in a brief fashion? So, by going with the scale of the square of the velocities, you're below the peak stresses, but you're worried about the physical geometry being weaker or different even though it fits within that envelope?

MR. RAJAN: Exactly. That is true.

CHAIRMAN CORRADINI: And by analysis, one could, at least if I understood the second part to your answer, one could by detail analysis show that if --

MR. RAJAN: A detail finite analysis of the plate itself.

CHAIRMAN CORRADINI: And the plate is sitting on top of the -- I'm still struggling here.

MR. RAJAN: No, it's -- the chimney sits on top of it.

CHAIRMAN CORRADINI: Okay, that's what I thought.

MR. RAJAN: Yes.

CHAIRMAN CORRADINI: That's what I

thought at the beginning, but the way you answered me, okay, it sits on top of it. Okay, fine. Got it.

MR. RAJAN: This is the top guide.

CHAIRMAN CORRADINI: Got it, thank you.

MEMBER ARMIJO: But the main support of the chimney, isn't that around the circumference, or is it all across the top plate?

MR. RAJAN: The top guide has some support, it's connected with the vessel. And there is also support, there's support in the bottom core plate, also has connections with the vessel.

MEMBER ARMIJO: I know that.

MR. RAJAN: So they are interconnected and it's --

MEMBER ARMIJO: But the chimney, I'm just trying to get the support --

MR. RAJAN: Yes, the chimney is bolted onto the top guide.

MEMBER ARMIJO: Bolted onto the top guide.

MEMBER SHACK: Bolted, or just pins?

MR. RAJAN: No, it's bolted on.

MEMBER SHACK: Bolted on.

MR. RAJAN: Bolted on.

MR. SHACK: And the bolt path is on the circumference or?

MR. DEAVER: Let me clarify that.

CHAIRMAN CORRADINI: Something doesn't make sense. Because they just said they could undo it.

MEMBER SIEBER: That's the partition.

MR. RAJAN: No, it's --

MR. DEAVER: This is Jerry Deaver with GEH. Let me clarify that. In going from revision 4 to revision 5, we were showing a bolted connection of the partitions at the base. But because of the removable chimney now, we now are not going to bolt it down at the base.

But I would like to say that, you know, from a loading perspective, we would like to primarily load the partitions on the periphery, as opposed to loading across the top guide. You know, we don't want to induce a new load on the top guide itself.

And in response to the RAI, we are doing a fine element analysis right now to do exactly what he was describing.

CHAIRMAN CORRADINI: Can I get you to kind of expand what you just said? So, it's not bolted, they're pinned. So they slide into something.

MR. DEAVER: Exactly.

CHAIRMAN CORRADINI: And then you said that you want it to be loaded from the outside. I don't completely understand.

MEMBER SIEBER: It's along the circumference.

CHAIRMAN CORRADINI: Yes, but you're going to have partitions all the way through, so they're going to be weighty in the middle. So I don't understand it.

MEMBER BROWN: Well, they're all welded together.

MR. DEAVER: Yes. The partitions are welded together, but we're likely to have a ring at the base also.

CHAIRMAN CORRADINI: Oh, okay. So the partitions are almost like a -- kind of like a -- okay, fine. I misunderstood. So, it's almost like a moveable screen. The whole thing's going to come out in one --

MR. DEAVER: One piece.

CHAIRMAN CORRADINI: One piece. Excuse me. I misunderstood that.

MEMBER BROWN: The whole chimney, I missed that also. The whole chimney assembly?

MR. DEAVER: The partition --

MEMBER BROWN: The partition.

MR. DEAVER: -- is an assembly, and it comes out in one piece.

CHAIRMAN CORRADINI: Okay. So, now I want to ask you the question that I wanted to ask. Which is, now I've got all this steam and water coming out, and it's whizzing by all of this, and I have maldistribution in the steam and water, and now I've got this very big screen and seven meters tall getting wiggled on it.

So, how are you -- I guess, I believe that you can do a 3-dimensional final element, I'm trying to figure out how you're going to give the loading on it from this. Are you going to use ABWR data to load it? I mean, I'm still going back to your original discussion about --

MR. RAJAN: ABWR they measured only the lateral motion.

CHAIRMAN CORRADINI: Yes. So that would be the sort of loading you would expect to look and see how it performs relative to that?

MR. DEAVER: Let me clarify one thing

here. Our fuel bundles sit in the top guide, but the flow does not go by the top guide surfaces itself. It -- you know, the top guide is a lateral support for the top of the fuel.

CHAIRMAN CORRADINI: Right.

MR. DEAVER: So there's no flow in between the structure in the top guide structure itself. It's all within the channels of the fuel.

MEMBER SHACK: With some bypass.

MR. DEAVER: There's a little bypass that occurs.

CHAIRMAN CORRADINI: Yes, okay. But I'm just trying --

MEMBER SHACK: But the loading you're going to get from your Hitachi tests on the channel, to answer Mike's question.

CHAIRMAN CORRADINI: I'm trying to understand the pressure --

MR. DEAVER: I'm not sure if we're talking top --

CHAIRMAN CORRADINI: -- I'm trying to understand the forcing function that you're going to observe the 3-dimensional element analysis with. And is it going to be test data?

MR. DEAVER: In the top guide, or the

partitions, now.

CHAIRMAN CORRADINI: What he's worried about.

MR. DEAVER: This topic is mainly the top guide.

CHAIRMAN CORRADINI: The top guide. Loaded with the partitions. And your point is, the way you're going to load it, it'll be on the outside ring.

MR. DEAVER: Exactly.

CHAIRMAN CORRADINI: Okay. All right. Thank you, I get it.

MR. DEAVER: We're primarily in our analysis trying to establish what natural frequencies and stiffnesses are present across the top guide to help.

CHAIRMAN CORRADINI: Okay. All right. That helped. Thank you very much.

MR. DEAVER: Okay.

MR. RAJAN: So if there are no additional questions, I'll proceed to 3.9.2.5. In this section, the staff reviewed the dynamic system analysis that were performed to confirm the structural design adequacy and ability of the reactor internals and the unbroken loops of the reactor internal piping to withstand with no loss of function the loads from a local in combination with a SSC.

The staff reviewed the methods of analysis, the concentration in defining the mathematical models, the descriptions of the forcing functions, the calculational schemes, the acceptance criteria and the interpretation of the analytical results.

In DCD Section 3.9.2, the applicant states that the analysis for the -- will be determine -- will determine the reactor internals pressure differentials resulting from an assumed break in the main steam line and the feed water line. To ensure that no significant dynamic amplifications of the load occurs as a result of the oscillatory nature of the blow down forces during an accident, the periods of applied forces were compared to the natural periods of the structures being acted upon by the applied forces.

A comprehensive vertical dynamic model of the RPV and the internals is used to determine these periods. In RAI 3.9-81, the staff asked and requested information that the applicant provide the analytical results to demonstrate that there is no significant dynamic amplification of the loads on the reactor internal component structures as a result of the postulated break in the main steam or feed water line.

Those results have not been provided to the staff so far, so this item, this RAI 3.9-81, remains an open item. And that concludes my part of the presentation.

MR. WALLIS: So the main steam line has a break, does this result in significant loading on the steam dryer?

MR. RAJAN: That is one of the concerns on all the reactor in general, and the steam dryer of course is part of the reactor internals.

MR. WALLIS: Does the staff know how to calculate these forces?

MR. RAJAN: Well, it's based on, as they pointed out, it's based on a detailed analytical model of the reactor internals. And of course, with -- we can make a simplified analysis, but for a detailed, since GE has already done that, we are -- we have requested for the analytical results of that analysis. And that apparently is being provided to us in the near future. But so far to date, we have not received those results.

MR. PATEL: Okay. I guess we'll go to Section 3.9.3, it's on ASME code, Class I, II, III component and component support and COL superstructure.

I guess this is basically ASME code-type of requirement, 10 CR 50.50 Part A. And GDC 124, 14 and 15. Basically, the ADWR review included loading combination, design transient and stress limit used for entering the structural integrity of the reactor pressure vessel assembly and other mechanical components, valve operability assurance, design and installation of pressure devices and component support.

In this area, we did not -- we had only two open items when we issued the safety evaluation for Revision 3. And then we had Revision 4, which removed one of the correction items and we had to issue one more RAI. So you know, we have three RAI open. I will discuss a little bit in detail.

The first RAI was the effect of the snubber fitting and the lost motion on equal load setting of multiple support -- multiple snubber support, which is RAI 3.9.1.14. And that was resolved.

There was another RAI, which was

3.9.1.17, that also included description of the snubbers production and qualification test program and the compliance of the snubber design to ASME code. And this one was resolved.

The third one is much kind of important open RAI. Initially, they had in Rev 3, they had the COL action item, which required them to make available design specification and design report of ASME Section 3, mechanical component to NRC.

And they removed that. And so right now, we are still in discussion with GEH to figure out what is the best way to handle it. So that is still open item.

And there is one more COL information item which is, still there. They will provide plan for detail snubber in the testing and inspection program.

So, basically, in this section, there is one COL action item which is open, which we don't -- we have not decided exactly how we are going to handle it. That completes 3.9.3.

Andrey Turilin will present the 3.9.4, controller drive system.

MR. TURILIN: Thank you. Good afternoon. Like he said, my name is Andrey Turilin. I'm going to talk about 3.9.4, control rod drive system. Basically Section 3.9.4 review says the design of the control rod drive components pertaining to ASME Section 3 code, primary the reactor coolant pressure boundary components.

Additionally we, the staff, also looked at other components such as the electro hydraulic fine motion control rod drives mechanism, the hydraulic control unit assemblies, supply system and the power to the fine motion control rod drive motors.

A review of the appropriate loadings and stresses and information criteria was also performed. Talking about the technical review summary, the staff in its review of Section 3.9.4, the staff evaluated the quality group classification of control rod drive components, mainly to ensure that reactor coolant pressure boundary components are designed to ASME Section -- ASME code, Class I requirements.

The staff also evaluated the structural adequacy of the system by looking at the loading combinations, which include normal, anticipated operational occurrences and natural and accident events.

The staff also looked at the stress limits and the deformation and fatigue limits, which are of interest in the instances where a failure of the movement, due to excessive deformation, could be postulated and such movement would be unnecessary for a safety-related function.

Additionally, the staff evaluated the testing programs, which include factory quality control tests, the functional, mechanical functional test, operational tests, acceptance tests and surveillance tests.

Originally there were five open -- there were five RAIs issued to GE. And all five were satisfactorily answered. There are no open items and there are no COL information items. That pretty much concludes Section 3.9.4 review.

CHAIRMAN CORRADINI: Thank you.

MR. PATEL: We have to just, one minute please.

MEMBER ARMIJO: Changing the troops?

MR. PATEL: Yes. This is the most important subject, I guess, for DBWR methodology, all the questions you may have. This is the time.

MR. SEKERAK: You're really setting me up here.

(Laughter)

MR. PATEL: This is Pat Sekerak. He's going to make the presentation on 3.9.5.

MR. SEKERAK: Good afternoon. My name is Pat Sekerak, I'm with the engineering mechanics branch of office of new reactors. And I'll discuss chapter 3.9.5, RPP internals.

Before we begin, to begin, I'd like to introduce individuals who continue to provide invaluable specialized technical service for reactor internals designs. And that includes Vikram Shah, in the middle, principal investigator from Argonne National Laboratory, Steven Hambrick, to my immediate right, who is the head of Structural Acoustics Department at Penn State University, and to the far right, Thomas Mulcahy, who is a senior technical investigator, also from Argonne National Laboratory.

Regarding review guidance, the primary objective for the design of the reactor vessel internal structure is to provide support and confinement of the reactor core with sufficient design margin to ensure fuel performance and reactivity control.

The core support function requires

application of the highest level of quality and design criteria, as indicated by the general design criteria referenced here. However, there is a graded application of the GDC criteria focused on those RPV internal structures identified as core support structures.

Regarding the status of the review summary, currently, the staff's technical review of the basis for the RPV internals design is concentrating on the design codes and standards specified in the ESBWR design control document and the analytical and testing methods used to implement the rules of those standards.

The RPV internals have been classified by GE into three different categories. First are safety-related core support structures, which include the core shroud, shroud supports, and core plate.

Second, there is a category called safety-related internal structures. These include the SLC system header and piping and in core guide tubes.

And finally, there is a category named non-safety-related, albeit, important to safety internal structures, which includes a steam dryer.

The design criteria and quality standards selected to meet the general design criteria applicable to RPV core support structure include the design and construction rules of ASME 3, subsection NG, in its entirety. The core support structures require ASME certification and code stamping, and are constructed to meet the full requirements of code subsection NG.

The design of so-called safety-related internal structures and the non-safety, albeit important to safety steam dryer, utilize a limited application of ASME 3 requirements, including the design by analysis rules of subsection NG 3000, and the applicable ASME 3 allowable stress criteria associated with that.

I think that the staff -- it's important to indicate that the staff review has also indicated the design process for the ESBWR steam dryer is also incorporating many of the lessons learned from operational failures of BWR steam dryers subjected to power-up rate conditions in the operating fleet.

And examples of this include, close side branch pipe intersections of the ESBWR steam, main steam system, are being designed to minimize the potential for acoustic resonance condition, and the resulting potential for fatigue degradation of the steam dryer, excuse me, due to amplified acoustic pressure loading.

This was one of the main causes of steam dryer degradation identified in the -- some of the beat up BWR 3 failures of the steam dryer recently in the operating fleet.

Now secondly, an important consideration is that the ABWR prototype for the ESBWR steam dryer design is similar to the replacement steam dryers installed in operating BWR plants which have experienced steam dryer fatigue failures.

These replacement dryers use design upgrades including thicker plate structure to improve stiffness and structural response to alternating pressure loads, and also introduced the slated or curved hood design replacing the old square hood design, which reduced the effects of vortex shedding and turbulence of steam flows flowing around the steam dryer.

Currently, although the staff review of DCD Section 3.9.5 is proceeding in a positive direction, the overall conclusion remains pre-decisional at this time due to a number of open items which still require resolution.

Regarding the open items, the open items currently remaining from previous review work fit within the general technical categories listed here. Progress has been made in resolving five of the 14 open items identified in the draft SER transmitted to the ACRS in support of this meeting.

Most of the nine open items remaining are expected to be resolved by the technical revisions of the new set of GE topical reports recently submitted and currently undergoing staff review. And the work ahead of use is captured primarily in the last bullet, on-going topical report reviews.

There are four topical reports listed here which are now being reviewed by the staff with two primary goals in mind. First, is to develop an understanding of the detailed methodology presented for approval of the steam dryer design process. And second, we hope to use these reports to assist in closure of existing open items.

The first objective will produce a new set of RAIs primarily due to the complex technical methodology presented in NEDC-33408P report, which GE refers to as PBLE, or Plant Based Load Evaluation methodology.

The PBLE method report describes an analytical tool for definition of acoustic and hydrodynamic pressure loads applicable to the steam dryer design. This PBLE method will be applied to both the new ESBWR steam dryer design, and to evaluation of structural integrity of existing steam dryers for BWR operating plants requesting extended power-up rates.

The staff will issue a new set of RAIs on these reports within the next month. The resolution process for these new RAIs in addition to closure of existing open items, is expected to extend well into the later part of this year.

The point being, that there's been significant amount of work done up to now, but there's also a significant amount of work remaining to close out existing open items and to review the three topical reports that under report reviews start with the steam dryer, primarily.

Those three topical reports, NEDC-33408, NEDE-33312, and NEDE-33313, are intimately related. And they all taken together, define the process for design of the steam dryer, including the load definition methodology, which probably is the most important part of the design process in defining a load system to be applied, and also, the structural evaluation of the steam dryer, once the load definition is fully defined.

And those three reports, which are currently under staff review, will hopefully provide the basis for the new steam dryer design. And I will say that the most important and most complex of all of those is the PBLE methodology, 33408P, which is a computerized predictive tool used to define, again, the flow induced loadings that will be applied to the steam dryer under operational load conditions.

MEMBER SHACK: From main steam line measurements, or from ab initio?

MR. SHEMANSKI: No, this is a predictive analytical tool. It will be verified. The results -- it will be used for a predictive analysis. The flow induced vibration program, defined in Subsection 3.9.2, will provide the final verification by testing to validate the predictive analysis. Excuse me, go ahead Steve.

MR. HAMBRICK: Yes, the tool is a mix of predictive technology as well as in plant measurements. So, the instrument, the dryer, with several transducers which they then apply the data from, as boundary conditions to a numerical model of the steam in the dome, which includes boundary conditions with the steam, or the water interface underneath, the walls and the inlets to the main steam pipes. So, it's a curve fit, if you will, to what's going on inside the actual plant. And they're using --

CHAIRMAN CORRADINI: But they need data.

MR. HAMBRICK: They're using data from ABWR, they're using data from existing dryers in quad cities before the installation, they applied site ranches, and also Susquehanna.

MS. CUBBAGE: We -- proprietary, yes, no?

MR. SHEMANSKI: I think --

CHAIRMAN CORRADINI: Proprietary, you're not allowed to say what just was said?

MR. SHEMANSKI: Maybe GE -- if we start to infringe on proprietary information that's in these reports, would GE please step up. Because we don't want to reveal anything that's proprietary in a public forum. I'm hoping we're not.

MR. KINSEY: This is Jim Kinsey from GEH. We're sensitive to that question and have been listening closely. And we're closely approaching the boundary.

(Laughter)

MR. SHEMANSKI: So, I think we --

CHAIRMAN CORRADINI: So, we need to say it's data with analysis based on the data for boundary issues.

MS. CUBBAGE: But I believe this meeting was noticed as the potential to close, so if the committee would like to pursue that avenue, we certainly can do that. And I believe -- you all don't have a time line to leave, right? So, we could do that at the end. We could come back to that.

CHAIRMAN CORRADINI: Fine. Okay.

MEMBER SHACK: What is the difference between the flow induced load definition and the acoustic load? Is that -- is there a one sentence distinction?

MR. KINSEY: We're probably going to jump over the line on that.

MEMBER SHACK: Oh, okay.

MR. HAMBRICK: They're coming up with loads based on existing measurements and then applying them to their dryer design.

MR. KINSEY: And again, this is Jim Kinsey from GEH. We're happy to address some of these questions. We have the right people here today. We'll just need to close the session to do that, if that's convenient for the subcommittee.

MS. CUBBAGE: As a matter of fact, since we were done with the prepared presentation here, maybe we should go on to the others and then come back in closed session. Is that okay?

MR. SHEMANSKI: Sure, whatever is appropriate. That would be fine.

MS. CUBBAGE: Let's swap out teams, get through the other slides real quick, and then we'll get into this.

MR. SHEMANSKI: One final comment that Pat made, they will indeed validate all this with in plant measurements during startup, with the ESBWR.

MR. PATEL: Tom Scarbrough is going present the 3.9.6.

MR. SCARBROUGH: Good afternoon. Tom Scarbrough, and I'm in component performance branch of NRO. I'm going to talk a little bit about 3.9.6, which is the functional design qualification and it's a recessing program.

The first slide there shows the regulations and reg guidance that was applicable. Part 52, Part 50, Appendix A, and the QA performance of Appendix B, 10 CFR 50.55(a), the in service testing requirements, and the guidance we use is the standard review plan 396. It's been updated to follow this new approach, and also commission paper SECY-05-0197, which as we heard earlier, in service testing is one of the operational programs, as well as MOV testing, Motor Operable Valve testing is an operational program. So it has a little bit of different approach to it in terms of how to address that. And I'll get into that in a couple of minutes.

The technical review summary, the information that we review in the DCD is spread throughout the document in some cases. 3.9.3.5, is valve operability assurance, which talks about the qualification and testing analysis, and I'll talk a little bit about that in a minute.

3.9.3.6, is the pressure relief devices, and it covers the safe relief valve, the vacuum breaker valves and the depressurization valves. 3.9.3.7, are compliment supports, and there it refers to OM code Section ISTD, because that's the new version, the new method of dealing with snubbers.

And then 3.9.6 itself, is the functional design qualification, in service testing, sort of overall. And it indicates that there are no safety-related pumps, which you heard earlier today, and the valves themselves will be covered by OM code, 2001 edition and 2003 addendum.

Now, our technical, next slide. Our technical review, how we went about it was, we used the lessons learned from the functional design qualification issues that we've had with valves over the past, you know, 15 years or so, as part of the review. In regard to valve performance, there also is a whole body of operating experience that we use in terms of looking at how they address that.

We had numerous RAIs requesting information in these areas. We had a public meeting on May 22nd, with GEH and also North Anna to talk about what was the goal of the DCD in terms of addressing this operational program for ISTD, and how are they going to deal with that in terms of COL applications.

And that was with the design center working group, DCWG. And that was a very successful meeting in dealing with that. And we've come to a point where we think we're heading toward a success path on that.

In terms of the RAIs themselves, as I said, there was -- there were numerous of them, a number of them. One area that we had, and you've sort of seen that somewhat today, where there are references to COL applicant and references to COL holder.

And in the early versions of the DCD, it referred to the applicant would be doing this, the COL applicant would be doing this. And then later, as the revisions moved forward, some of those references turned into COL holder would do that.

And part of our task is to prepare a safety evaluation which provides a finding on the adequacy of the program. And therefore, as described in SECY paper 05-197, the COL applicant has to provide a full description that fully described the operational programs.

And so we had to determine, okay, where are we going to have this information so we can write the safety evaluation. And that's part of the challenge that we had with the wording change. And we think we're heading towards a solution on that.

Also, we have a lot of questions on the functional capability qualification. Because in that original summary of 3.9.3.5 of the DCD, it talks about testing and qualification and testing qualification analysis, it could be done by combination of test or analysis. And you all talked about that some today. But it was very general.

And one of the things we want to do is try to provide some specificity to that. There is a new ASME standard, QME1-2007, which was a result of 20 years of work to incorporate the lessons learned from the valve qualification issues and the valve performance issues into a very proscriptive standard. And that's been issued, and the staff is working on endorsing that in reg guide 1.100, which should be hopefully out soon.

But we wanted to work that into our discussions. Also pure audit verification of power operative valves, there's a history there, there's information from the operating plants, from generic plate 8910, there's a joint owners group program on both motor-operated valves and other power operative valves, and we wanted to make sure that that was incorporated.

And the last area of issue there was the depressurization valve qualification program. There was some work done with the SBWR, and they had information from that. So, we were able to go down and take a look at that information at the E offices in Washington and look at how they did that qualification program. They did quite a bit of testing at Wiley, so we were able to look at that data.

So, those were some of the areas that we dealt with through the RAI process. And in terms of the open items, a number of those areas, those RAIs were addressed through either responses and there was additional discussions, additional indications of some adjustments that could be made to the DCD as a result of the May 22nd meeting.

We did have one open item that remained open from RAI 3.9-168. And it had to do with the safety relief valves and their IST test frequency. It didn't appear consistent with ASME code, and we asked them to go back and take a look at that. And they came back just recently and said, yes, there were some changes they need to make to the DCD table and they're in process of doing that.

And so that should show up in -- as we do the review of Revision 5. So, that should work out.

In terms of the COL item, we still need to address the process by which the applicant is going to ensure that IST program, MOV operational test program is fully described per the SECY paper 05-197. And we're working on the wording of that. Because what happens is, the COL applicant wants to rely on DCD as much as possible, but there are some areas where it's plant-specific for their operational program. So they need to provide information that's separate from that.

So, it really needs to be -- the COL item really needs to be as a combination, the COL applicant will provide through the DCD and through it's own FSAR submittal, the full description. And so we need to work that out with them. So, we're in the process of doing that.

I did hear that you all had a question on the MSIVs in terms of -- and there has been a change in how they describe those. In Revision 3, they were indicated to be a Y-pattern globe valves, with air operators, with spring assist. And that's a kind of a standard. We've looked at these quite a bit, this sort of MSIVs, for the power-up rates.

Because we were concerned about the higher flow rates might cause the valves to close faster than allowed. So, they do have compensating factors so they don't close too fast, say between three and five seconds. And that was part of what they had to do.

Also, they are part of the qualification program, the 3.9.3.5 process where they have to provide qualification, and that new Revision, in Revision 5 of the DCD, indicates that these valves need to be qualified through QME1 2007 if they're a new design. If they're a previous design, they'll have to follow some of the critical parts to incorporate a lessons learned. That has to be done as well.

They still have to do through that process, plus they have to be a part of the IST program, and they are listed in the IST program table in the DCD. So, they have to go through that process as well.

And also, there is a -- because this is a specific valve, there are specific ITAACs for valves for -- to make sure that they're able to operate properly, and there's an ITAAC for this MSIV as well to make sure they close under the proper conditions.

So, that's the -- that's where they were in terms of how describing Revision 3. Now, Revision 5 has taken out the specific design discussion in Chapter 5, but it still indicates they are globe valves in the IST table, and their operators, and so they have that sort of general description of what types of valves they are. But they don't have the sort of detailed internal discussion that they had in Chapter 5. So, we'll be talking to them about that and see where we go with that change of description.

What they've done is, they've described more functionally what has to happen, what the design requirements are as opposed to saying specifically what the valve type internal design is. And so we'll be reviewing that as part of our review of Revision 5.

That's basically all I had for 3.9.6. Are there any questions.

MEMBER STETKAR: I guess I'm the source of the question about the MSIVs and I've been trying to follow it since last October. So, everything you've just said I'm happy to hear that. I was just curious why there's nothing about them written anywhere in the SER other than in general terms in Chapter 3. Why there's no evidence in Chapter 5 of the SER, that you actually looked at them as components and this kind of I'll call it story, but discussion of why the design as at least presented in DCD Rev 3, was reasonable because these are no different than any other -- there's not even a paragraph in there.

And there are long paragraphs and pages about other valves in the plant.

MR. SCARBROUGH: Yes, I'm not sure why that wasn't in there.

MEMBER STETKAR: And it's not. We were told it was in Chapter 3, so that's why --

MR. SCARBROUGH: Okay.

MEMBER STETKAR: And it's not.

MS. CUBBAGE: Let's move on.

MEMBER BLEY: At least you'll find the testing.

MEMBER STETKAR: Oh, on 14, yes.

MEMBER SHACK: A question on the qualification on the depressurization valves. These are identical to the ones that were done for the SBWR, or?

MR. SCARBROUGH: Right. These are the same size. They -- in terms of a qualification for it.

MEMBER MAYNARD: And it's the same design with the squib for the deluge system?

MR. SCARBROUGH: Well, they -- because of the size differences, they were working on different designs, size designs, because they wanted to make sure that --

MEMBER MAYNARD: But the mechanism is identical. It's the size of the valve which is different?

MR. SCARBROUGH: No, there was a different mechanism because one had a sort of a plunger that got pushed out of the way, another one had a cantilever that pushed over. And they were trying to make sure that that cantilever stayed over. They don't want to have a problem. So I think they're still working on that design. They went back and the last I heard they were rethinking that design because they want to make sure that there's no either the -- that both designs will provide a pure flow area and it doesn't get hung up.

So, I think they're looking at both of those types of designs. I'm not sure which one they've settled on. But those -- they did have a slightly different design because of the size and they thought they could have a different approach to it. But I think they're going to go back and look at that, the last I heard on it.

MR. PATEL: I guess, next, John Fair is going present Section 3.12.

MR. FAIR: Yes. I'm John Fair from NRR. Originally 3.12 was developed at NRR with the assistance of Brookhaven National Lab. And since the transition to NRO, I've maintained a review of the open item. So, I'm still reviewing the open items for NRO.

As GEH pointed out earlier, there was no SRP Section 3.12 to -- originally for them to write the DCD to. So, what we used as guidance from ABWR's SER which did have a section 3.12. I'd say the only, the big difference between what we've done in our 3.12 and what ABWR did in 3.12, is ABWR lumped a lot of section 3.6 and a lot of section 3.2 in their 3.12.

But since we had separate reviewers and separate branches doing section 3.6 and 3.2, we took that out of the Section 3.12 for the ESBWR. Next slide is on the review guidance.

I'll just point out that the second bullet, we have a typo, which should be 10 CFR 52.47 for the ITAAC. Since I'm at NRR, you know, Part 50, I can't think in 52 yet. But other than that, it's regularly, it's the same GDCs that are used in mechanical and 50.55(a) is just the codes and standards.

And the SRP sections that we use for acceptance criteria were 373 and 39, which were existing at the time.

The next section, I just point out some of the areas of interest in the SE. We did two audits at GE's sites, the one in Wilmington and the one in GE San Jose. I think at the time we did the Wilmington audit, there was a lot of transition going on with GEH. And so we found that a lot of the documentation we were looking for to review at the Wilmington audit, we really had to go back to San Jose to get the information, and then have the technical experts to discuss it with us.

So, at the first audit, there was a little bit of a problem getting the documentation together for some of the things that we wanted to review which were some of the verification documentation for computer programs and things like that.

So, we looked at that in the second audit, and they had pulled that together a little better the second time we went around to GE San Jose offices.

The second item I want to point out was ASME code addition. They're using 2001 through 2003 addenda, but they are maintaining the restriction that the staff put in 50.55(a) for the use of the seismic piping rules. They're maintaining the pre-1994 seismic piping allowable stresses in their DCD.

The next item of interest is the single earthquake design criteria. Now, what happens in the single earthquake design criteria is, that you eliminate the OBE and you eliminate some of the loads that are evaluated in the fatigue analysis, and you eliminate the evaluate for seismic anchor motion loads.

So what was done in the ABWR in the other design certifications was additional criteria was provided to cover that area in terms of the fatigue analysis where two SSC load cycles were used for the fatigue analysis, and a separate allowable for seismic anchor motions was added in to cover those areas.

And the next item of interest is the feed water nozzle thermal stratification evaluation. GEH had developed some stratification loads based on testing of, I think it was a Lung Min design, ABWR and were going to use that for ESBWR evaluation on the assumption that those were conservative load definitions.

After some discussion, back and forth with the staff, they committed to do some thermal monitoring on the ESBWR to verify that they had conservative load definitions for the stratification evaluation.

MR. WALLIS: Are these fluctuations, or are they just normal stratification, or is it a -0

MR. FAIR: It's a combination of --

MR. WALLIS: A fatigue-type thing is it?

MR. FAIR: It is related to a fatigue analysis. It's design transients for the fatigue analysis, and they're going to instrument temperature, displacement and I believe strain gage measurements to verify that they had a conservative load definition.

MR. WALLIS: But they're close enough to the existing plants, so that's okay, aren't they? They're close enough are they to --

MR. FAIR: I'm not sure I --

MEMBER SHACK: The ABWR.

MR. WALLIS: The Japanese plant, presumably, right?

MR. FAIR: Well, the original assumption

was that the load definition that they had developed from the measurements on the Lung Min plant was conservative for the ESBWR. The intent of this was to verify that with testing on ESBWR. The next --

MEMBER SHACK: Just coming back to this, John, so you're going to get two contributions. So you're going to get a bending moment just because of the thermal stratification, then you're going to get to see --

MR. FAIR: Get some fluctuations, yes. And we did not go into looking at the details of the load definitions, because at the time of the audits, they had not done the feed water line analysis. So that's something that is a potential to be looking at later down the line when they're complete with the design.

The next item of interest is we had Brookhaven do a confirmatory analysis on the main steam line. We chose the main steam line because it had a lot of different analysis associated with it. It had seismic analysis of the steam line, it had SRV lines, it had discharge loads, and it had a main steam stop valve closure transient. So, we had Brookhaven try to model that up, and do some confirmatory analysis to see how well we matched with GE's analysis.

When we did this, we ran into some limitations with Brookhaven's piping analysis code that we have used for years to do bench marking. The model was fairly big that we selected from GE. And GE was using some analysis methodologies out of reg guide 1.92 that hadn't been built into the Brookhaven PISYS pipe code.

So, what we had to wind up doing on that is to do some bounding analysis with the PISYS safe piping code to see if we could bound the GE results. And after a lot of discussion back and forth, I think pretty much we're happy with what we've got on this confirmatory analysis. But we wish we could have gotten a little better confirmatory analysis if we had updated the GE PISYS, I mean, the BNL PISYS safe code before we started this evaluation.

And again, the last thing I wanted to bring up from the review was, the fatigue analysis criteria. This is the first application that we're asking an applicant to evaluate environment fatigue on, and it's one of the issues down in the open item issues I'll discuss in a second here.

As far as the open items, these are the open items as discussed in the SE that was provided to the ACRS. Most of these are now closed based on follow-up submittals from GE. And I'll go over the ones that are closed, and tell you which ones are open.

The first one had to do with the independent support motion. A combination of group responses, GE and the DCD were proposing SRSS. The staff position that we had in NUREG-1061, required absolute sum. We asked GE to provide us some -- a study to justify the use of SRSS in lieu of the absolute sum that the staff guidance was requiring.

GE picked two fairly significant lines to do an evaluation of. The feed water line, and the main steam line, which ran through various elevations and various buildings, at structure locations.

The results of the evaluation show that the -- and the evaluation was based on the comparison of the SRSS with multi-support time history, which is the methodology the staff considers the most accurate method of doing the calculation.

The results of the comparison show that there were a few locations that exceeded the -- where the multi-support time history loads exceeded the SRSS combination as proposed by GE for the ISM. So, in order to resolve the issue, GE agreed to use their SRSS with an additional ten percent increase on the loads and the stresses to bound the results of the comparison from the sample study. And we're going to find that as an acceptable approach. It's also consistent with other studies we've seen where independent support motion studies were done and compared the multi-support time histories.

The second issue that we had was the bench marking of the PISYS computer code. When we did the audit and looked at the benchmark for the PISYS code, there were a couple of locations that exceeded the acceptance criteria in the NRC's benchmark new reg report.

And it appeared that the PISYS code also was -- had been based on an earlier addition of the Reg Guide 1.92, instead of the Reg Guide -- the addition that was referenced in the DCD. GE has subsequently gone back and redone the bench marking, updated the code to meet the latest Reg Guide 1.92 criteria. And they've come in and said that they were within the acceptance criteria of the benchmark new reg, and so we find that acceptable.

The next issue had to do with a

decoupling criteria for small branch line piping. What happens on the small branch line piping is when you decouple from the large pipe, the original proposal was to use the response spectra that's used at the support to the -- of the large pipe for the small pipe analysis.

However, if there's a significant response of the large pipe, it gets amplified from the supports and input into the small branch line piping. So, in order to resolve the concern, GE proposed a set of criteria which is essentially make it rigid near the connection point, or have a big overlap region between the branch piping where you cut it off from the main piping, or to generate a response spectra at the attachment point and pick up the amplification from the big pipe to the small pipe.

MR. WALLIS: Which is best? Which is most realistic?

MR. FAIR: Well, the most technically accurate way is to do a full coupled model. If you develop a response spectra from the attachment point, you tend to be over driving the small pipe. Because some of the energy will reduce the large pipe's response.

The easiest method to do it is to put a support right next to the attachment point so you get no amplification.

The next issue we have, which is unresolved at this point in time is the -- DCD has SRSS combination for a lot of loads, including SRVs, LOCAs and earthquakes. The staff has guidance in new Reg 0484 for determining when you can use SRSS. And it's essentially if you do some kind of a study to justify that you have an 84 percent non-exceedence probability, using the SRSS flow combination. And we requested that GEH do an evaluation to justify the places where they're using this SRSS load combination.

The next issue that was open, was the high frequency mode combination. As I discussed a little bit earlier with the confirmatory analysis, GE had not been using the latest edition of the Reg Guide 1.92 for the high frequency mode combination. They had referenced an earlier criteria that was out of the SRP.

They've subsequently come in and referenced the latest SRP -- Reg Guide. I'm sorry. Reg Guide 1.92 criteria, and we find that acceptable.

The next issue was environmental fatigue. As I said previously, this is the first applicant that we're requesting that they meet the environmental fatigue Reg Guide that was just issued.

As part of coming into and agreeing to meet the Reg Guide, they've requested to change the pipe break criteria. Just a little correction of what was said earlier, the fatigue usage factor criteria for pipe break postulation was not in the Reg Guide 1.207. This was a proposal by GEH because of the fact that when you cranked in the environmental fatigue, you raised the usage factor of all the locations, and you would possibly cause a lot of additional pipe support -- pipe break postulations.

We discussed this, I think, when we presented this Reg Guide to the ACRS. And that was an industry concern. GEH did a study showing that would increase the number of locations which you would have to postulate pipe breaks. This criteria was also referenced many years ago in the ANSI standard 58.2. And at that time, there was an effort to raise that pipe break postulation criteria up to the .4 factor because of a concern of excessive number of pipe rupture locations. At that time, the staff didn't accept that proposal because of the concern within environmental fatigue was just developing.

Now that we've solved the concern with environmental fatigue, we think it's appropriate to accept that proposal to increase the criteria to .4.

And the last issue --

MEMBER SHACK: Are they doing this for all their analysis, or they're still picking some representative number of places to look at?

MR. FAIR: No, this is across the board.

MEMBER SHACK: Across the board.

MR. FAIR: This is, yes. And the last issue I had was uniform support motion, combination of inertia and SAM loads. Currently in our SRP 3.9, it requires that combination be done by absolute sum, which is the worst combination. GE and the DCD put in a SRSS. We've requested them to either justify it or commit to the SRP criteria.

It was my understanding that GE was not using this methodology in the seismic. They were using the ISM methodology. So, I didn't think it was a big technical issue, but we have not resolved it yet. Until they change the DCD and either give us a justification or meet the SRP criteria, this will remain open.

And that's the end of the issues.

CHAIRMAN CORRADINI: Questions. Is this the time to go into closed session then about -- are we going back?

MR. PATEL: We have one more.

CHAIRMAN CORRADINI: Okay, I apologize.

MS. CUBBAGE: We went out of order.

MR. PATEL: The thing is, I guess we still have 3.6.1.

MS. CUBBAGE: Do it quickly.

CHAIRMAN CORRADINI: I didn't realize that they're related, sorry.

MR. PATEL: Actually, 3.6.1 and 3.6.2 are very -- so we'll just take a moment.

CHAIRMAN CORRADINI: I'm sorry. I didn't realize it.

MR. PATEL: I'm sorry. No, that's our fault. 3.6 is related to the protection against postulated piping failure outside containment and the regulatory requirements are given here in GDC 4 and SRV 3.6.1, and technical position.

Mainly, the protection is provided, you know, for all the safety-related systems, which require you know, process safe shutdown systems. The protection is provided by separation, by barrier seal, and closures, and also the piping restraints. Those are the three methods they mainly used.

There was only one open item, actually, it was related to RTNSS because there were no discussion about RTNSS system protection. And we had one COL action item. As of Rev 3, it was there, but then in Revision 4 they have changed and made it to -- it will go to the ITAAC. But basically the description is still the same, so it has not changed in the content. That's 3.6.1 in short.

So now, Renee will present in Section 3.6.2.

MS. LI: I'm Renee Li from engineer mechanics branch two. I'm responsible for the review of Chapter 3.6.2, which is the determination of rupture location and their associated dynamic effects.

As Chandu mentioned, that previously in the other DCD review, this section of review was included in the 3.12 review and you can see even in his error in the Part 52.47 is carried over into my slide. I apologize for that.

(Laughter)

MS. LI: So for the ITAAC, the aspect that's pertaining to Chapter 3.6.2, is to have the pipe break has analysis report available for NRC inspection. And the report is to summarize the results of the pipe break analysis and to demonstrate that system, structure and the components that protect from the dynamic effects of the postulated pipe failure.

In DCD 4, the environmental and the dynamic effects design basis, again, the aspect that's pertaining to 3.6.2 is that SSCs important to SECY should be designed to be compatible with the environmental conditions resulting from the pipe failure and be protected from the dynamic effects of the postulated failure, such as jet impingement or pipe whipping effects.

MEMBER SHACK: 3.6.1, then you'll have an ITAAC that's really quite comparable to the one you have here for the 3.6.2 --

MS. LI: Yes.

MEMBER SHACK: -- instead of the COL action item.

MS. LI: Right. Now, of course we use SRP section 3.6.2 including the branch technical position 3-4, which contains all the detail, guideline for the criteria to postulate break and their configuration.

And since the definition of high energy line and moderate energy line is included in the branch technical position 3-3, which is part of SRP 3.6.1, so our review interfaces with the Section 3.6.1 review.

The industry standard that's involved is the ANSI/ANS 58.2-1988. I will cover -- I will talk about this standard later in more detail, and I will refer us ANSI/ANS 58.2.

The last is the 10 CFR 52, again, Appendix S -- or, no. This is Appendix S. Single earthquake design. In SECY paper 93-087, the staff will command the elimination of OBE from the design basis on the basis that it would not result in a significant decrease in the over all plant safety margin.

As far as the RAI status, originally, there were 19 RAI associated with Section 3.6.2. At the time of issuing the current SER as open items, six RAI were resolved, and the one was partially resolved. After the issuing of the SER until now, there were five additional RAI resolved. And that leaves eight open RAI, which I will talk about later.

Next is, you know, SER item of interest. One of the most important area that we review is the criteria used to define the pipe break and the crack location and the configuration. Then is the evaluation of the dynamic effects that include jet impingement and pipe whip effects.

Here I would like to make a note about the ANS 58.2 standard. This standard has been commonly used by industry for determining the jet expansion modeling and for the jet impingement assessment and has been accepted by the NRC.

However, during the GSI-191 issue resolution, two SEIs member, Dr. Wallis and Dr. Ransom has revealed there are several inaccuracies and omissions in the standard. And even though the GSI-191 was to address the containment sump blockage, such as the insolation which would be you know broken off during the pipe rupture event, however, those come on, we believe, that may directly impact the 3.6.2 jet impingement evaluation.

Therefore, during the ESBWR review, since ESBWR pipe break evaluation follows the guideline of this standard, so with technical assistance with a private lab, the staff has asked several RAI, which are related to this ANS 58.2 standard. And those eight open items, they are all in this area.

MR. WALLIS: Could I ask you about the first bullet, this pipe and crack locations.

MS. LI: Yes.

MR. WALLIS: GEH said the pipes break at the ends.

MS. LI: Okay.

MR. WALLIS: Did you accept that statement?

MS. LI: If they can demonstrate the resulting stress level within the piping system below the threshold, providing the SRP section 2.

MR. WALLIS: Then you would accept that.

MS. LI: Yes.

MR. WALLIS: Now, what about the way it breaks? I mean, it seems to me, that you don't really know the shape of the break. So, it's rather difficult to apply ANS 58.2 to a jet when you don't know how it's coming out and what the shape of it is.

MS. LI: The branch technical position, 3-4, give the guideline of under what situation you will postulate circumferential break, under what condition you will postulate the longitudinal break along the axis. So there SRP 2 have the guideline for those.

MR. WALLIS: So then you think that in a circumferential break, that the two pipes separate somehow?

MS. LI: Yes.

MR. WALLIS: I don't see how it's possible. Because one pipe's coming through this shield wall, and it's restrained from sideways motion, isn't it?

MEMBER SIEBER: Worst case there.

MS. LI: Yes. Because as far as the break, that gives you the worst case when you totally separate.

MR. WALLIS: All right. It just seems to me a realistic analysis is difficult.

MEMBER SHACK: That's why we call it a postulated accident.

MR. WALLIS: Well, what is a postulated accident have to do with reality?

MEMBER BLEY: The gap in there where the break can occur is like, I thought I heard two to two and a half feet. Is that right?

MEMBER SHACK: That's what they said.

MEMBER BROWN: so, from the RPV wall to that shield is two and a half feet.

MEMBER BLEY: So, it's pretty hard to imagine how you could get --

MEMBER ARMIJO: Well, there's jet displacement in the two ends.

MS. LI: Okay. My last slide, as I mentioned, we still have eight open items and since they are all related to ANS 58.2, so I kind of summarized in the four categories.

First is, it does not consider effects of blast wave. But I think today in their presentation, indicated that they would consider blast wave if it, you know, applicable.

And next is the jet expansion modeling and jet pressure distribution and also the feedback amplification.

CHAIRMAN CORRADINI: So, if the ANS standard -- I don't -- Professor Wallis will correct me. So if the ANS standard is wrong, or has omissions, what has the staff accepted in the past if you don't follow the ANS standard?

MS. LI: In the past, we didn't know about omissions that --

CHAIRMAN CORRADINI: So everybody else is grandfathered into the omission? Is that what you just told me?

MS. LI: No.

CHAIRMAN CORRADINI: Oh, okay.

MS. LI: Here, Dr. Wallis and Dr. Ransom revealed those omissions. The staff you know, stopped that ANS 58.2 standard provide a simplified, acceptable methodology.

CHAIRMAN CORRADINI: Okay.

MS. LI: But as indicated -- actually, the staff indicate in 2003 --

MS. CUBBAGE: Seven, March '07. March '07.

MS. LI: They took original of SRP.

MS. CUBBAGE: March '07.

MS. LI: March '07, that staff is evaluating those inaccuracies and for the time being, the review will be on plant-specific case-by-case evaluation. Therefore, that's why we asked those RAI.

CHAIRMAN CORRADINI: So, I'm a little bit off topic, so let's just go back to a couple of certifications. So, for AP-1000, what is the staff doing? Because I assume there's omissions there.

MS. LI: Yes, but -- okay. Because of --

CHAIRMAN CORRADINI: So is that going to be taken up by any sort of changes to the certification process? I'm just trying to understand.

MS. LI: We don't think this -- because we used the word, postulate value, and because of the pipe break probability of pipe break is so low, that we don't believe this will be a back fit, would be proper to be a back fit issue. That's why for ABWR, for AP-1000, which yes, they used that ANS 58.2 standard. But we do not plan to go back, reopen the issue.

CHAIRMAN CORRADINI: Because this is a low probability issue.

MS. LI: Yes. The consequence of course is high, but you know, you have to consider the probability and I think when you integrate both --

CHAIRMAN CORRADINI: So is this a design basis issue?

MR. WALLIS: Well, the ANS standard really talks about a free jet when it comes out of a hole and it goes a long way. That's what the ANS standard is about. And our criticisms had to do with the -- seemed to be misunderstanding about how supersonic flow behaves in a long jet.

MS. LI: Yes.

MR. WALLIS: These jets, most of them are coming out into this shield wall at close range. And I'm not sure how the ANS standard is relevant for that.

MS. LI: Yes. Actually, today is the first time I heard about the approach. They -- so far, they haven't -- GE hasn't shown us the -- today what they showed the configuration. So I think that approach from now, is that we're going to have a meeting with GEH for them to tell us those exact locations. I was happy to hear that their intent was to limit the location to the terminal end. So we will have only limited case to look at.

And if they can indeed demonstrate the separation, you know, from the break location, that would be great.

MR. WALLIS: So then you'll come back to us with something.

MR. HAMBRICK: Dr. Wallis, you'd asked about the difference between free jets and jets interacting with nearby surfaces. We do have RAIs and they're asking about potential feedback mechanisms and amplification of loading due to that.

MR. WALLIS: I was saying the ANS standard really talks about a free jet. It doesn't really say much about what happens if it's confined in a space.

MR. HAMBRICK: And we address that with RAIs.

MS. LI: That concludes my presentation.

MS. CUBBAGE: I think we're ready for closed session.

CHAIRMAN CORRADINI: Further questions?

MR. PATEL: We are ready now. I guess we are done.

CHAIRMAN CORRADINI: Why don't we call a five minute recess and then we'll clear the room.

(Whereupon, the open session of proceedings in the afore-mentioned matter was concluded at 4:55 p.m.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of: Subcommittee on ESBWR: Open

Name of Proceeding: Advisory Committee on Reactor Safeguards

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3 – Design of Structures, Components, Equipment, and Systems
(Sections 3.6, 3.9, and 3.12)

June 18, 2008

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.6.1 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment
Chandu Patel – NRO/DNRL/NGE1

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.6.1 –Protection Against Postulated Piping Failures in Fluid Systems Outside Containment

Regulatory Requirements and Guidance

- GDC 4
- Branch Technical Positions BTP SPLB 3-1, BTP EMEB 3-1
- SECY for RTNSS
- SRP 3.6.1

Technical Summary

- The ESBWR plant is designed for protection against piping failures outside containment, to ensure that such failures would not cause the loss of needed functions of safety-related systems or prevent the plant's safe shutdown capability.
- General protection methods:
  - By separation
  - By barriers, shields, and enclosures
  - By pipe whip restraints

Significant Open Items

- Protection of RTNSS systems against postulated piping failures in fluid systems outside of containment (RAI 22.5-5)

COL Action Item

- The COL applicant shall provide sketches of applicable piping systems showing the location, size, and orientation of postulated pipe breaks and the location of pipe whip restraints and jet impingement barriers.

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.6.2 - Determination of Rupture Locations and their Associated Dynamic Effects
Renee Li – NRO/DE/EMB2

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.6.2 – Determination of Rupture Locations

Regulations and Regulatory Guidance

- 10 CFR 50.47(b)(1) - ITAAC
- GDC 4
- SRP Sections: 3.6.2 including BTP 3-4 and 3.6.1 including BTP 3-3
- Industry Standards: ANSI/ANS 58.2-1988
- 10 CFR 50 Appendix S (SECY-93-087)

RAI Status Summary

- Original number of RAIs = 19
- Number of RAIs resolved = 6
- Number of Additional RAIs resolved after issuance of SER with open items = 5
- Number of Open Items = 8

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.6.2 - Determination of Rupture Locations

SER Items of Interest

- Criteria used to define pipe break and crack locations and configurations
- Evaluation of jet impingement and pipe whip effects

  Potential nonconservative assessments of the jet impingement loads due to inaccuracies and omissions in ANS 58.2 identified by ACRS (Wallis-ADAMS ML 050830344, Ransom- ADAMS ML 050830341)

Significant Open Items (RAIs 3.6-6 and 3.6-11 thru 3.6-17)

Inaccuracies and Omissions in ANSI/ANS 58.2

- Effects of blast wave
- Jet expansion modeling
- Jet pressure distribution
- Jet dynamic loading and structural dynamic response including potential feedback amplification of blowdown force and jet resonant effects

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.1 – Special topics for Mechanical Components
Chandu Patel – NRO/DNRL/NGE1

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.1 – Special Topics

Regulations and Regulatory Guidance

- General Design Criteria 1, 2,14 and 15
- 10 CFR 50, Appendices B and S
- SRP Section 3.9.1

Technical Review Summary

- DCD Tier 2, Table 3.9-1 shows design transients and the number of cycles for each transient that are consistent with applicable SRP 3.9.1 guidelines.
- GEH identified computer programs in Tier 2 DCD Appendix 3D which are in accordance with requirements of Appendix B to 10CFR50.
- GEH evaluations of components under faulted loading conditions identified in Tables 3.9-1 and 3.9-2 are consistent with the guidance in SRP 3.9.1 and meet the requirements of ASME III Appendix F.
- GEH identified components (e.g., snubbers, reactor internals) that were tested to verify their design adequacy. The experimental stress analysis methods used in the design of ESBWR components are in compliance with ASME Section III, Appendix II, and are therefore acceptable.

Open Items

- None

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.2.1 – Piping Vibration, Thermal Expansion, and Dynamic Effects
Jai Rajan – NRO/DC/EMB1

June 18, 2008

ACRS Subcommittee Presentation ESBWR Design Certification Review Chapter 3.9.2.1 – Piping Vibration, Thermal Expansion, and Dynamic Effects

Regulations and Regulatory Guidance

- GDC 2
- ASME Code, Section III
- RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants"
- ASME OM S/G- 2003 Standard, Part 3, "Requirements for Pre-operational and Initial Startup Testing of Nuclear Plant Piping Systems"
- ASME OM S/G- 2003 Standard, Part 7 "Requirements for Thermal Expansion Testing of Nuclear Plant Piping Systems"

Open Items

- None

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review

Chapter 3.9.2.2 – Seismic Analysis and Qualification of Seismic Category I Mechanical Equipment

Chandu Patel – NRO/DNRL/NGE1

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.2.2 – Seismic Analysis and Qualification

Regulations and Regulatory Guidance

- General Design Criteria 1, 2, 4, 14, and 15
- 10 CFR Part 50, Appendix B
- 10 CFR Part 100, Appendix A

Technical Review Summary

- The review consists of an evaluation of DCD Tier 2, Section 3.9.2.2, and portions of Sections 3.7.2, 3.7.3, and 3.10, which are related to the seismic analysis and qualification of mechanical equipment and components.
- Areas reviewed include seismic analysis methodologies for equipment and components, modeling of major components, number of earthquake cycles and fatigue evaluation, combination of modal responses, damping values, qualification of large mechanical components, effects of rigidity of support anchorage, torsional effects of eccentric masses, etc.
- Two RAIs remained open during the preparation of the SER.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.2.2 – Seismic Analysis and Qualification

<u>Open Items</u>

- The effects of the assumed rigidity of the support anchorages to the building structure on the calculated seismic response of piping, equipment and components, especially heavy ones (RAI 3.9-35, closed after the SER was prepared)
- Qualification testing and analysis of control rod drive (CRD) housing (with enclosed CRD mechanism), including the computer codes and industry standard used (RAI 3.9-43, closed after the SER was prepared)

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.2.3, 3.9.2.4, and 3.9.2.5
Jai Rajan – NRO/DC/EMB1

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.2.3 – Dynamic Response Analysis

Regulations and Regulatory Guidance

- GDC 2 and 4
- Regulatory Guide 1.20
- SRP 3.9.2.3 and 3.9.5

Open Items (from staff review of ESBWR DCD, Rev. 3)

- Steam dryer load definition and methodology to predict stresses at locations to be monitored on the steam dryer during initial power ascension test. (RAIs 3.9-58, 61, & 63)
- Stress limit curve for ESBWR steam dryer to be used during the initial power ascension test. (RAI 3.9-66)
- Predicted and allowable stress amplitudes and potential high stress locations on the steam dryer. (RAI 3.9-71)

These open items are closed because they are superseded by the PBLE method.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.2.4 – Preoperational Flow-Induced Vibration Testing

Regulations and Regulatory Guidance

- GDC 2 and 4
- Regulatory Guide 1.20, Rev. 3
- SRP Sections 3.9.2 and 3.9.5

Open Items

- Classification of ESBWR reactor internals as Non-Prototype Category II (RAIs 3.9-75 & 96)
- FIV Response of ESBWR Top Guide based on ABWR Test Data (RAI 3.9-77 S02)

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.9.2.5 – Dynamic System Analysis of Reactor Internals Under Faulted Conditions

Regulations and Regulatory Guidance

- GDC 2, 4, and 14
- Regulatory Guide 1.20, Rev. 3
- ASME Code, Section III

Open Item

- The analytical results to 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 or FW line (RAI 3.9-81)

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.3 – ASME Code Class
1, 2, and 3 Components, and Component Supports, and Core Support Structures
Chandu Patel – NRO/DNRL/NGE

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.3 – ASME Code Class 1, 2, & 3

Regulations and Regulatory Guidance

- 10 CFR 50.55a
- GDC 1, 2, 4, 14, and 15

Technical Review Summary

- Areas of review include loading combinations, design transients, and stress limits used for ensuring the structural integrity of reactor pressure vessel assembly and other major mechanical components; valve operability assurance; design and installation of pressure-relief devices; and component supports
- The number of original RAIs is 30, of which two remained open during the preparation of the SER
- One additional RAI was identified after the SER was prepared. This is related to the requirement for component design information

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ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.3 – ASME Code Class 1, 2, & 3

Open Items

- Effects of snubber end fitting clearance and lost motion on equal load sharing of multiple snubber supports (RAI 3.9-114, resolved)
- Description of snubber production and qualification test programs, and the compliance of snubber design to ASME Code, Section III, Subsection NF (RAI 3.9-117, resolved)
- Reinstatement of a COL information item, originally included in DCD Rev. 3 but was omitted in Rev. 4, regarding the requirement of making available design specifications and design reports of ASME Code Section III mechanical components for NRC audit (RAI 3.9-177)

COL Information Items

- COL holders will provide a plan for the detailed snubber inservice testing and inspection program in accordance with the ASME O&M Code

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.4 – Control Rod Drive Systems
Andrey Turilin – NRO/DE/EMB1

June 18, 2008

ACRS Subcommittee Presentation ESBWR Design Certification Review Chapter 3.9.4 – Control Rod Drive Systems

Control Rod Drive System
- Design of ASME Section III B&PV code components, including pressure containing components, to the appropriate loadings and criteria

Technical Review Summary
- Quality group classification (RCPB components are ASME B&PV code Class 1)
- Loading combinations, stress and deformation limits during normal and postulated conditions
- Testing programs

Open Items
- GE satisfactory answered five RAIs
- No Open Items remaining
- No COL Information Items

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.5 – Reactor Pressure Vessel internals
Patrick Sekerak – NRO/DE/EMB1

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.5 – RPV Internals

Regulations and Regulatory Guidance

- GDC 1 - Quality standards commensurate with safety function.
- GDC 2 - Seismic resistant design
- GDC 4 - Design for operational environment and postulated accidents
- GDC 10 - Design margins to ensure fuel performance / reactivity control

Review Summary

The staff review is addressing the design basis for the RPV internals including; Application of ASME III, Subsection NG rules for design and construction of core support structures.

Use of design by analysis rules of ASME III, Subsection NG for design of safety-related internal structures, and use of Subsection NG allowable stress criteria for the steam dryer, a non-safety related RPV internals component.

Incorporation of lessons learned from operational failures of BWR steam dryers subjected to extended power uprate conditions.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.5 – RPV Internals

Open Items [14 Open Items, RAI no. in brackets, *indicates recent closure]

- Steam dryer flow-induced load definition and structural analysis [3.9-135, -136, -146*]
- Potential for acoustic resonance in main steam and other systems [3.9-134, -144]
- Core support structure primary stress and deformation limits [3.9-148, -149*, -150*]
- Flow-Induced Vibration Assessment Prog. for RPV internals [3.9-132*, -138, -143, -147*]
- Steam dryer instrumentation for start-up testing [3.9-133, -151]

Ongoing Topical Report Reviews

- RPV Internals Flow-Induced Vibration Program *(GEH NEDE-33259, Rev. 1)*
- Steam Dryer Flow-Induced Load Definition Methodology *(GEH NEDC-33408P)*
- Steam Dryer Acoustic Load Definition *(GEH NEDE-33312P)*
- Steam Dryer Structural Evaluation *(GEH NEDE-33313P)*

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.9.6 – Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints
Thomas Scarbrough – NRO/DE/CIB2

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.6 – Functional Design, Qualification, and Inservice Testing Program

Regulations and Regulatory Guidance

- 10 CFR Part 52
- 10 CFR Part 50, Appendix A, General Design Criteria, and Appendix B, Quality Assurance Criteria
- 10 CFR 50.55a, Inservice Testing
- NRC Standard Review Plan Section 3.9.6
- Commission Paper SECY-05-0197

Technical Review Summary

- Section 3.9.3.5, Valve Operability Assurance, specifies safety-related valves qualified by testing and analysis
- Section 3.9.3.6, Pressure Relief Devices, discusses safety-relief valves, vacuum breaker valves, and depressurization valves
- Section 3.9.3.7, Component Supports, specifies snubbers will meet ASME OM Code, Section ISTD
- Section 3.9.6, Inservice Testing, indicates no safety-related pumps in ESBWR design, and that valves meet OM Code 2001 Edition/2003 Addenda

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ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.6 – Functional Design, Qualification, and Inservice Testing Program

Technical Review Summary (Continued)

- Review of functional design and qualification provisions based on lessons learned from valve qualification issues
- Review of IST program based on lessons learned from valve performance issues at operating nuclear power plants
- RAIs prepared to obtain additional information
- May 22 public meeting held to discuss ESBWR IST program for COL applications referencing ESBWR design (ESBWR DCWG)

- COL applicant versus holder responsibility
- Functional capability qualification process for valves
- Periodic verification of power-operated valve design-basis capability
- Depressurization valve qualification program

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ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.9.6 – Functional Design, Qualification, and Inservice Testing Program

Open Items

- Numerous RAIs on Rev. 3 to ESBWR DCD addressed through RAI responses and latest DCD revision including May 22 meeting results
- One open item remains where staff is reviewing GEH May 14 response to RAI 3.9-168 to revise DCD IST table for specific safety relief valves and other valves to be consistent with ASME Code requirements
- COL Item needed for COL Applicant to ensure that IST program is fully described per SECY-05-0197 including applicable milestones

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Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.12 - Piping Design
John Fair – NRR/ADES/DE/EMCB

June 18, 2007

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.12 – Piping Design

Regulations and Regulatory Guidance

- 10 CFR 50.55a – Codes and Standards
- 10 CFR 50.47(b)(1) - ITAAC
- GDCs: 1, 2, 4, 14, 15
- SRP Sections: 3.7.3 and 3.9
- Regulatory Guides 1.29, 1.61, 1.84, 1.92, 1.199, 1.147, 1.207
- Industry Standards: ANSI, ANS & ASME
- Other guidance (generic communications, NUREGs, and SECY's)

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ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.12 – Piping Design

SER Items of Interest

- Staff audits
- ASME Code edition
- Single earthquake design criteria
- Feedwater nozzle thermal stratification
- Main steam piping confirmatory analysis
- Fatigue analysis criteria

Significant Open Items

- Independent support motion (ISM) combination of group responses (RAI 3.12-3, resolved)
- Benchmarking of PISYS computer code (RAI 3.12-11, resolved)
- Decoupling criteria for small branch piping (RAI 3.12-15, resolved)
- SRSS of dynamic loads (RAI 3.12-17)
- High frequency mode combination (RAI 3.12-21, resolved)
- Environmental fatigue (RAI 3.12-22, resolved)
- Uniform support motion (USM) combination of inertia and SAM loads (RAI 3.12-27)

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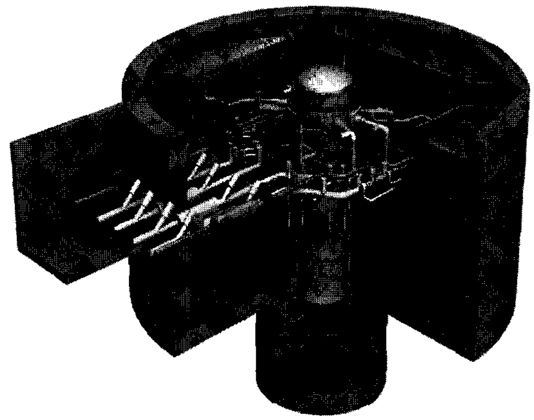
ESBWR - Overview
DCD Chapter 3 Design of Structures, Components, Equipment and Systems - Sections 3.6 & 3.9

Advisory Committee on Reactor Safeguards



Pijush Dey
Dave Keck
Jeffrey Waal
June 18-19, 2008

GE Hitachi Nuclear Energy

Overview of Section 3.9 - Mechanical Systems and Components

- Section 3.9 Provides Description Of:
  - > Special Topics for Mechanical Components
  - > Dynamic Testing and Analysis
  - > ASME Code Class 1, 2 and 3 Components and Supports
  - > Control Rod Drive System
  - > Reactor Pressure Vessel Internals
  - > Inservice Testing of Pumps and Valves

2

Section 3.9.1 – Special Topics

- This section includes the following topics:
  - > Design Transients – Normal and thermal transient events; and dynamic loading events are defined
  - > Computer Programs Used in Analysis are defined with details contained in Appendix 3D
  - > Experimental Stress Analysis – Limited to Piping Snubbers and Restraints
  - > Faulted Condition Evaluation Considerations – Seismic Category I equipment is individually discussed

3

Section 3.9.2 – Dynamic Testing and Analysis of Systems, Components and Equipment

- Provides description of:
  - > Piping vibration, thermal expansion and dynamic effects
  - > Seismic qualification of safety-related mechanical equipment
  - > Dynamic response of reactor internals under transient and normal operating conditions
  - > Initial startup FIV testing of reactor internals
  - > Dynamic analysis of reactor internals under faulted conditions
  - > Correlation of test and analysis results

4

Section 3.9.3 – ASME Code Components and Supports

- Provides Design Information related to:
  - > Loading combinations, design transients and stress limits
  - > Component information related to ASME Code requirements (RPV, piping, other)
  - > Valve operability assurance
  - > Design & installation of pressure relief devices
  - > ASME component support design
  - > ASME threaded fastener design – contains material related to SRP 3.13

5

Section 3.9.4 – Control Rod Drive System

- CRD system is primarily discussed in DCD Section 4.6.1; however Section 3.9.4 contains a discussion of:
  - > Applicable regulations
  - > CRD system components
  - > Design loads and stress limits
- CRD Performance Assurance program tests are described in DCD Section 4.6

6

Table 3.9-1

Plant Events

	ASME Code Service Limit	No. of Cycles
A. Plant Operating Events		
1. Boltup	A	45
2. a. Hydrostatic Test (two test cycles for each boltup cycle)	Testing	90
b. Hydrostatic Test (shop and field)	Testing	3
3. Startup (55.6°C/hr Heatup Rate)	A	180
4. Turbine Roll and Increase to Rated Power	A	180
5. Daily and Weekly Reduction to 50% Power	A	20,200
6. Control Rod Pattern Change	A	300
7. Loss of Feedwater Heaters	B	60
8. Scram:		
a. Turbine Generator Trip, Feedwater On, and Other Scrams	B	60
b. Loss of Feedwater Flow, MSIV Closure	B	60
9. Reduction to 0% Power, Hot Standby, Shutdown (55.6°C/hr Cooldown Rate)	A	172
10. Refueling Shutdown and Unbolt	A	45
11. Scram:		
a. Reactor Overpressure with Delayed Scram (ATWS)	C	1
b. Automatic Blowdown	C	1
12. Improper Plant Startup	C	1
B. Dynamic Loading Events		
13. Safe Shutdown Earthquake (SSE) at Rated Power Operating Conditions	B	20
14. Safe Shutdown Earthquake (SSE) at Rated Power Operating Conditions	D	1
15. Safety Relief Valve (SRV) Actuation (One) or single DPV actuation with depressurization (scram)	B	8
16. Loss-of-Coolant-Accident (LOCA):		
Worst of small break LOCA (SBL), intermediate break LOCA (IBL), or large break LOCA (LBL)	D	1

Section 3.9.6 – Inservice Testing of Pumps and Valves

- Since ESBWR does not include any safety related pumps, none are included in the IST program
- Provides a full description of the ESBWR IST program for valves
- DCD Table 3.9-8 lists all valves that are part of the IST program including valve positions, test parameters, and test frequencies

Section 3.12 - ASME Code Class 1, 2 and 3 Piping Systems, Piping Components and Associated Supports

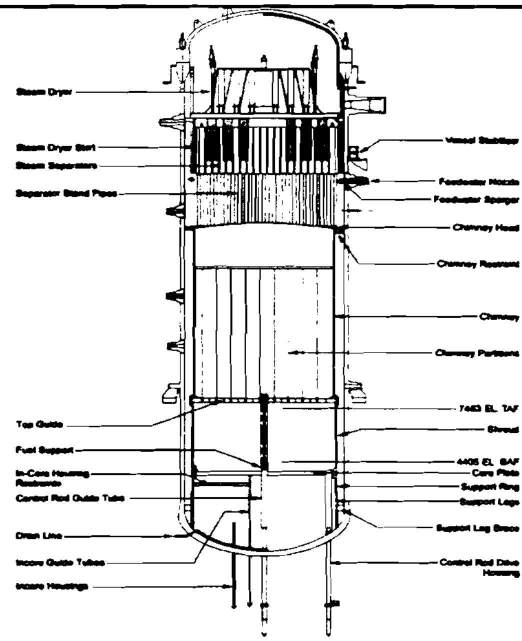
- The requirements for piping analysis and supports are covered in DCD Tier 2, sections 3.7.3 and 3.9.

9

Section 3.9.5 – Reactor Pressure Vessel Internals

- Provides Description of:
  - > Individual reactor core support and other internal components
  - > Load conditions including RPV line break accidents, earthquakes, and internal pressure differences
  - > Design bases related to safety and power generation, loadings, stress, deformation, and fatigue limits

10



ESBWR Reactor Assembly Showing Reactor Internal Components

11

Overview of Section 3.6 - Protection Against Dynamic Effects Associated With The Postulated Rupture of Piping

- Plant Design for Protection Against Pipe Failures
- Determination of Break Locations
- As-built Inspection of High-Energy Pipe Break Mitigation Features

12

Section 3.6.1 – Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Inside and Outside of Containment

- Provides description of:
  - > Design Bases criteria, objectives and assumptions
  - > Piping identified as high and moderate energy
  - > Design evaluation of pipe break events and features to provide protection against the effects of pipe break events
  - > Protection methods include Physical Separation, Barriers, Shields and Enclosures, and Pipe Whip Restraints

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Section 3.6.2 – Determination of Pipe Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping

- Pipe ruptures are postulated in accordance with BTP 3-4; however fatigue usage limit of 0.40 is used when environmental fatigue is applied in accordance with RG 1.207
- ESBWR intends to design piping below BTP 3-4 limits such that high energy pipe breaks need only be postulated at piping terminal ends
- Analytical methods, to define blowdown forces, will be determined using ANSI/ANS 58.2 Appendix B and CFD analysis, as applicable to fully characterize pipe breaks

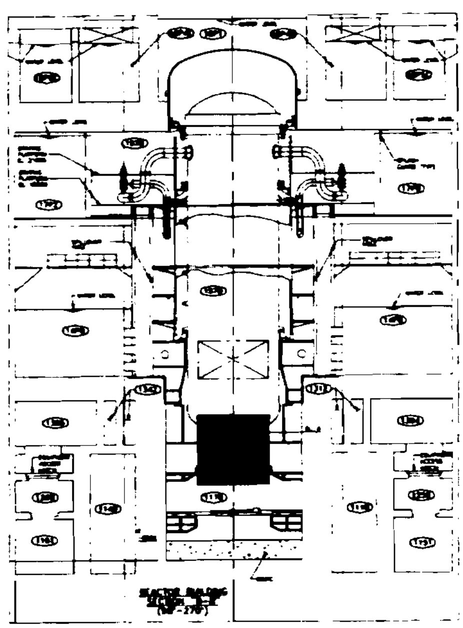
14

Section 3.6.2 - Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping (continued)

- Determination of jet impingement and effects on safety related components will use the methods described in ANSI/ANS 58.2 Appendix C and D, and CFD analysis to fully evaluate the effects of fluid jets
- The effects of the initial pipe rupture blast wave on safety related structures and components will also be evaluated

15

Elevation View



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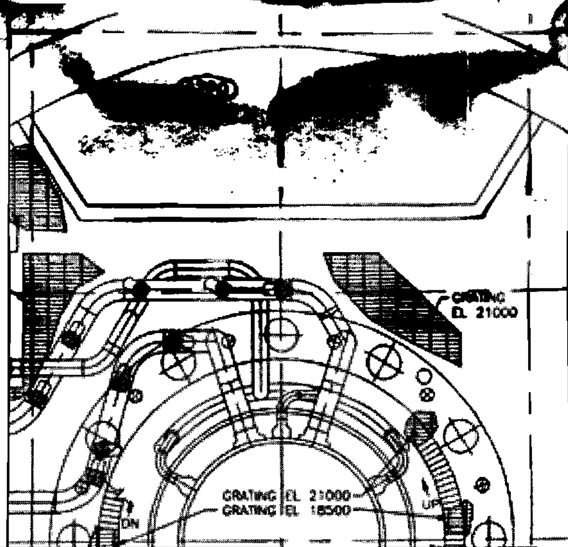


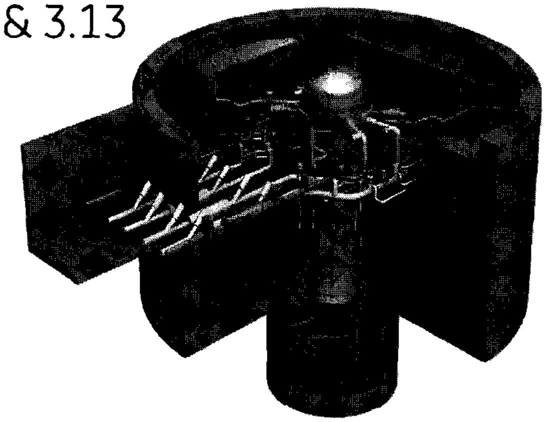
Section 3.6.4 – As-built Inspection of High-Energy Pipe Break Mitigation Features

- Prior to plant startup, an as-built inspection of high-energy pipe break mitigation features will be performed
- This includes the inspection of pipe whip restraints and jet shield installations, physical separation distances, and the location of structures identified as pipe break mitigation features

Summary

- Section 3.6 provides a full description of the program for mitigation of the effects of pipe breaks.
- Section 3.9 provides a solid basis for design of safety related equipment that fully complies with the requirements of the ASME Code.

ESBWR - Overview
DCD Chapter 3 Design of Structures, Components, Equipment and Systems - Sections 3.10, 3.11 & 3.13
Advisory Committee on Reactor Safeguards



Jerry Deaver
Kevin Baucom
Jeffrey Waal
June 18-19, 2008

GE Hitachi Nuclear Energy

Overview of Section 3.10 - Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

- Provides the requirements for seismic and dynamic qualification of mechanical and electrical equipment.
- Qualification is performed by test, analysis, or a combination of test and analysis.
- Mechanical and electrical equipment are designed to withstand earthquake and other accident related loads.

2

Section 3.10.1 – Seismic and Dynamic Qualification Criteria

- Qualification in accordance with IEEE 323 and 344, as endorsed by RG 1.89 and 1.100
- Input motion is defined by Required Response Spectrum.

3

Section 3.10.2 – Methods for Equipment Qualification

- Provides description of:
  > Qualification by test
  > Qualification by analysis
  > Qualification by combined test and analysis.
  > Qualification by actual seismic experience is not used.

4

Section 3.10.3 – Electrical Equipment Supports

- Electrical supports are qualified by test with representative equipment installed, as practical.
- Designed using the floor response spectra.

5

Overview of Section 3.11 - Environmental Qualification of Mechanical and Electrical Equipment

- Provides the requirements for environmental qualification of mechanical and electrical equipment.
- Environmental requirements for EQ envelop the most limiting design conditions.

6

Section 3.11.1 - Equipment Identification

- Equipment in the EQ program includes all three categories (b)(1), (b)(2) and (b)(3) of 10 CFR 50.49(b).
- DCD Table 3.11-1 identifies specific equipment included in the EQ program.
- Equipment in a harsh environment must be able to function properly during design basis accident conditions.

7

Section 3.11.2 - Environmental Conditions

- Conditions considered in the EQ program include temperature, pressure, humidity, radiation, and chemical.
- Qualification is in accordance with IEEE-323 as endorsed by RG 1.89, and RG 1.209.

8

Section 3.11.3 – Loss of HVAC

- Loss of HVAC is considered in the design basis conditions for equipment qualification.
- Safety-related HVAC is not required.

9

Section 3.11.4 – Chemical and Radiation Environment

- EQ equipment subject to submergence, such as lower elevations, are qualified by test considering submergence, chemistry, pH and operability requirements.
- Radiation sources, and the resulting total integrated doses are included in the EQ program.

10

Section 3.13 - Threaded Fasteners for ASME components.

- The requirements for threaded fasteners are covered in DCD Tier 2, section 3.9.3.9.

11

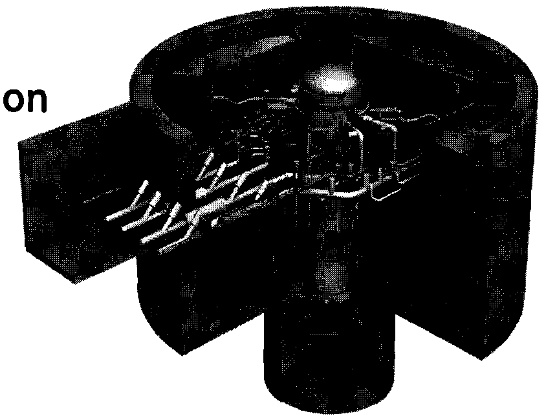
Summary

- Sections 3.10 and 3.11 provide a solid basis for the qualification of equipment for seismic, dynamic, and environmental conditions, in accordance with the applicable regulations.

12

ESBWR DCD Chapter 3 Sections 3.1-3.5

Design of Structures
Advisory Committee on Reactor Safeguards



Clement Rajendra
Jeffrey Waal

June 18-19, 2008

GE Hitachi Nuclear Energy

Presentation Content

- Chapter 3, Sections 3.1-3.5 Overview
- Section Descriptions
- Summary

2

Chapter 3, Sections 3.1 - 3.5 Overview

- Chapter 3 describes the design of structures, components, equipment and systems.
  - > Section 3.1 describes the conformance of the ESBWR with NRC General Design Criteria.
  - > Section 3.2 provides the seismic and safety classifications of structures, systems and components.
  - > Section 3.3 describes wind and tornado loadings.
  - > Section 3.4 describes the flood protection design basis.
  - > Section 3.5 describes the missile protection design basis.

3

Section 3.1 – Conformance With NRC General Design Criteria

- Section 3.1 provides an evaluation of the ESBWR design versus the NRC General Design Criteria (GDC) and refers to specific DCD sections for the further discussion of the criteria.
- The criteria are addressed in the following groups:
  - Group I – Overall Requirements (Criteria 1 - 5)
  - Group II – Protection by Multiple Fission Product Barriers (Criteria 10 - 19)
  - Group III – Protection and Reactivity Control Systems (Criteria 20 – 29)
  - Group IV – Fluid Systems (Criteria 30 – 46)
  - Group V – Reactor Containment (Criteria 50 – 57)
  - Group VI – Fuel and Radioactivity Control (Criteria 60 –64)

4

Section 3.2 – Classification of SSCs

- Section 3.2.1 – Seismic Classification
  - > Based on RG 1.29 and SRP 3.2.1.
  - > Seismic Category I required for all safety-related SSCs.
  - > Seismic Category II required for nonsafety-related SSCs whose failure could degrade performance of safety-related SSCs.
  - > Some nonsafety-related SSCs assigned to Seismic Category I when required by regulations.
  - > Remaining SSCs assigned to Seismic Category NS.

5

Section 3.2 – Classification of SSCs

- Section 3.2.2 – System Quality Group Classification
  - > Based on RG 1.26 and SRP 3.2.2.
  - > Quality Group A – Pressure-retaining portions and supports for Reactor Coolant Pressure Boundary.
  - > Quality Group B – Pressure-retaining portions and supports not in Quality Group A for safety-related containment isolation, ECCS and residual heat removal functions.
  - > Quality Group C – Pressure-retaining portions and supports for other safety-related functions not included in Quality Groups A and B.
  - > Quality Group D – Pressure-retaining portions and supports for other systems that contain or may contain radioactive material.

6

Section 3.2 – Classification of SSCs

- Section 3.2.3 – Safety Classification
  - > Consistent with safety classifications used in ABWR DCD.
  - > Very closely tied to Quality Group classifications for safety-related SSCs.
  - > Safety Class 1 – RCPB components and supports.
  - > Safety Class 2 – Mechanical SSCs involved in containment isolation functions not included in Safety Class 1, ECCS and RHR functions.
  - > Safety Class 3 – All other mechanical safety-related SSCs not included in Safety Classes 1 and 2. All safety-related electrical/I&C SSCs are Safety Class 3.
  - > Safety Class N – Nonsafety-related SSCs.

Section 3.2 – Classification of SSCs

- Table 3.2-1 – Classification summary table grouped by system (excerpt shown below for System B11)

Table 3.2-1

Classification Summary

Principal Components[1]	Safety Class[2]	Location[3]	Quality Group[4]	QA Req.[5]	Seismic Category[6]	Notes
B NUCLEAR STEAM SUPPLY SYSTEMS						
B11 Reactor Pressure Vessel System						
1. Reactor pressure vessel	1	CV	A	B	I	
2. Reactor vessel appurtenances – reactor coolant pressure boundary (RCPB) portions	1	CV	A	B	I	
3. Control Rod Drive housing and in-core housing	1	CV	A	B	I	
4. Control rods	2	CV	—	B	I	
5. Standby Liquid Control (SLC) system header and spargers	2	CV	—	B	I	
6. Reactor vessel support and stabilizer	1	CV	A	B	I	
7 Other safety-related reactor internals, including core support structures (Subsection 3.9.5)	3	CV	B	B	I	
8. Reactor internals – Nonsafety-Related components (Subsection 3.9.5)	N	CV	—	E	II	

Section 3.2 – Classification of SSCs

- Table 3.2-2 defines minimum Quality Group, Seismic, Electrical and QA requirements classifications for each Safety Class

Table 3.2-2

Minimum Safety Class Requirements

Safety Class	Minimum Design Requirements for Specific Safety Class: Quality Group	ASME Section III Code Class	Seismic Category[1]	Electrical Classification[2]	Quality Assurance[4]
1	A	1	I	N/A	10 CFR 50 Appendix B
2	B	2	I	N/A	10 CFR 50 Appendix B
3	C	3	I	Class 1E	10 CFR 50 Appendix B
N	D[3]	N	II or NS	Non-Class 1E	—

9

Section 3.2 – Classification of SSCs

- Table 3.2-3 defines applicable codes and standards for design based on Quality Group classification

Table 3.2-3

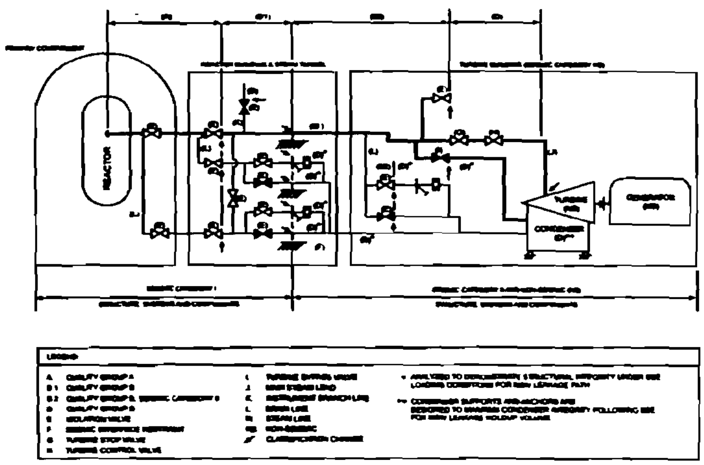
Quality Group Designations – Codes and Industry Standards

Quality Group Classification	ASME Section III Code Classes	Pressure Vessels and Heat Exchangers[4]	Pipes, Valves, and Pumps	Storage Tanks (0-103 kPaG) 0-15 psig	Storage Tanks Atmospheric	ASME Section III Component Supports	Non-ASME Section III Component Supports	Core Support Structures and Reactor Internals	Containment Boundary
A	1	NCA and NB TEMA C	NCA and NB	—	—	NCA and NF	—	—	—
B	2	NCA and NC TEMA C	NCA and NC	NCA and NC	NCA and NC	NCA and NF	—	—	—
	CC[1] and MC	—	—	—	—	—	—	—	NCA, CC[1], and NE
	CS	—	—	—	—	—	—	NCA and NG	
C	3	NCA and ND TEMA C	NCA and ND	NCA and ND	NCA and ND	NCA and NF	—	—	—
D	—	ASME Sect. VIII Division I TEMA C	ASME B31.1 for piping and valves[2]	API-620 or equivalent[3]	API-650 AWWA-D100 ASME B96.1 or equivalent[3]	—	Manufacturer's Standards, e.g., ASME B31.1, AISC	—	—

10

Section 3.2 – Classification of SSCs

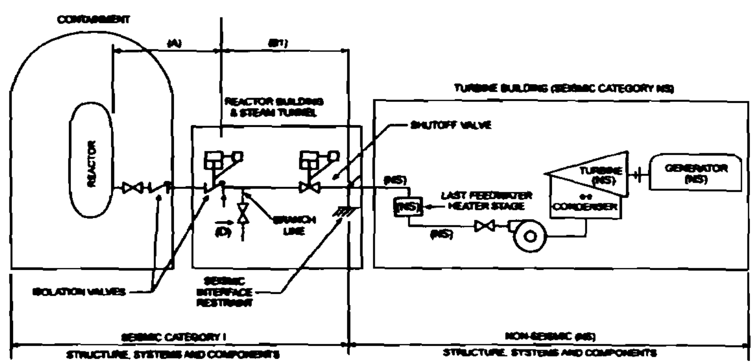
- Figure 3.2-1 shows classification boundaries for power conversion system



11

Section 3.2 – Classification of SSCs

- Figure 3.2-2 shows classification boundaries for feedwater system



Note: See Figure 3.2-1 for Legend.

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Section 3.3 - Wind and Tornado Loadings

- Seismic Category I and II structures designed to withstand 150 mph wind (3-sec gust).
  - >The design wind is converted to a velocity pressure for determining the building loads.
  - >Methodology in ASCE Standard 7-02 used with Exposure Category D.

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Section 3.3 - Wind and Tornado Loadings

- Seismic Category I & II buildings are designed to withstand the effects of a design basis tornado with maximum winds of 330 mph.
  - >Tornado design loads include wind loads, differential pressure loads and missile loads.
- Control Building Emergency Filtration Unit air intake openings are provided with tornado dampers.
- Remainder of plant structures designed to not adversely impact Seismic Category I structures, systems or components.

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Section 3.4 - Water Level (Flood) Design

- Section 3.4 describes flood protection design basis.
- Methods provided for protection from external flood sources include:
  - > Design plant grade elevation is to be at least 1 ft above the design flood level.
  - > Walls below flood level are designed for hydrostatic loads.
  - > Water stops installed in joints below flood and ground water levels.
  - > External surfaces waterproofed below grade.
  - > Water seals installed at pipe penetrations below grade.
  - > Roofs are designed to prevent pooling.

15

Section 3.4 - Water Level (Flood) Design

- Internal Flooding due to pipe breaks and cracks, fire hose discharges and other water sources.
- Protective features provided to mitigate or eliminate consequences of internal flooding include:
  - > Structural enclosures or barriers

Curbs and sills

  - > Leakage detection components
  - > Floor Drainage systems (No credit taken in evaluation)
  - > Safety-related equipment is located above the maximum flood level or qualified for flood conditions.

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Section 3.5 - Missile Protection

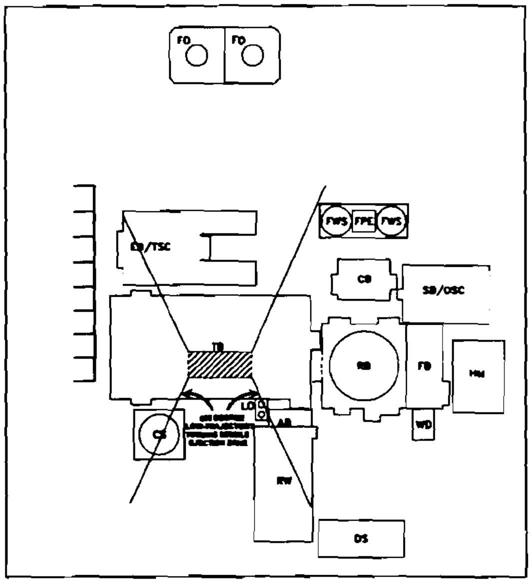
- Section 3.5 describes Missile Protection design basis.
- Seismic Category I structures are designed for missile protection.
- Systems requiring missile protection are safety-related systems and Offgas Charcoal Bed Adsorbers.

17

Section 3.5 - Missile Protection

- Rotating equipment examined for possible source of credible and significant missiles.
- Main steam turbine missiles.
  - >Favorable location relative to containment location.
  - >Quality assurance in design, fabrication, maintenance and inspections (See Section 10.2)
  - >COL Applicant provides Turbine Maintenance and Inspection Program and Turbine Missile Generation Probability Calculation.
- Missiles from pressurized component failures are evaluated.

18



ESBWR Standard Plant Low-Trajectory Turbine Missile Strike Zone

19

Section 3.5 - Missile Protection

- Tornado generated missiles are the limiting natural phenomena hazard.
  - >Seismic Category I buildings are designed to resist tornado missiles.
- The site proximity missiles for the ESBWR Standard Plant are assumed to be statistically insignificant.(COL Applicant addresses site-specific hazards.)

20

Section 3.5 – Missile Protection

- Aircraft hazards are also considered to be statistically insignificant. (COL Applicant addresses site-specific aircraft impact hazard)
- Barrier design procedures to prevent local and overall damage due to missiles are provided.

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Summary

- Chapter 3, Sections 3.1 – 3.5 provides design basis of structures, components, equipment and systems.

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U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3 – Design of Structures, Components, Equipment, and Systems
(Sections 3.1 through 3.5, 3.10, 3.11, and 3.13)

June 18, 2008

ESBWR Design Certification Chapter 3 Outline

- 3.2.1 Seismic Classification
- 3.2.2 System Quality Group Classification
- 3.3.1 Wind Loadings
- 3.3.2 Tornado Loadings
- 3.4.1 Internal Flood Protection for Onsite Equipment Failures
- 3.4.2 Analysis Procedures
- 3.5.1.1 Internally Generated Missiles (Outside Containment)
- 3.5.1.2 Internally-Generated Missiles (Inside Containment)
- 3.5.1.3 Turbine Missiles
- 3.5.1.4 Missiles Generated by Tornadoes and Extreme Winds
- 3.5.1.5 Site Proximity Missiles (Except Aircraft)
- 3.5.1.6 Aircraft Hazards
- 3.5.2 Structures, Systems, and Components to be Protected from Externally-Generated Missiles
- 3.5.3 Barrier Design Procedures
- 3.6.1 Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment
- 3.6.2 Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping
- 3.6.3 Leak-Before-Break Evaluation Procedures
- 3.7.1 Seismic Design Parameters
- 3.7.2 Seismic System Analysis
- 3.7.3 Seismic Subsystem Analysis
- 3.7.4 Seismic Instrumentation
- 3.8.1 Concrete Containment
- 3.8.2 Steel Containment
- 3.8.3 Concrete and Steel Internal Structures of Steel or Concrete Containments
- 3.8.4 Other Seismic Category I Structures
- 3.8.5 Foundations
- 3.9.1 Special Topics for Mechanical Components
- 3.9.2 Dynamic Testing and Analysis of Systems, Structures, and Components
- 3.9.3 ASME Code Class 1, 2, and 3 Components, and Component Supports, and Core Support Structures
- 3.9.4 Control Rod Drive Systems
- 3.9.5 Reactor Pressure Vessel Internals
- 3.9.6 Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints
- 3.9.7 Risk-Informed Inservice Testing
- 3.9.8 Risk-Informed Inservice Inspection of Piping
- 3.10 Seismic and Dynamic Qualification of Mechanical and Electrical Equipment
- 3.11 Environmental Qualification of Mechanical and Electrical Equipment
- 3.12 ASME Code Class 1, 2, and 3 Piping Systems, Piping Components and their Associated Supports
- 3.13 Threaded Fasteners - ASME Code Class 1, 2, and 3

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3 Sections & Reviewers

<u>Richard McNally</u>
3.2

<u>Mohamed Shams</u>
3.3.1
3.3.2
3.4.2

<u>David Shum</u>
3.4.1
3.5.1.1
3.5.1.2
3.5.1.4
3.6.1

<u>George Georgiev</u>
3.5.1.3
3.13

<u>S. Rao Tammara</u>
3.5.1.5
3.5.1.6

<u>Renee Li</u>
3.6.2

<u>David Jeng</u>
3.7.

<u>Samir Chakrabarti</u>
3.8

<u>John Wu</u>
3.9.1

<u>Jai Rajan</u>
3.9.2

<u>Arnold Lee</u>
3.9.2.2
3.9.3

<u>Andrey Turilin</u>
3.9.4

<u>Patrick Sekerak</u>
3.9.5

<u>Thomas Scarbrough</u>
3.9.6
3.11

<u>P.Y. Chen</u>
3.10

<u>Amar Pal</u>
3.11

<u>John Fair</u>
3.12

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3 RAI Status

Total RAIs Issued – 583

Open RAIs – 57

<u>Open RAI Details</u>

- 3.8 – 19
- 3.9 – 15
- 3.6 – 8
- 3.11 - 7

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UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.2 – Classification of Structures, Systems, and Components
Chandu Patel – NRO/DNRL/NGE

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.2 – Classification of Structures, Systems, and Components

Regulations and Regulatory Guidance
- GDC 1 and 2
- Regulatory Guides 1.26, 1.29, 1.143, 1.151
- SECY for RTNSS SSCs
- SRP 3.2.1 and 3.2.2

Technical Summary
- Seismic classification consistent with RG 1.29
  - o Quality grouping consistent with RG 1.26
  - o Classification Boundaries are identified
- Nonsafety-related SSCs evaluated by the RTNSS process

Significant Open Items
- Electrical Systems Supporting Post 72-Hour Functions (RAI 3.2-63)
- QA for Seismic II SSCs, and Graded QA for Risk Significant RTNSS Systems (RAI 3.2-6)
- Turbine Building Reclassified From Seismic II to NS (RAI 3.2-66)

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.3 – Wind and Tornado Loadings

Regulations and Regulatory Guidance
- GDC 2
- Regulatory Guide 1.76
- SRP 3.3

Technical Summary
- Cat I structures design criteria includes:
  - o Extreme Wind Speed – 150 mph
  - o Maximum Tornado Wind Speed – 330 mph
- Tornado design loads include wind pressure, pressure drop and missiles
- Adverse interaction between NS and seismic Cat I structures is precluded

Significant Open Items
- Address potential adverse interaction between the Radwaste Building and adjacent seismic Cat I structures under tornado loads – RAI 3.3-3
  - o Applicant will design Radwaste building for full tornado wind – issue is now closed.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.4.1 – External and Internal Flood Protection

Regulatory Requirements and Guidance
- GDC 2
- Regulatory Guides 1.59, 1.102
- Section IV.C of 10 CFR Part 50, Appendix S
- SECY for RTNSS
- SRP 3.4.1

Technical Summary
- GEH discussed the flood protection measures that are applicable to the ESBWR design for postulated external flooding resulting from natural phenomena, as well as for internal flooding from system and component failures.
- GEH conducted an analysis based on the site envelope parameters to identify the safety-related SSCs that require protection against flooding from both external and internal sources.

Significant Open Items
- Emergency operating procedures as an external flood condition develops. (RAI 3.4-12)
- Protection of RTNSS systems from external and internal flooding (RAI 22.5-5)
- Calculation for the maximum volume of floodwater in each area (RAI 3.4-9)

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.4.2 – Analysis Procedures

Regulations and Regulatory Guidance

- GDC 2
- SRP 3.4.2

Technical Summary

- Highest flood and ground water levels are below finished grade – no flood hydrodynamic effects considered
- Hydrostatic pressure is considered in the design of embedded structural elements.

Significant Open Items

- None

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.1.1 - Internally Generated Missiles (Outside Containment)

Regulatory Requirements and Guidance

- GDC 4
- SECY for RTNSS
- SRP 3.5.1.1

Technical Summary

- GEH, described the criteria for identifying missiles and protecting SSCs from their effects.
- GEH evaluated the potential internally generated missiles that could result from failure of the plant equipment located outside the containment.
- GEH categorized the potential internally generated missiles into two groups:
  - Internally generated missiles resulting from in-plant rotating equipment overspeed failures.
  - Internally generated missiles resulting from in-plant high-pressure system ruptures

Significant Open Items

- Protection of RTNSS systems from protected from internally generated missiles outside containment. (RAI 22.5-5)

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.1.2 - Internally Generated Missiles (Inside Containment)

Regulatory Requirements and Guidance

- GDC 4
- SECY for RTNSS
- SRP 3.5.1.2

Technical Summary

- GEH categorized the potential internally generated missiles within the containment into three groups:
  - Missiles generated by rotating equipment (e.g., pump impellers, compressors, and fan blades).
  - Missiles generated by pressurized components (e.g., valve bonnets, thermowells, nuts, bolts, studs, valve stems, and accumulators).
  - Gravitational missiles

Significant Open Items

- Protection of RTNSS systems from internally generated missiles inside containment. (RAI 22.5-5)

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.1.3 - Turbine Missiles

Regulations and Regulatory Guidance

- GDC 4
- Regulatory Guides 1.115
- ASME Code, Section III and XI
- SRP 3.5.1.3

Technical Summary

- ESBWR turbine generator is favorably oriented.
- For favorably oriented turbines, the probability of turbine missile generation, P1, should be less than 1×10^{-4}
- The turbine ITAAC specifies that turbine missile probability analysis confirm that probability of turbine missile generation, P1, is less than 1×10^{-4} per year.

Open Items

- None

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.1.4 – Missiles Generated by Natural Phenomena

Regulatory Requirements and Guidance

- GDC 2, 4
- Regulatory Guides 1.76, 1.117
- SECY for RTNSS
- SRP 3.5.1.4

Technical Summary

- Tornado-generated missiles, which have been determined to be the limiting natural phenomena hazard in the design of all structures required for the safe shutdown of the nuclear power plant, are used in the design basis for the ESBWR design.

Significant Open Items

- None

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.1.5 – Site Proximity Missiles (Except Aircraft)

Regulatory Guidance

- GDC 4
- Regulatory Guides 1.206, 1.91

Technical Summary

- Nature and proximity of man-related hazards
- Establish the risk of hazard is very low
- Reviewing event probability for which the expected rate of occurrence of potential exposure in excess of the 10 CFR 100 guideline is estimated to be less than order of magnitude of 10^{-7} per year

The envelope of ESBWR Standard Plant Site Design Parameters in DCD are provided in Tier 2 Table 2.0-1. The site is selected such that the probability of occurrence of the Site Proximity Missiles (except aircraft) is less than 10^{-7} per year. Since the information regarding Site Proximity Missiles (Except aircraft) in the site vicinity is site-specific, the review needs to be performed at the time of COL stage, based on the COL applicant's address of site-specific information in accordance with SRP Section 3.5.1.5.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.1.6 – Aircraft Hazards

Regulatory Guidance

- GDC 3, GDC 4
- Regulatory Guides 1.206

Technical Summary

- Nature and proximity of man-related hazards (airports)
- Establish the risk of hazard is very low
- Reviewing event probability for which the expected rate of occurrence of potential exposure in excess of the 10 CFR 100 guideline is estimated to be less than order of magnitude of 10^{-7} per year

The envelope of ESBWR Standard Plant Site Design Parameters in DCD are provided in Tier 2 Table 2.0-1. The probability of aircraft hazards impacting the ESBWR Standard plant and causing consequences grater than 10 CFR Part 100 (and 10 CFR 50.34(a)(1) exposure is less than 10^{-7} per year. Since the information regarding potential aircraft hazards in the vicinity of the site is site-specific, the review needs to be performed at the time of COL stage, based on the COL applicant's address of site-specific information in accordance with SRP Section 3.5.1.6.

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.2 – Structures, Systems, and Components To Be Protected from Externally Generated Missiles

Regulatory Requirements and Guidance

- GDC 2, 4
- Regulatory Guides 1.13, 1.27, 1.115, 1.117
- SECY for RTNSS
- SRP 3.5.2

Technical Summary

- GEH discussed the SSCs to be protected from externally generated missiles, including all safety-related SSCs on a plant site that have been provided to support the reactor facility.

Significant Open Items

- Protection of RTNSS systems against externally generated missiles. (RAI 22.5-5)

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.5.3 – Barrier Design Procedures

Regulations and Regulatory Guidance

- GDC 2 and 4
- Regulatory Guides 1.76 and 1.142
- SRP 3.5.3

Technical Summary

- Concrete barrier thicknesses are conservative for design basis tornado.
- Analysis procedures for tornado missile effects are consistent with SRP 3.5.3 guidance.

Significant Open Items

- None

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UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.10 – Seismic and Dynamic Qualification of Mechanical and Electrical Equipment
Mohammed Abid – NRO/DE/EMB1

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Document Review
Section 3.10 – Seismic and Dynamic Qualification

Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

- The staff reviews the applicant's methods of test and analysis employed to ensure the structural integrity and the operability of Seismic Category I mechanical and electrical equipment (including instrumentation and control) under the full range of normal and accident loading (including seismic and reactor building vibration).

Regulatory Guidance

- GDC 1, GDC 2, GDC 4, GDC 14, and GDC 30
- Appendix S and Appendix B to 10 CFR Part 50
- Regulatory Guide 1.29, 1.60, 1.61, 1.63, 1.92, 1.97, 1.100, and 1.122
- SRP Chapter 3.10
- Interim Staff Guidance on Addressing Seismic Issues Associated with High-Frequency Ground Motion Evaluations

Industry Standard

- IEEE 344-1987

ACRS Subcommittee Presentation
ESBWR Design Certification Document Review
Section 3.10 – Seismic and Dynamic Qualification

SER Items of Interest

3 RAIs remain open in the SER with Open Items sent to the ACRS (i.e., RAI 3.10-5, RAI 3.10-6 and RAI 3.10-8). All RAIs are closed.

RAI 3.10-5

Requested General Electric-Hitachi (GEH) to revise the COL information to require COL applicant to provide a milestone for submitting an implementation schedule for seismic and dynamic qualification of ESBWR mechanical and electrical equipment.

In its response, GEH stated that DCD Tier 2, Section 3.10.4 will be revised accordingly in Revision 5.

The staff confirms revised DCD Section provides the necessary COL information. RAI 3.10-5 is closed.

ACRS Subcommittee Presentation
ESBWR Design Certification Document Review
Section 3.10 – Seismic and Dynamic Qualification

RAI 3.10-6

Requested GEH to provide basis for the assumed number of SRV actuation events and the total SRV test duration stated in DCD.

In its response, GEH stated that ESBWR design (with isolation condenser system (ICS) and its larger steam volume) results in ZERO SRV openings during design basis anticipated operational occurrences (AOO), because ICS is sized to prevent SRV actuations with 3 of 4 trains in operation (Sect. 5.4.6.3). GEH concluded that the number of SRV actuation events and the total SRV test duration stated in the DCD is conservative.

The staff finds GEH response satisfactory for the assumed SRV Actuation events and test durations. RAI 3.10-6 is closed.

ACRS Subcommittee Presentation
ESBWR Design Certification Document Review
Section 3.10 – Seismic and Dynamic Qualification

RAI 3.10-8

Requested GEH to address the adequacy of the seismic qualification of ESBWR mechanical and electrical equipment for plant site with High-Frequency seismic excitations.

In its response, GEH stated that ESBWR certified seismic design response spectra (CSDRS) uses a single ENVELOPE ground motion, containing both Low- and High-Frequency ground motion (North Anna ESP site- specific spectra), to generate in-structure response spectra for use in seismic qualification of mechanical and electrical equipment. The seismic qualification of ESBWR mechanical and electrical equipment meets IEEE 344-1987.

The staff concludes that ESBWR design is adequate for plant site with High- Frequency seismic excitations. RAI 3.10-8 is closed.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.11 – Environmental Qualification of Mechanical and Electrical Equipment
Amar Pal – NRO/DE/EEB

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Chapter 3.11 – Environmental Qualification

Regulations and Regulatory Guidance
- 10 CFR 50.49
- 10 CFR 52.47 (b)(1)- ITAAC
- GDCs: 1, 2, 4, 23 of Appendix A and III, XI, XVII of Appendix B of Part 50.
- Regulatory Guides 1.89,1.97, 1.209, and 1.180
- Industry Standards: IEEE
- Other Guidance – SECY – 05-0197

Technical Summary
- Equipment Covered Under EQ Program
  - o Safety-related mechanical equipment in harsh environment (GDCs)
  - o Electrical equipment important to safety in harsh environment (10 CFR 50.49)
    - Safety-related electrical equipment
    - Non-safety-related electrical equipment whose failure could prevent satisfactory accomplishment of safety-function
    - Certain post-accident monitoring equipment
  - o Safety-related digital and non-digital I&C equipment in mild environment. (GDCs)

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Technical Summary (Cont'd)

- EQ PROGRAM SUMMARY
  - o The equipment is designed to have the capability to perform its design safety functions under all anticipated operational occurrences and normal, accident, and post-accident environments, and for length of time for which its functions are required.
  - o The environmental capability of the equipment is demonstrated by appropriate testing and analyses.
  - o A QA program meeting the requirements of Appendix B to 10 CFR Part 50 is established and implemented to provide assurance that all requirements have been satisfactorily accomplished
  - o EQ of mechanical, electrical, and I&C equipment meets the relevant requirements of 10 CFR 50.49, GDC 1, 2, 4,and 23 in Appendix A to 10 CFR Part 50; Criteria III, XI, and XVII in Appendix B to 10 CFR Part 50.
  - o The qualified life is verified using methods and procedures of qualification and documentation as stated in IEEE-323-1974.
  - o EQ Program is an Operational Program per SECY-05-0197
  - o GEH has proposed an ITAAC to verify EQ equipment has been qualified per NRC regulations.
  - o EQ records will be maintained in an auditable form for the entire period during which the EQ equipment is installed

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Open Items

- Use of IEEE Standard 323-1974 vs IEEE 323-2003 (Review ongoing) (RAI 3.11-11)
- RAI responses related to environmental parameters (radiation and temperature) needed for staff to complete its review. (RAIs 3.11-18, 20, 23 through 27)

COL Item

- COL Applicant will provide a full description and milestone for program implementation of the EQ program that includes completion of the plant-specific Equipment Qualification Document (Based on Rev. 5)

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

ESBWR Design Certification Review
Chapter 3.13 – Threaded Fasteners – ASME Code Class 1, 2, and 3
Chandu Patel – NRO/DNRL/NGE

June 18, 2008

ACRS Subcommittee Presentation
ESBWR Design Certification Review
Section 3.13 - Threaded Fasteners for ASME Code Class 1, 2 and 3

Regulations and Regulatory Guidance
- GDC 1, 4, 14, 30, 31
- 10 CFR Part 50, Appendix B and G
- ASME Code, Section III
- Regulatory Guide 3.13
- SRP 3.13

Technical Summary
- Threaded fasteners complies with the requirements ASME Code Section III, and, therefore, meets 10 CFR 50, Appendix A and GDC 1, 14, 30 and 31.
- Lubricants containing halogens, sulfur, lead or molybdenum sulfide are avoided and controls to avoid contamination conforms to the recommendations of RG 1.37 and, therefore, meet 10 CFR 50, Appendix B, Criterion XIII
- Threaded fasteners are preservice and inservice inspected in accordance with the requirements ASME Code Section XI and, therefore, meet 10 CFR 50.55a

Open Items
- None