

# **Official Transcript of Proceedings**

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UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

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603rd MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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THURSDAY

APRIL 11, 2013

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OPEN SESSION

+ + + + +

ROCKVILLE, MARYLAND

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

## 1 COMMITTEE MEMBERS:

2 J. SAM ARMIJO, Chairman

3 JOHN W. STETKAR, Vice Chairman

4 HAROLD B. RAY, Member-at-Large

5 SAID ABDEL-KHALIK, Member

6 SANJOY BANERJEE, Member

7 DENNIS C. BLEY, Member

8 CHARLES H. BROWN, JR. Member

9 MICHAEL L. CORRADINI, Member

10 DANA A. POWERS, Member

11 JOY REMPE, Member

12 MICHAEL T. RYAN, Member

13 STEPHEN P. SCHULTZ, Member

14 WILLIAM J. SHACK, Member

15 JOHN D. SIEBER, Member

16 GORDON R. SKILLMAN, Member

17

18

19

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1 NRC STAFF PRESENT:

2 ZENA ABDULLAHI, Designated Federal Official

3 JON AKE

4 JEFF CIOCCO

5 NILESH CHOKSHI

6 MICHAEL EUDY

7 STEPHEN MONARQUE

8 LYNN MROWCA

9 CLIFFORD MUNSON

10 JEFF SCHMIDT

11 MIKE TAKACS

12

13 ALSO PRESENT:

14 BOB HORTON

15 KEVIN LYNN

16 JOHN RICHARDS \*

17 LARRY SALOMEN \*

18 RYAN SPRENGEL

19 REBECCA STEINMAN

20 DON WOODLAN

21 \*Present via telephone

22

23

24

25

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## C-O-N-T-E-N-T-S (CONTINUED)

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

8:29 a.m.

CHAIR ARMIJO: [presiding] Good morning.

The meeting will now come to order.

This is the first day of the 603rd meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following:

First, WCAP-17116-P, Westinghouse BWR ECCS Evaluation Model, Supplement 5, Application to the ABWR, Revision 0.

Second, update on the Electric Power Research Institute Ground Motion Model Project.

Third, selected chapters of the Safety Evaluation Reports with Open Items associated with the U.S. Advanced Pressurized Water Reactor Design Certification and the Comanche Peak Combined License Application.

And fourth, preparation of ACRS reports.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act.

Ms. Zena Abdullahi is the Designated Federal Official for the initial portion of the meeting.

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1                   We have received no written comments or  
2                   requests to make oral statements from members of the  
3                   public regarding today's session.

4                   There will be a phone bridge line. To  
5                   preclude interruption of the meeting, the phone will  
6                   be placed in a listen-in mode during the presentations  
7                   and Committee discussion.

8                   A transcript of portions of the meeting is  
9                   being kept, and it is requested that the speakers use  
10                  one of the microphones, identify themselves, and speak  
11                  with sufficient clarity and volume so that they can be  
12                  readily heard.

13                  Our first presentation will address the  
14                  WCAP Report, and that will be led by Dr. Banerjee.

15                  MEMBER BANERJEE: Thank you, Mr. Chairman.

16                  I am Sanjoy Banerjee, Chair of the Thermal  
17                  Hydraulic Phenomena Subcommittee. But we had,  
18                  actually, a joint meeting of the Thermal Hydraulic  
19                  Phenomena; ABWR, and Materials, Metallurgy, and Fuels  
20                  Subcommittee on March 5th. For some obscure reason,  
21                  I was made Chairman of this meeting. So, I guess I  
22                  have to -- don't look so happy. You could have been  
23                  Chairman, too, as you're the Chairman of the ABWR  
24                  Committee, aren't you?

25                  (Laughter.)



1 All right. In any case, we had a meeting  
2 on March 5th afternoon. We heard from both the  
3 Applicant, NINA, as well as the staff. The matter at  
4 hand is approval of really a suite of codes, which  
5 consists of the code GOBLIN, an option in this case  
6 which is not exercised called DRAGON, and the fuel  
7 heatup code, which is called CHACHA-3D, for, again,  
8 reasons which are obscure because it is not 3D.

9 (Laughter.)

10 MEMBER POWERS: That is a great title.  
11 But it is a nice title.

12 (Laughter.)

13 MEMBER BANERJEE: It sort of dates the  
14 code in some sense because it is not called Bossa Nova  
15 or Samba or something else, yes.

16 (Laughter.)

17 In any case, to proceed --

18 MEMBER SHACK: The Charleston, yes.

19 MEMBER BANERJEE: The Charleston.

20 (Laughter.)

21 GOBLIN is a code which was developed  
22 really by ASEA. It incorporates the so-called one-  
23 dimensional drift-flux model, which works rather well  
24 for vertical flows. One of our former Chairmen,  
25 Graham Wallis, was the originator of this model, as

1 was Novak Zuber, who actually served as a consultant  
2 to us for many, many years. In any case, that doesn't  
3 mean we should bless it, but it is a strong sort of  
4 support for it.

5           Anyway, ASEA, then, of course, became ABB,  
6 and a lot of the facilities, many of you may have  
7 seen, that validated the code were in Sweden, the  
8 FRIGG loop. This code has been applied rather widely  
9 in Europe as well as in the U.S. to BWR-2 to -6s.

10           The unique feature with the ABWR is the  
11 internal pumps compared to the other licensed  
12 applications here or, let's say, approved applications  
13 of the code. What else can I say, other than the ABWR  
14 is a system where large break cannot occur below the  
15 active fuel length. Therefore, most of the breaks are  
16 at a higher elevation, larger breaks like feedwater  
17 line breaks. So, core uncover and minimum coolant  
18 sort of inventory that you see in all sorts of LOCA  
19 calculations are such that the issues of PCT get  
20 pushed to the very early stages of the transient.  
21 There is no significant core uncover at later stages.

22           So, you will see from the Applicant and  
23 Westinghouse their calculations, which are Appendix-  
24 K-base, which will show you the code does a good job.  
25 And then, the staff will show you some confirmatory

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1 calculations which support the conclusions.

2 So, with that, I think I should turn it  
3 over to I think Scott. Or is it Michael that you want  
4 to say a few words?

5 MR. EUDY: I'll say a couple of words.

6 MEMBER BANERJEE: Okay.

7 MR. EUDY: Good morning. I am Michael  
8 Eudy. I am the NRO Project Manager for the staff  
9 reviews of the fuel-related licensing Topical Reports  
10 that are applicable to ABWR.

11 We provided a Safety Evaluation to the  
12 Committee a couple of months ago. And last month, we  
13 presented our findings to the ACRS Subcommittee. We  
14 are pleased to be back to present to the full  
15 Committee today.

16 And I would like to note there were a  
17 couple of questions raised for the Applicant and the  
18 staff during the Subcommittee meeting, and we are  
19 prepared to address those during today's meeting.

20 I will turn it over to South Texas or --

21 MEMBER BANERJEE: So, when you want to  
22 close the meeting, just let us know.

23 MR. HEAD: Well, I think our plan is the  
24 slides themselves are not proprietary, but we feel  
25 like the discussion easily could go into proprietary

1 discussion. So, I think it is our request to go ahead  
2 and close it.

3 MEMBER BANERJEE: Right now?

4 MR. HEAD: Yes.

5 MEMBER BANERJEE: Okay. Zena, could we  
6 just make sure?

7 Do we have a bridge line open?

8 (Whereupon, at 8:37 a.m., the meeting went  
9 into Closed Session.)

10 (Whereupon, at 10:01 a.m., the meeting  
11 went back into Open Session.)

12 CHAIR ARMIJO: Look, we are well ahead of  
13 schedule. Congratulations to everybody for that.

14 What I would like to do is take a 15-  
15 minute break. I would like the members to come back  
16 to do a quick reading of John's letter between now and  
17 the time of 10:45, when we will have the EPRI  
18 presentation. So, we will take advantage of this 45  
19 minutes, 15 minutes of break, and then, come back for  
20 30 minutes to address some issues on John's letter.

21 Okay. Thanks. Fifteen minutes, 1-5.

22 (Whereupon, the foregoing matter went off  
23 the record at 10:01 a.m. and went back on the record  
24 at 10:43 a.m.)

25 CHAIR ARMIJO: Okay. We are back in

1 session.

2 Our next topic is update on the Electric  
3 Power Research Institute Ground Motion Model Project.  
4 The discussion will be led by Mr. Ray.

5 MEMBER RAY: Thank you, Mr. Chairman.

6 There have been enough jokes about this  
7 already.

8 But let me, anyway, say that the Fukushima  
9 Subcommittee was briefed yesterday morning on the  
10 status of addressing the Near-Term Task Force  
11 Recommendation 2.1 on seismic. This was a  
12 comprehensive update covering the two stages of Phase  
13 1 in some detail and touching briefly on Phase 2.

14 A key element in developing the site-  
15 specific ground motion is the second link in the chain  
16 from the seismic source to the ground surface at the  
17 site. As you will see on the slides shortly, the  
18 first link is the characterization of the source. The  
19 second link which will be briefed to the full  
20 Committee today is referred to as the Ground Motion  
21 Model or sometimes the Ground Motion Attenuation  
22 Model. It translates the source to the bedrock  
23 beneath the site. The third link is the Site  
24 Amplification Model.

25 The March 2011 50.54(f) letter states that

1 the current EPRI Ground Motion Model, which dates from  
2 2004 and 2006, should be used to perform these  
3 calculations for central and eastern U.S. plants.  
4 However, since the Seismic Source Characterization  
5 Study applicable to these plants, the first link that  
6 I mentioned, was updated last year and published as  
7 NUREG-2115, NEI and EPRI thought it made sense to  
8 update the Ground Motion Model as well, consistent  
9 with the intent of 50.54(f) that the current  
10 methodologies and guidance be used.

11 NEI and EPRI, as regarding the Ground  
12 Motion Model Update, NEI provided a letter this past  
13 Monday which was distributed to the members by Derek  
14 yesterday, and it reads in pertinent part as follows:

15 "The industry is currently completing a  
16 SSHAC Level 2 study to update the EPRI Ground Motion  
17 Attenuation Model based on recently-obtained data and  
18 the latest use of the technical experts."

19 And I will say, parenthetically, I think  
20 that is the area of interest that we want to focus on.

21 "Given the new information that exists, it  
22 makes sense to use this updated model, rather than the  
23 older version of the model, for the central and  
24 eastern U.S. plants. We intend to submit the Ground  
25 Motion Model Update Final Report to the NRC by June

1 3rd, 2013. Assuming NRC endorsement of the updated  
2 model by August 30th, 2013, the central and eastern  
3 U.S. plant will be able to submit their requested  
4 site-specific hazard information to the NRC by March  
5 31st, 2014.

6 "This is an informational briefing which  
7 is driven by that schedule and is intended to keep the  
8 Committee as current as possible regarding this  
9 significant area of post-Fukushima actions."

10 Nilesh, you had something you wanted to  
11 say introducing this?

12 MR. CHOKSHI: Thank you.

13 First of all, I think as you mentioned at  
14 yesterday's meeting, a short preview of this topic we  
15 are going to discuss today. Cliff Munson and Jon Ake  
16 are doing most of the presentation.

17 But I wanted to let you know that the some  
18 of the presenters from industry are in the room,  
19 Kimberly Keithline and Bob Wharton, and they are also  
20 available on the phone. Because I think in initial  
21 planning, you also wanted to have industry presenters  
22 be available for discussion. So, I want to make sure  
23 that you know that.

24 MEMBER RAY: Yes, with regard to the phone  
25 line, normally, we keep it in a listen-only mode.

1       However, you should alert us to when input from that  
2       source is appropriate to address issues as they are  
3       discussed. Keeping the line open all the time tends  
4       to be a distraction to some members because it is a  
5       fairly noisy line normally. So, let's try to remember  
6       to seek that source of input when it is appropriate.

7               MR. CHOKSHI: I think that is all. I  
8       think I will turn it over to Cliff.

9               MR. MUNSON: So, I think what we are going  
10      to present today -- and we don't have a lot of slides  
11      -- but I think it is a success story. I want to  
12      characterize it as a success story.

13              We were initially on a path trying to  
14      endorse and get through this update such that we  
15      didn't impact the 50.54(f) schedule, which had the  
16      hazard submittals, the central/eastern U.S. hazard  
17      submittals in September. And as you will hear, we  
18      did, in a sense, have a mid-course correction where we  
19      saw some elements of the model that was presented to  
20      us in February that we had issues with.

21              But we believe there is merit in getting  
22      the best-possible ground motion models to use for the  
23      hazard reevaluations. It is very important to get the  
24      input motion into the structures correct, so that the  
25      structural modeling and the fragility calculations are



1 done in the best fashion. So, we believe there is  
2 merit in taking an extra six months to allow for the  
3 completion of this model and have the hazard  
4 submittals in March of 2014.

5 There is abundant new data. Since we had  
6 the 2004/2006 model, new modeling approaches have been  
7 developed which have been brought to bear, and the  
8 EPRI project has also done some site evaluations. So,  
9 we believe that there is considerable merit in going  
10 forward with an update, as we are currently going to  
11 present to you.

12 So, I will turn it over to Jon.

13 MR. AKE: Next slide, please.

14 MEMBER RYAN: Try not to hit the  
15 microphones because it puts thunder and lightning in  
16 the recorder's ears.

17 MR. AKE: Yes.

18 MEMBER RYAN: Thank you.

19 MR. AKE: Sorry about that.

20 Yes, thank you very much. Outstanding  
21 introduction, Dr. Ray.

22 What we would like to go over today are  
23 just a little bit of background on the ground motion  
24 models themselves, just to make sure everybody  
25 understands some of what we are talking about here

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1 and, then, describe in a little bit more detail the  
2 existing model that has been used in the past, the so-  
3 called EPRI 2004-2006, which was actually developed in  
4 the 2002 timeframe initially and, then, updated, one  
5 portion of the model was updated in 2006.

6 And then, describe a little bit what has  
7 happened in the update that Cliff mentioned a moment  
8 ago, what the specific things that are being updated  
9 in that mode, and then, finish with a summary of the  
10 path forward.

11 Next slide, please.

12 For those of you who were here yesterday,  
13 you have seen this before. This we have shamelessly  
14 stolen from the EPRI document, the so-called seismic  
15 prioritization and implementation document. This is  
16 a really good slide for introducing these things. So,  
17 you will probably see it again in the future,  
18 actually.

19 But, as Dr. Ray pointed out, this problem  
20 can be really broken down into three component pieces,  
21 the first of which is the lower lefthand corner of the  
22 slide: the identification and characterization of the  
23 seismic sources, where do they occur, how big are the  
24 earthquakes that occur on those, and how often do they  
25 occur?

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1                   MEMBER POWERS: Well, do the seismic  
2 signals not diffract off strata within the ground  
3 layer?

4                   MR. AKE: They do, yes.

5                   MEMBER POWERS: It is not there.

6                   MR. AKE: Should we say this is a  
7 schematic representation? Yes, in fact, in point of  
8 fact, the waves would be interacting with all these  
9 various interfaces. If there are so-called impedances  
10 between the different layers, that will cause  
11 refraction/reflection and diffraction of the wave  
12 field through all this different layers. We are not  
13 representing that in this particular -- you know, this  
14 is a highly-schematic representation.

15                   But in the portion of the path shown  
16 there, you will notice that the little schematic  
17 wiggly line wave forms decrease in amplitude from the  
18 lefthand representation to the righthand  
19 representation, indicating attenuation, if you will,  
20 or diminution of the amplitude of the signal with  
21 distance.

22                   And that is part of what --

23                   MEMBER POWERS: Absorption or scattering  
24 or both?

25                   MR. AKE: All of the above. It is

1 intrinsic absorption as well as scattering and that  
2 sort of thing. So, all those things enter into this  
3 problem, the physics of this problem.

4 And on the far righthand side of the  
5 figure there, we again reiterate that the last few  
6 hundreds of meters to, in this particular case, where  
7 our nuclear reactor is sitting, the so-called site  
8 amplification has a significant impact on both the  
9 amplitude of the wave fields that enter the base of  
10 our structure, also, as well as the frequency content  
11 of those waves.

12 We will come back to this in just a  
13 minute, but for a moment remove the nuclear reactor  
14 from that position. In place of that nuclear reactor,  
15 imagine that is a seismic recording station. So, the  
16 data that I would record at that seismic recording  
17 station, in fact, does have that effect of that local  
18 site amplification, as well as the overall path  
19 properties between the seismic source and the base of  
20 the soils there. We will touch on that again in a  
21 moment.

22 Next slide, please.

23 Just to summarize, this slide describes a  
24 little bit about the ground motion models for stable  
25 continental regions. The central and eastern United

1 States and southeastern Canada are geologically  
2 characterized as something we call stable continental  
3 regions. That is to be contrasted to places like  
4 Nevada, California, Alaska, which we would  
5 characterize as active tectonic regions, much more  
6 recent geological disturbance and tectonic activity,  
7 many more earthquakes, that sort of thing. So, there  
8 are slight differences between the tectonics of these  
9 areas, but also places that are characterized as  
10 stable continental regions, typically, it has been  
11 hundreds of millions of years, many tens to hundreds  
12 of millions of years since the last real active  
13 tectonic episodes in those areas.

14 Sort of the simplified way of thinking  
15 about a stable continental region, think cooler  
16 crustal rocks and very effective wave transmission  
17 properties as opposed to active tectonic regions tend  
18 to have a little bit higher heat flow, much less  
19 efficient and effective wave propagation. That is why  
20 you see such a big difference between the  
21 characteristics of the ground motions between the  
22 eastern United States and California or the western  
23 United States.

24 These ground motion models, we usually  
25 estimate either things like peak ground acceleration

1 or various spectral acceleration, in this case  
2 response spectral acceleration, using various things  
3 called prediction equations or ground motion  
4 prediction equations you will often see them referred  
5 to.

6 And they characterize those ground motions  
7 in terms of earthquake magnitude, source-to-site  
8 distance, how far away my site is from the earthquake  
9 source, and the local site conditions.

10 And the third bullet is really the key one  
11 we are going to touch on a little bit here. In places  
12 like California or Japan or Taiwan, it is much easier  
13 to come up with these ground motion prediction  
14 equations because there is abundant data and it covers  
15 a wide band of both magnitude and distances that we  
16 have recordings for.

17 And unfortunately for us in the central  
18 and eastern United States, the ground motion data is  
19 very sparse in the magnitude-distance ranges that we  
20 think of for engineering interest. You know, we  
21 really don't feel that relatively-small magnitude  
22 earthquakes produce damaging ground motions to  
23 engineered structures, but, unfortunately, we don't  
24 have many large magnitude events in the East.

25 And the final bullet says that we are

1 typically in stable continental regions. We rely  
2 heavily on theoretical calculations to develop the  
3 models, as opposed to a purely empirical or  
4 observational approach, which is what we typically use  
5 in more active tectonic regions.

6 Next slide, please.

7 MEMBER POWERS: Can we go back to your  
8 little schematic? You don't need to take it  
9 physically back there. But thinking back on your  
10 little schematic of the transmission, is that general  
11 thinking about the transmission that is the  
12 diffraction/absorption, the amplification, and then,  
13 subsequent amplification, is that a function of the  
14 magnitude of the signal or can I take data from the  
15 small vibrations and accurately predict large  
16 vibrations?

17 MR. AKE: Good question. You get an "A"  
18 for the day. That is a good question.

19 (Laughter.)

20 But hold that for one second because I am  
21 going to come right back to that in just a second  
22 here.

23 (Laughter.)

24 That is a really good question, and we are  
25 going to come right back to that in just a second

1 here.

2 This is a map that shows some of the -- I  
3 am kind of going to jump a little bit here because  
4 this fit in two different places, and we put it here  
5 first to start with.

6 But this is a map, and the little  
7 triangles on this map are various recording stations  
8 that have recorded earthquake data, recent significant  
9 earthquake data in the central and eastern United  
10 States and southeastern Canada.

11 As part of this update project, thinking  
12 back to that slide we had a moment ago, our schematic  
13 slide where we had the upper few hundreds of meters of  
14 material that influenced the characteristics of the  
15 seismic signal, we recorded our recording station.  
16 Well, one of the things we have endeavored to do, and  
17 this update project has done a very good job about, is  
18 they have gone and at many of these locations they  
19 have actually made in situ seismic measurements of the  
20 near-surface shear wave velocity structure to try to  
21 develop site amplification models for that particular  
22 recording station. So, in essence, we can divide that  
23 amplification out of our recorded signal then, and  
24 then get a truer estimate of the actual rock ground  
25 motions.



1                   Something I should have said on the  
2 previous slide that just occurred to me, these ground  
3 motion models for stable continental regions,  
4 especially those that we are using in the nuclear  
5 field, are almost always derived for firm or hard-rock  
6 site conditions. So, the data that we have recorded  
7 here we would like to remove, if it is not on firm or  
8 hard-rock site conditions, we would like to remove  
9 that portion of the signal from those recordings, so  
10 that we have, then, in our database something that is  
11 equivalent hard-rock recordings that we can use in our  
12 evaluation.

13                   CHAIR ARMIJO: For all locations?

14                   MR. AKE: Yes.

15                   CHAIR ARMIJO: Yes. Great.

16                   MR. AKE: And as part of this particular  
17 project, we think one of the real positives of this  
18 project is they actually went out in the field, both  
19 contractors hired by EPRI as well as researchers from  
20 the University of Texas at Austin, went out and  
21 actually made field measurements of shear wave  
22 velocity at a number of these different sites, all of  
23 these filled sites here.

24                   But this also shows, indicates that there  
25 are a number of sites making recordings in the eastern

1 United States, but a number of these are actually  
2 temporary locations that are not permanent.

3 MEMBER RAY: Excuse me. Those  
4 measurements, did they always do borings?

5 MR. AKE: No, almost none of those did  
6 borings.

7 CHAIR ARMIJO: Surface?

8 MR. AKE: Yes, they were a surface  
9 geophysical technique. Almost all of them were a  
10 surface-wave-based technique used to estimate, to  
11 invert for shear wave velocity structure beneath the  
12 recording site.

13 MEMBER RAY: Okay.

14 MR. AKE: They are so-called noninvasive,  
15 simply because it is much, much faster and much less  
16 expensive.

17 MEMBER RAY: Well, but I do know that  
18 sometimes sites do resort to core drilling --

19 MR. AKE: Yes, right.

20 MEMBER RAY: -- and down-hole  
21 measurements.

22 MR. AKE: Many of the sites in Japan and  
23 Taiwan have been characterized with a full down-hole  
24 array of different geophysical measurement techniques,  
25 yes.

1 CHAIR ARMIJO: But is it equivalent shear  
2 wave measurements from the surface going down versus  
3 coming up?

4 MR. AKE: Yes, we feel that the down-hole  
5 measurement techniques probably have greater fidelity  
6 than do the surface wave techniques, but, again, you  
7 are balancing that tradeoff between what the cost and  
8 rapidity with which you can do the measurements  
9 versus --

10 CHAIR ARMIJO: They are not so different?

11 MR. AKE: No.

12 CHAIR ARMIJO: Okay.

13 MR. AKE: Yes. Yes, considering all the  
14 other --

15 CHAIR ARMIJO: Variables?

16 MR. AKE: -- problems, and since we have  
17 this, it is probably not the worst.

18 Anything else you wanted to say about this  
19 one?

20 MR. MUNSON: I think just to emphasize  
21 that some of those red triangles, they are actually  
22 moving across the continent. They are in an array  
23 that are moving across the continent. So, I think  
24 they are actually not in those locations anymore.

25 MR. AKE: Yes, that is a very good point,

1       that we are going to refer to an abundance of new data  
2       in a moment here that has been acquired since the  
3       original Ground Motion Model was derived, but part of  
4       that is because this large array that is marching  
5       across the nation on a decadal basis here is now  
6       currently in the central and eastern U.S. and has  
7       recorded a number of different earthquakes. We are  
8       fortunate that earthquakes occurred when the array was  
9       in the central part of the country, so we did pick up  
10      a lot of new data that wasn't available previously.

11               Next slide, please.

12               MEMBER SKILLMAN: Would that suggest that  
13      there were earthquakes in the area that the array just  
14      abandoned?

15               MR. AKE: Actually, the array was in a  
16      position to actually capture --

17               MEMBER SKILLMAN: Well, I got that, but --

18               MR. AKE: Yes.

19               MEMBER SKILLMAN: -- eight years earlier,  
20      the array was somewhere else.

21               MR. AKE: Yes.

22               MEMBER SKILLMAN: And you do not have that  
23      data.

24               MR. AKE: No. Well, yes, but --

25               MR. MUNSON: Not from those stations, but

1 for others.

2 MR. AKE: Right. It is marching west to  
3 east. So, eight or ten years ago, actually, the  
4 previous model was derived before this thing really  
5 got off the ground, before the so-called U.S. array  
6 started its traverse of the country. So, that data  
7 was not available at the time.

8 MEMBER BLEY: I hadn't heard of this  
9 before. This is something - USGS is doing this or --

10 MR. AKE: Actually, it is supported by the  
11 National Science Foundation.

12 MEMBER BLEY: And they are just picking  
13 these things up and moving them every few years?

14 MR. AKE: Yes, think of it as a strip of  
15 maybe 30 or 40 stations-wide on a 50-kilometer spacing  
16 between the stations that goes all the way from Canada  
17 to the southern border, and it sits in one place for  
18 about six months, you know, and basically, it is  
19 rolling left or right. So, the stations on the far  
20 west are picked up and moved to the East. And  
21 sequentially, it is just marching across the country.  
22 I think it is going to be a tremendous research boon  
23 in terms of collecting a lot of data.

24 This next plot here shows, this is a plot  
25 that was put together as part of the update project

1 here. This shows all of the data that is available  
2 that was used in this project. Almost all of this  
3 data is from the central and eastern U.S. or  
4 southeastern Canada with a couple of notably  
5 exceptions.

6 Up here, you can see this plots, each one  
7 of these little diamonds would represent a set of  
8 earthquake recordings at an individual station. So,  
9 this is basically the data. So, this is for a given  
10 distance and given magnitude, I have a large number of  
11 different recordings at different distances.

12 MEMBER POWERS: So that the data are a few  
13 seismic events, but a lot of stations?

14 MR. AKE: Yes. In many cases, it would  
15 be, if you think back to that -- if you would go back  
16 for one second, Lisa, to the map? For example, think  
17 about where the Mineral, Virginia earthquake occurred,  
18 which is down near North Anna in central Virginia.  
19 You can see there is a large number of stations going  
20 from western Virginia all the way up through central  
21 Virginia, Maryland, and into southern Pennsylvania.  
22 All of those stations would have recorded that single  
23 magnitude 5.8 earthquake.

24 So, if we go forward now, if you look at  
25 magnitude 5.8 on this plot and follow it across, you

1 can see there would be a large number of diamonds at  
2 magnitude 5.8. So, that individual earthquake would  
3 have been recorded at a variety of different distances  
4 by different stations.

5 MEMBER BLEY: That whole row might be that  
6 one --

7 MR. AKE: It probably is.

8 MR. MUNSON: Yes.

9 MR. AKE: The interesting thing to point  
10 out here is, usually if you see a horizontal line like  
11 that, that is an individual earthquake that was just  
12 acquired at a large number of different stations.

13 The interesting thing to point out here is  
14 -- Cliff did this; I thought it was very clever -- the  
15 red box is really the part -- you maybe could extend  
16 that down to a magnitude 5.5, but this is the box of  
17 engineering interest for us. And you will see that it  
18 is mostly white space.

19 I would point out that the magnitude 7.6  
20 plots up there are actually not anything from central  
21 and eastern U.S. or even North America. It is  
22 actually an earthquake from Bhuj in India about a  
23 decade ago that is also characterized as stable  
24 continental region.

25 So, in some cases we have imported a

1 little bit of data duty-free.

2 (Laughter.)

3 And also, if you look at the magnitude 6.8  
4 dots here, those are from an earthquake in western  
5 Canada, north central to western Canada, from a place  
6 called Nahanni that probably could be just as easily  
7 viewed as being an active tectonic region as a stable  
8 continental region. But, again, because of the fact  
9 we are so data-deficient in this box -- it is  
10 generally hard-rock site conditions there -- we have  
11 used that data in this dataset as well.

12 MR. MUNSON: I have to point out one of  
13 those dots in the 6.8 is from Gazli in Uzbekistan.

14 MR. AKE: Yes.

15 MR. MUNSON: So, the former Soviet Union.  
16 And in the audience is one of our Russian  
17 Seismologists that actually got that data.

18 MR. AKE: Yes.

19 CHAIR ARMIJO: Just a quick question. The  
20 distance is that line, straight line, from the  
21 epicenter to these recording stations. So, it is  
22 depth and --

23 MR. AKE: It actually ignores depth in  
24 this case.

25 CHAIR ARMIJO: It ignores depth?



1 MR. AKE: Yes. It is as if you think  
2 about that plot, our little schematic diagram, if you  
3 take that where the seismic source was and project  
4 that to the surface and just measure the distance from  
5 your --

6 CHAIR ARMIJO: Oh, okay, it is surface  
7 distance?

8 MR. AKE: Yes.

9 CHAIR ARMIJO: Okay.

10 MR. AKE: It is surface distance, yes.

11 MEMBER POWERS: Other than the fact that  
12 your area of what you call engineering interest is  
13 deficient in data points from the actual central and  
14 eastern United States, what am I supposed to derive  
15 from this plot?

16 MR. AKE: In the next 10 seconds, I am  
17 going to answer your question of a moment ago.

18 (Laughter.)

19 MEMBER POWERS: You think you are the  
20 straight man.

21 (Laughter.)

22 MR. AKE: Yes, I know. I know perfectly.

23 But if you will notice -- this gets back  
24 to Dana's question of a moment ago -- we have a lot of  
25 data in this beyond 10 kilometers and less than

1 magnitude 6. We have a lot of data. And that data  
2 may not help us a lot with understanding how magnitude  
3 scaling works for the very large magnitudes, but that  
4 data can be very informative in terms of understanding  
5 how that attenuation or diminution with distance  
6 occurs.

7 In other words, we usually break that up  
8 into a couple of different pieces -- and I will touch  
9 on this in a moment -- of the so-called geometrical  
10 spreading. Because the wave field decay is something  
11 like 1 over R or 1 over distance or 1 over distance to  
12 a power. It helps us understand that scaling as well  
13 as understand something about this thing we refer to  
14 as Q or seismic quality factor, which is that  
15 intrinsic attenuation part you referred to a moment  
16 ago.

17 Those two pieces, that dataset down there  
18 can be quite informative about that. And that is, the  
19 significantly-expanded database that exists in that  
20 portion of this plot has been, I think, useful in the  
21 last 10 years or so to derive new relationships and  
22 understand more about the physics of how those parts  
23 of the scaling problem work.

24 MEMBER BLEY: If I understood Dana's  
25 question, though, he was saying the information on the

1       attenuation properties that you generate down here,  
2       are the physics well-known enough such that it is a  
3       linear application if you have a stronger earthquake?

4               MR. AKE: We believe, as long as we are  
5       talking about that part of the problem, the problem  
6       that represents propagation in very hard rock, we  
7       think, yes, that is well-modeled as a linear process.  
8       If, however, we were talking about how we model the  
9       propagation through softer materials, especially near-  
10      surface materials, one cannot make that assumption.

11             MEMBER BLEY: Okay. I don't know how well  
12      we know the surface of the earth. But between any two  
13      separated points, I expect you go through a real mix  
14      of materials --

15             MR. AKE: Yes, and our models --

16             MEMBER BLEY: -- such that your caveat  
17      says maybe we don't know much about the --

18             MR. AKE: And our models are highly  
19      simplified in that respect because there honestly is  
20      no way to be able for any arbitrary seismic source  
21      that I may not even know exactly where it is, if you  
22      think about that whole concept of background  
23      earthquakes or earthquakes that are occurring on  
24      faults we don't know where they are, and we are just  
25      characterizing them as some point that may give rise

1 to earthquakes in the future, we do not understand the  
2 characteristics of that travel path enough to make a  
3 really detailed evaluation of that. We are doing it  
4 with a highly-simplified representation.

5 MEMBER BLEY: So, you treat it as if it  
6 were linear?

7 MR. AKE: Yes.

8 MEMBER BLEY: Okay.

9 MR. AKE: Yes.

10 CHAIR ARMIJO: Jon, I just want to make  
11 sure I understand. All the data points above 6.5, are  
12 any of those U.S.?

13 MR. AKE: No.

14 CHAIR ARMIJO: But all the ones below,  
15 let's say, 6 are all the U.S. data from these  
16 tracking --

17 MR. AKE: Actually, several of the larger  
18 ones there are the 5.9. I think there is actually a  
19 Canadian import event that occurred near Sagane in  
20 Canada.

21 CHAIR ARMIJO: Okay. Well, at some point  
22 -- I am still struggling --

23 MR. AKE: About 5.8.

24 CHAIR ARMIJO: How do those data apply to  
25 the central/eastern U.S. model?

1 MR. AKE: The very large events?

2 CHAIR ARMIJO: Yes.

3 MR. AKE: We would characterize those  
4 regions as stable continental regions.

5 CHAIR ARMIJO: So, you say they are kind  
6 of representative of --

7 MR. AKE: Yes.

8 MR. MUNSON: We don't --

9 CHAIR ARMIJO: You just make an assumption  
10 that --

11 MR. MUNSON: -- discriminate on borders.

12 (Laughter.)

13 MR. AKE: Yes.

14 CHAIR ARMIJO: So, you are just getting  
15 data --

16 MR. AKE: Right.

17 CHAIR ARMIJO: -- from equivalent  
18 geological sites?

19 MR. AKE: Yes, geological and tectonic  
20 settings.

21 CHAIR ARMIJO: Okay. Okay.

22 MR. AKE: In other words, we think that  
23 the similarity in the geological and tectonic settings  
24 is the most important factor.

25 CHAIR ARMIJO: So, you just import them

1 here and plug them in?

2 MR. AKE: Yes.

3 MEMBER SHACK: He has got it from India.  
4 That is about as far as he can import it.

5 (Laughter.)

6 CHAIR ARMIJO: Russia, Pakistan. But I  
7 was just getting at the general public sees this and  
8 says, "Oh, my God, look at those giant earthquakes,"  
9 and we don't treat them.

10 MR. AKE: Right.

11 MEMBER POWERS: Just because you haven't  
12 observed them when you have seismometers, we do get  
13 them. We just didn't happen to have a seismometer at  
14 that time.

15 MR. AKE: Right, at the time.

16 MEMBER POWERS: Yes.

17 MR. AKE: And you understand why that is.  
18 We don't have infinite resources to put out recording  
19 devices everywhere. And honestly, we have tended to  
20 focus our recording efforts on areas, on active  
21 tectonic areas and on major urban areas, because those  
22 are the things that we think we get the biggest bang  
23 for our buck from installing those instruments. And  
24 so, that is a problem we will be forced to live with  
25 for the foreseeable future.

1 MEMBER SHACK: But, I mean, New Madrid is  
2 estimated at like 8.1 to 8.3, right, something like  
3 that?

4 MR. AKE: Yes, maybe mid-7 state, yes.  
5 Yes.

6 CHAIR ARMIJO: So, it did happen; we just  
7 didn't get it?

8 MR. AKE: Yes.

9 MEMBER POWERS: So, seismometers were made  
10 out of wood in those days and brick. Don't forget the  
11 brick. And they had a swinging bell in Boston.

12 MR. AKE: Yes, exactly.

13 MEMBER BLEY: But to Sam's point, the new  
14 model relies on paleo data, other information than  
15 just recorded events.

16 CHAIR ARMIJO: Yes.

17 MEMBER BLEY: So, we don't pretend that  
18 they can't happen because they haven't happened --

19 MR. AKE: Right. The source  
20 characterization model very clearly identifies that  
21 those events can happen at some non-zero frequency of  
22 occurrence. So, those are in that model, to be sure.

23 CHAIR ARMIJO: No, I understand it now.

24 MR. AKE: The model allows for very large  
25 earthquakes to occur everywhere in the model. It is

1 just the rate is low.

2 CHAIR ARMIJO: Okay.

3 MEMBER POWERS: In the not-too-distant  
4 future, you are going to discuss frequency, and I  
5 can't do the calculation in my head fast enough. If  
6 you take a 10-hertz vibrational frequency, what kind  
7 of wavelength is that through the hard rock? Or any  
8 other hertz? I can do the change from one hertz to  
9 another.

10 MEMBER BLEY: You must have a rule of  
11 thumb, something that you use.

12 MEMBER POWERS: Well, it is a straight  
13 sound, is what you have.

14 VICE CHAIR STETKAR: Jon is doing it.

15 MR. AKE: Yes. Well, for 1 hertz, it  
16 depends upon the velocity of the material. For hard-  
17 rock material, for 1 hertz, you are basically going to  
18 get 2.8-kilometer wavelength for 1 hertz. It is a  
19 very long wavelength.

20 MEMBER POWERS: Well, maybe not because in  
21 thinking about -- I mean, Dennis pointed out there is  
22 a mishmash of material. We don't have to have that  
23 down, understand that material down to this length.  
24 You have to understand it down to the wavelength.

25 MR. AKE: Right.



1                   MEMBER POWERS: And if it is 2 kilometers,  
2 then you are looking for things on the order of --

3                   MR. AKE: Well, right, but, as those waves  
4 transmit up into the near-surface material, obviously,  
5 your wavelengths get much, much shorter very quickly.

6                   MEMBER POWERS: Right, but through the  
7 hard-rock part of it --

8                   MR. AKE: Right.

9                   MEMBER POWERS: -- you need to know  
10 discontinuities --

11                  MR. AKE: Right.

12                  MEMBER POWERS: -- on the order of  
13 kilometers or on the order of --

14                  MR. AKE: Which is why we feel justified  
15 in somewhat more simplified models to represent that  
16 portion of the propagation path.

17                  MEMBER POWERS: Right.

18                  MR. AKE: Do you want to go to the next  
19 one, Lisa? Thanks.

20                  This is just an example that shows, when  
21 we talk about ground motion prediction equation or  
22 ground motion models -- in a way, I am going to kind  
23 of mix terminology here a little bit, and I apologize  
24 in advance -- ground motion prediction equations  
25 produce things like these curves here, which this is

1 for 10-hertz spectral acceleration. And it shows the  
2 predicted spectral acceleration at 10 hertz versus  
3 distance for three different magnitudes, magnitude  
4 5.5, 6.5, and 7.5, indicated by the different colors  
5 here.

6 For a particular ground motion prediction  
7 equation -- this one is from Atkinson and Boore, 2006  
8 -- there are a couple of things to point out here.  
9 So, when we talk about attenuation models or  
10 attenuation prediction equations or ground motion  
11 prediction equations, this is what we are really  
12 talking about.

13 In this particular case, this shows the  
14 median ground motion values predicted for each one of  
15 these magnitudes by that particular equation. A  
16 second part of that equation that is not plotted on  
17 here that we would plot on here would be -- that is a  
18 median for each one of those. About that median is  
19 something we refer to as the signal or aleatory  
20 variability. In other words, it is sort of the random  
21 variability that we see in our observations for a  
22 particular -- say a 10-hertz magnitude 5.5 at 10  
23 kilometers might see plus or minus 1 standard  
24 deviation, might be a plus or minus factor of 1.5 in  
25 amplitude.

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1                   So, that variability is a rather strong  
2                   effect that ultimately goes into the seismic hazard  
3                   calculations and is an important part of that. I  
4                   won't touch on that much, but that is something that  
5                   is a factor or a piece of these models.

6                   MEMBER POWERS: When you have spoken about  
7                   an acceleration and a magnitude where you using moment  
8                   magnitudes, I think --

9                   MR. AKE: Right.

10                  MEMBER POWERS: -- there is another  
11                  variable, it strikes me, and it is the duration of the  
12                  ground motion. Does that get captured in thinking  
13                  about that or is this part of your aleatory  
14                  uncertainty that you speak about?

15                  MR. AKE: No, it isn't.

16                  MEMBER POWERS: Or is it something else?

17                  MR. AKE: It isn't, Dr. Powers, and I will  
18                  tell you the reason why is what we are plotting here  
19                  is actually response spectral acceleration. And that  
20                  does not depend upon the duration of the signal.

21                  MEMBER POWERS: It should not, no.

22                  MR. AKE: Yes. It is merely a  
23                  representation of the maximum excursion of a 5-percent  
24                  damped oscillator, if you will.

25                  MEMBER POWERS: I mean, the reason it

1 comes up is, in looking at large-magnitude  
2 earthquakes, there is frequent discussion of the  
3 duration of ground motion. And it gets into the  
4 response of engineering structures --

5 MR. AKE: Yes.

6 MEMBER POWERS: -- that that makes a  
7 difference. The structure is much more capable for a  
8 brief amount of acceleration.

9 MR. AKE: Right.

10 MEMBER POWERS: That the continued  
11 acceleration --

12 MR. AKE: A few cycles as opposed to a  
13 long duration of multiple cycles, yes.

14 MEMBER POWERS: And when you get into very  
15 long -- and I have never seen that axis in discussion  
16 of ground motion. It has always been moments,  
17 distance, acceleration, but never duration. But it  
18 seems like when we engineer things that that duration  
19 becomes much more important.

20 MR. MUNSON: And we do account for that  
21 when we develop ground motion response spectra, which  
22 we showed yesterday. And engineers will take that  
23 ground motion response spectra and fit a time history  
24 to it, and the time history will have a specified  
25 duration. That duration is something we review and

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1 look at to make sure it is long enough.

2 MEMBER POWERS: How do you know what  
3 duration to use?

4 MR. AKE: Actually, we in the past have --  
5 and there are published relationships that are similar  
6 to the ground motion prediction equations, but they  
7 are for duration. They are either for duration or for  
8 an energy factor or something, areas of intensity, or  
9 something like that. But it is basically some sort of  
10 energy function that there are also published  
11 equations for those that in the past we have --

12 MEMBER POWERS: May I see those  
13 publications?

14 MR. AKE: Yes. And there is actually a  
15 NUREG-6728. There is a set of tables in the back of  
16 that I can share with you that is a function like  
17 that. You can make a plot of the so-called areas  
18 intensity, which is an energy measure, and, you know,  
19 it goes from zero to 1, obviously.

20 But it is basically the duration in this  
21 case is defined as something between the 5th and 75th  
22 percentile of that buildup function. So, it gives you  
23 some measure of how the energy is being delivered to  
24 the structure. Is it on a long, drawn-out or is that  
25 total energy packaged in a very small time period?

1                   MEMBER RAY: But the design basis  
2                   calculations, they typically saturate the heck out of  
3                   the structure for analysis.

4                   MR. CHOKSHI: Yes. I think on the design  
5                   basis, because those are linear elastic design, the  
6                   reaction really doesn't matter. But, as Dr. Powers  
7                   pointed out, if you are doing risk assessment, and if  
8                   you really want to understand the effects of large  
9                   earthquakes, the thing you could do is actually model  
10                  and use, call it earthquakes compatible with  
11                  magnitudes. And then, you are just, in order to bring  
12                  in the right phase relationship as well as the  
13                  duration --

14                  CHAIR ARMIJO: Does EPRI have a model that  
15                  does that, that they used for the North Anna?

16                  MEMBER SHACK: Cumulative absolute  
17                  velocity --

18                  CHAIR ARMIJO: Yes, yes.

19                  MEMBER SHACK: -- is one way to do that.

20                  CHAIR ARMIJO: Yes, yes.

21                  MEMBER SHACK: I mean, that is, I think,  
22                  the typical industry.

23                  MR. CHOKSHI: But the cumulative absolute  
24                  velocity is the property of an actual record.

25                  MEMBER SHACK: Right, but they have a

1 predictive model that they sort of use.

2 MR. CHOKSHI: You can.

3 MEMBER SHACK: Yes.

4 MR. CHOKSHI: You know, if you have a  
5 recorder, then you can judge. But the best way is to  
6 use an actual record compatible with the magnitude and  
7 distance you are looking at it.

8 MEMBER POWERS: But the problem I have or  
9 the question I have -- I don't know that I have a  
10 problem yet -- is that I have recorded lots and lots  
11 of earthquakes in the 5 region, but I am only worried  
12 about earthquakes in the 7 region, and I haven't  
13 recorded them. And so, unless I am very predictive in  
14 a field that is not noted for its high-quality  
15 predictive capability -- (laughter) -- then I am not  
16 so confident about that.

17 MR. AKE: I guess the only thing I would  
18 say is it is how it is used in the process. Duration  
19 doesn't matter as long as we are trying to keep things  
20 in the linear elastic range. It is when you are  
21 toying with moving out of that linear elastic range,  
22 that is where the duration affects. Although I would  
23 point out, though -- this is kind of an aside -- that  
24 is something that is explicitly brought in in a way by  
25 these so-called magnitude scaling factors and things

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1       like liquefaction analysis, the soil failure analyses.  
2       Those are highly dependent upon the number of cycles.  
3       So, there are explicit factors that are brought into  
4       the analysis techniques for things like that.

5               MR. CHOKSHI: In the fragility analysis,  
6       there are approximate ways of dealing with when you  
7       start predicting the actual failures, when you are in  
8       the non-linear --

9               MR. AKE: Right, right.

10              Can we move on to the next one, Lisa?  
11       Thanks.

12              Just to summarize a little bit, just a bit  
13       of a background on the existing EPRI Ground Motion  
14       Model, the 2004 Ground Motion Model, this model was  
15       developed in about the 2002 timeframe, 2002-2003  
16       timeframe. And it was conducted as a SSHAC Level 3  
17       process, Senior Seismic Hazard Analysis Committee  
18       Level 3 process. It was followed in development of  
19       this, the first time that particular Level 3 process  
20       was utilized.

21              And the way the model is set up is the  
22       following: it is broken down into a series of four  
23       different clusters which are shown here. Each one of  
24       these clusters represents a different conceptual model  
25       for how the different ground motion prediction



1 equations characterize different parts of the problem.

2 The first two clusters are different  
3 conceptual models about how the seismic source is  
4 modeled in developing the original spectra that is  
5 used to propagate to the site of interest.

6 The third model is what we call a hybrid  
7 approach, which recognizes that there are different  
8 crustal properties between the central and eastern  
9 United States in, say, sites and active tectonic  
10 regions. But I have lots of data in active tectonic  
11 regions and I have good ground motion prediction  
12 equations for those.

13 By looking at the differences in the  
14 crustal properties, they merely come up with scaling  
15 factors to adjust those western-U.S.-type  
16 relationships to eastern U.S. crustal conditions. So,  
17 that is a Cluster 3 in this particular model.

18 And the last one is a purely theoretical  
19 finite source/greens function. So, it treats the  
20 seismic source, rather than a point source, as a  
21 finite-sized source and calculates specific -- and  
22 this gets to the question you had a few moments ago,  
23 Dr. Powers -- you know, the actual  
24 refractions/reflections along the path, the so-called  
25 greens function that goes from every point on that

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1 source to your site of interest. So, it is a purely  
2 theoretical approach.

3 Each of these different models in these  
4 clusters, weighting factors were developed for those  
5 based on a variety of different criteria.

6 MEMBER BANERJEE: So, what is this greens  
7 function?

8 MEMBER POWERS: He knows what a greens  
9 function is. He is pulling your leg here.

10 (Laughter.)

11 MEMBER BANERJEE: Yes, I know. I know  
12 what a greens function is, but it is a purely linear  
13 function.

14 MR. AKE: It is linear.

15 MEMBER BANERJEE: So, is this sort of a --

16 MR. AKE: It is given a --

17 MEMBER BANERJEE: I know you can integrate  
18 it over a finite source.

19 MR. AKE: In this case, each one of the  
20 greens functions represents basically --

21 MEMBER BANERJEE: A point.

22 MR. AKE: A point or a small part or  
23 portion of that large extended fault source.

24 MEMBER BANERJEE: So, everything is linear  
25 in the calculation?

1 MR. AKE: Yes.

2 MEMBER BANERJEE: Is that a reasonable  
3 assumption?

4 MR. AKE: Yes.

5 MEMBER POWERS: Yes, that is not bad.

6 MR. AKE: Yes.

7 MEMBER BANERJEE: So, you can superpose a  
8 solution?

9 MR. AKE: Yes, exactly. That is exactly  
10 what you are doing, is you are calculating a good  
11 assumption --

12 MEMBER POWERS: It is nonlinear,  
13 immediately at the source it is probably not linear  
14 because you are breaking things.

15 MR. AKE: Well, it is --

16 MEMBER POWERS: But if I move out a little  
17 bit --

18 MR. AKE: Right.

19 MEMBER POWERS: -- then, yes, the rock is  
20 moving linearly.

21 MR. AKE: Right. Yes, yes, yes.

22 MEMBER BANERJEE: So, it is elastic.

23 MEMBER POWERS: Elastic, yes.

24 MR. AKE: It is a linear elastic --

25 MEMBER BANERJEE: You can assume

1 elasticity. There is no plasticity definitely.

2 MEMBER POWERS: Well, immediately near the  
3 source the guarantee is to be some plasticity.

4 MEMBER BANERJEE: Right, but that is the  
5 source.

6 MEMBER POWERS: But move a mile away and,  
7 then, it is all elastic.

8 MEMBER BANERJEE: But you are assuming the  
9 sources. And these are reasonable assumptions?

10 MR. AKE: Yes. Yes.

11 So, each one of these different ground  
12 motion prediction equations, in the righthand column  
13 here of the models, these are the ground motion  
14 prediction equations equivalent to what I showed you  
15 in the previous slide. They all have weights that are  
16 assigned to them by the team that was producing this  
17 model. Those weighted values are used to produce  
18 synthetic data, if you will. In other words, ground  
19 motion, amplitude values at specific magnitudes and  
20 distances with the weights assigned to them by the  
21 team.

22 And then, they are in the next stage where  
23 the function will form to produce a new ground motion  
24 prediction equation. For those in that Cluster 1,  
25 there is one, two, three, four, five, six, seven

1 models that we are going to produce a single model now  
2 out of that that represents a composite of those seven  
3 models. Okay? This is what we are going to end up  
4 doing in the updated model as well.

5 Now the second part of what goes on in  
6 this development process is, based on the amount of  
7 deviation amongst those different models from that new  
8 composite median model in Cluster 1, they will come up  
9 with an epistemic factor that they will have two  
10 different models that represent, if you will, plus 1  
11 and minus 1 standard deviations about that median  
12 model.

13 So, Cluster 1 now will be replaced, those  
14 seven models will be replaced with three models that  
15 represent a median of plus and minus 1 standard  
16 deviation epistemic factor that represents now that  
17 Cluster 1. And the same process is gone through for  
18 each of those four clusters.

19 So, this is the way this model attempts to  
20 not only bring together all the available models, but  
21 also try to represent how much epistemic uncertainty  
22 is associated with those different models in the  
23 process.

24 MEMBER POWERS: I am a little confused  
25 maybe.

1 MR. AKE: Well, if you all get this on the  
2 first pass through this, you are a lot better than we  
3 are because we had to read this about 10 times.

4 (Laughter.)

5 MEMBER POWERS: I mean, okay, you have got  
6 seven different descriptions here.

7 MR. AKE: Right.

8 MEMBER POWERS: And that is wonderful,  
9 actually, in a highly-judgmental area of how you  
10 aggregate together a lot empirical data.

11 MR. AKE: Yes.

12 MEMBER POWERS: And so, you have a hybrid  
13 model. And so, you look and say, okay, how do they  
14 deviate around this kind of, for want of a better  
15 term, consensus model? How do they deviate around  
16 that? That gives me my epistemic uncertainty.

17 MR. AKE: Right.

18 MEMBER POWERS: That sounds as plausible  
19 as anything I can think of. It is this weighting  
20 factor that is a little bit of a mystery to me now.  
21 Because if I go in and do that, then I am probably  
22 variance-narrowing somehow here.

23 MR. AKE: And that is a good point. I  
24 guess we didn't put something together to describe  
25 that a little bit better. But the way that they came

1 up with those weights was really focused on two  
2 different aspects of the problem. They looked at the  
3 available data, which actually the data that was  
4 available then is not everything we saw in that plot  
5 a moment ago. It was actually a small fraction of the  
6 plot, of the data that was on that plot we showed a  
7 moment ago. That plot we showed a moment ago was the  
8 data that is current available. It was much less back  
9 then.

10 They looked at how these individual models  
11 deviated from the available data.

12 MEMBER POWERS: Uh-huh.

13 MR. AKE: Okay? So, they plotted them up  
14 for various magnitude ranges and distance ranges and  
15 said, how did each one of these models differ from the  
16 data? So, there was a quantitative data-driven  
17 component to the development of the weights.

18 The second part of the development of the  
19 weights was based on what they referred to as  
20 consistency with seismological theory. So, it was a  
21 more qualitative attribute that the technical  
22 integration team that was developing this model looked  
23 at how those different models, how they comported with  
24 what the general consensus of seismological theory  
25 was, how good were they.

1                   And so, it was nearly -- I don't remember  
2                   exactly what fraction of the weight was derived on the  
3                   data deviation, how much was based on the  
4                   seismological characteristics, but it was those two  
5                   factors put together that ended up with the weights on  
6                   these.

7                   MR. MUNSON: And also, the data itself was  
8                   weighted in terms of we care more about magnitude 5s  
9                   and 6s at shorter distances. So, that data is more  
10                  important. How you fit that data is more important  
11                  than magnitude 3 at 200 kilometers.

12                  MEMBER POWERS: I would guess there are a  
13                  couple of questions that come to mind. Were the  
14                  weightings extreme? That is, if I looked at Atkinson  
15                  and Boore as an example --

16                  MR. AKE: Hold that question.

17                  (Laughter.)

18                  MEMBER POWERS: I am already holding two.

19                  (Laughter.)

20                  MR. AKE: That is one of the things we are  
21                  going to come back to and talk about in the updated  
22                  model that is an aspect of the model that we did have  
23                  some difficulties with, is that particular point. We  
24                  are going to come back to that.

25                  MEMBER POWERS: And then, the other



1 question I will ask, which I am perfectly willing to  
2 hold because I hold so much -- (laughter) -- is that  
3 when you do weighting, then you start comparison to  
4 data, do you run into voting paradoxes? That is,  
5 Atkinson and Boore suck on A; Silva, et al., are very  
6 good on A, but such on B. On the other hand,  
7 Abrahamson and Silva are much better than Silva, but  
8 much worse than Atkinson in some way.

9 MR. AKE: Yes.

10 MEMBER POWERS: So, you get into a voting  
11 strategy.

12 MR. AKE: There is that, and the updated  
13 -- in this model I don't think it was done. The 2004  
14 model, I don't think it was done nearly as well as it  
15 has been done in the proposed updated model. And I am  
16 going to touch on that in just a minute here because  
17 there is something to that.

18 MEMBER POWERS: I am going to have such a  
19 collection of questions already.

20 (Laughter.)

21 MR. AKE: I know.

22 MEMBER BANERJEE: Before you move on, when  
23 you say "a model," can you tell me what you mean?

24 MR. AKE: The model in this, what we are  
25 referring to here, yes, there are two different --

1       this is what I mean by, this is what I alluded to a  
2       moment ago. I am probably confusing you with  
3       terminology. This is what we are referring to here as  
4       the Ground Motion Model, the EPRI Ground Motion Model.  
5       In other words, it is made up of the schema of all  
6       these different ground motion prediction equations  
7       that you see in the righthand column. So, it is,  
8       essentially, a logic tree strategy for developing this  
9       overall ground motion model.

10               MEMBER BANERJEE: But each of those things  
11       up there, the references --

12               MR. AKE: Yes.

13               MEMBER BANERJEE: -- have a specific set  
14       of --

15               MR. AKE: Prediction equations.

16               MEMBER BANERJEE: -- whatever these are --

17               MR. AKE: Yes.

18               MEMBER BANERJEE: -- algebraic or partial  
19       differential equations or some mix of these.

20               MR. AKE: They are simple algebraic  
21       equations that says the spectra acceleration at 10  
22       hertz, for example, is equal to a set of coefficients  
23       times terms that include the magnitude and the  
24       distance and the source type, and things like that.

25               MEMBER BANERJEE: It is just algebraic?

1 It cannot have any history, right? Unless you are  
2 solving a wave equation.

3 MR. AKE: No, these are purely --

4 MEMBER BANERJEE: These are purely  
5 empirical?

6 MR. AKE: These are simply, these are  
7 regression equations.

8 MEMBER BANERJEE: Okay.

9 MR. AKE: They are simple regression  
10 equations.

11 MEMBER BANERJEE: So, they are just  
12 empirical?

13 MR. AKE: Yes. Yes.

14 MEMBER BANERJEE: So, therefore, why do  
15 you expect them to fit anything different?

16 MR. AKE: Because they actually do --

17 MEMBER BANERJEE: What are the physics  
18 there?

19 MR. AKE: Well, that is the point, that  
20 these are -- and that gets to the question that Dr.  
21 Powers asked a few moments ago -- other than the last  
22 one, these are not strongly physically-based. They  
23 are an empirical approach to doing this problem.

24 MEMBER BANERJEE: Surely seismology has  
25 gotten beyond this by now.

1 (Laughter.)

2 I mean, it has been going on for quite a  
3 long time, right? Don't they solve wave equations and  
4 things?

5 MR. AKE: Yes, and that is what No. 4 is  
6 solving, is the wave equations, yes.

7 MEMBER BANERJEE: That is right.

8 MEMBER POWERS: In truth, what they  
9 regressed is well-tutored by the wave equations.

10 MR. AKE: Yes.

11 MEMBER POWERS: I mean, they are  
12 empirical, but not grossly empirical.

13 MEMBER BANERJEE: The solution to the wave  
14 equation.

15 MEMBER POWERS: Well, I mean, you know  
16 that the vibrational structure is going to be  
17 dependent on things like impedance and stuff like  
18 that. And so, they are not completely devoid of any  
19 physics, though.

20 MEMBER SHACK: Yes, I mean, you have some  
21 notions of R dependence from wave propagation. And  
22 so, you are going to pick a form that sort of  
23 incorporates that distance dependence.

24 MEMBER BANERJEE: Okay. So,  
25 qualitatively.

1 MR. AKE: Right. They, in general terms,  
2 represent the physics of wave propagation, yes. But  
3 the reason we don't -- and I will tell you that even  
4 right now; we will touch on this again in a minute --  
5 we have undertaken another exercise to update ground  
6 motion prediction equations that is actually much more  
7 exhaustive than what we are describing here. This is  
8 clearly an interim project. Okay? This is to try to  
9 answer the mail for the Recommendation 2.1 50.54(f)  
10 letter request. We will come back to that in a moment  
11 when I describe this other project.

12 But we are attempting to step back and be  
13 much more physically-based in that project, but that  
14 is a non-trivial exercise.

15 MEMBER BANERJEE: So, is there just -- I  
16 know nothing about this -- is there sort of a model  
17 which exists and is accepted in seismology, even if it  
18 is a set of stochastic differential equations like --  
19 I don't know -- larger equations are in physics? Is  
20 there something like that that you simply can't solve  
21 because you don't know enough detail?

22 MR. AKE: Well, the problem of doing the  
23 finite source representation for a large number of  
24 magnitudes and distances and properly doing the number  
25 of realizations that one needs to do, in seismological

1 theory when we have a large set of recordings from a  
2 given earthquake, and we essentially invert or solve  
3 for the characteristics of the source itself, in other  
4 words, how much slip occurred on that fault, where on  
5 that fault, when did that flip occur during the retro-  
6 process, things like that, there is a high degree of  
7 heterogeneity in that. And earthquake-to-earthquake,  
8 there is huge variability in that.

9 So, to capture that variability, okay, in  
10 a forward-modeling fashion is extraordinarily  
11 challenging.

12 MEMBER BANERJEE: But you can do the  
13 inverse problem, right? I mean, it is ill-posed, but  
14 you can do it?

15 MR. AKE: Well, right. Right.

16 MEMBER BANERJEE: Right?

17 MR. AKE: That is correct.

18 MEMBER BANERJEE: Yes.

19 MR. AKE: And that is what we do to come  
20 back and estimate that. Okay, I have one realization  
21 now. That earthquake happened. That earthquake will  
22 never happen again. How do I now predict what the  
23 future earthquakes will be?

24 Well, the way we do that is by tens of  
25 tens of tens of thousands of simulations. Well, the

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1 simulations, if you are going to do those for a broad  
2 range of magnitudes and a broad range of distances, we  
3 will have retired all of these plants by the time  
4 those calculations are finished.

5 MEMBER BANERJEE: An interesting problem.  
6 No wonder Dana is interested in this.

7 (Laughter.)

8 MEMBER RAY: We are going to get to the  
9 update here eventually.

10 (Laughter.)

11 MR. AKE: Yes.

12 MEMBER RAY: I am just hoping that it  
13 doesn't overrun the --

14 MR. AKE: Actually, the good news is I  
15 think Dr. Ray already went through most of this.

16 (Laughter.)

17 The existing option models that are 2004  
18 and 2006, I would mention that the original 2004  
19 model, what I referred to a moment ago when we were  
20 looking at those attenuation functions, which were the  
21 aleatory variability part of that, that was updated in  
22 2006. So, when you see the nomenclature EPRI 2004-  
23 2006, the median models were developed in the 2004  
24 model. Those are still used. The aleatory  
25 variability part was updated in 2006.

1           Those are the models that are being used  
2           by the ESP and COL applicants in their submittals.  
3           And that was what was identified in the 50.54(f)  
4           letter.

5           MEMBER SHACK: Well, I think Sanjoy might  
6           be interested to know just how many of the models that  
7           were proposed in 2004 are now rejected by the authors.

8           (Laughter.)

9           MR. AKE: And as we had heard originally,  
10          the EPRI and NEI decided to undertake the update of  
11          the existing model for use in answering the  
12          Recommendation 2.1.

13          Oh, go back one. I just wanted to mention  
14          one thing.

15          This gets to what we were talking about a  
16          moment ago, that the so-called NGA-East, the Next  
17          Generation Attenuation Equations, East for the stable  
18          continental region east of the Rockies, is a project  
19          that was begun a number of years ago by the NRC, DOE,  
20          and EPRI. And that is being done as a SSHAC Level 3  
21          project. We are scheduled to finish in late 2015 at  
22          this point.

23          But it is a much more physically-based  
24          process than what we are outlining here and a bit more  
25          steps back and say, how do we explore parameters based



1 in a more robust way, and things like that, than has  
2 been outlined here?

3 Okay. So, now let's talk about the  
4 update. A significant amount of new data has been  
5 reported since the 2002 timeframe on the original  
6 equations or the original model was developed. And  
7 specifically, there have been at least four magnitude  
8 5 and greater earthquakes in southeastern Canada or  
9 the eastern United States that were generally fairly-  
10 well recorded. That is actually extremely-useful  
11 information that has been developed that we did not  
12 have available to us before.

13 And also, this project has done a really  
14 good job about trying to come up with shear wave  
15 velocity measurements at the recording stations and,  
16 then, come up with a rather clever way to go about  
17 different techniques to try and to remove those site  
18 response effects from the existing data, so making an  
19 apples-to-apples comparison. If my ground motion  
20 prediction models are for hard-rock site conditions,  
21 I would like the data that I am judging that model  
22 against to be as close to corrected to hard-rock site  
23 conditions as I can get it, obviously, to avoid the  
24 apples-to-oranges comparisons.

25 And then, the last is that -- and this

1 gets to what you were talking about a moment ago -- a  
2 number of the existing or older models have been  
3 superseded by newer models, both by the authors of  
4 those original models themselves as well as by others.

5 MEMBER BANERJEE: I guess the real problem  
6 is, if it is hard rock, it is elastic. And if it is  
7 not, if it is soil, then you have got a problem,  
8 right? It is very heterogeneous media.

9 MR. AKE: Right, and the soil stations  
10 tend to produce very different spectral shapes --

11 MEMBER BANERJEE: Right.

12 MR. AKE: -- which is what we wish to  
13 avoid. We would like to have the greatest fidelity in  
14 those spectral shapes because those, then, in and of  
15 themselves, if the reactors we are going to evaluate  
16 are sitting on soil, we want to propagate that through  
17 the appropriate soil column, prediction equations  
18 through the proper soil column.

19 So, this is the Revised Ground Motion  
20 Update Table here that illustrates that now we have a  
21 different set of equations. There are some equations  
22 that carry over and some that are new models that have  
23 replaced existing models.

24 The same general conceptual framework.  
25 Since this is an update, and not a replacement of the

1 existing model, the same general scheme, four  
2 clusters, has been maintained in the update. The  
3 conceptual model for Clusters 2 and 3 are slightly  
4 different than they were before, but it is the same  
5 general idea, that we represent different conceptual  
6 models to say in this case about how the geometrical  
7 spreading occurs. And then, your field represents the  
8 different cluster models here.

9 And to get back to the question that Dr.  
10 Powers had a few moments ago, when we first saw this  
11 model in mid-February of this year, there were a  
12 couple of these models in Cluster 2 and 3 that had  
13 virtually all of the weight assigned to them. When  
14 going forward and trying to estimate, then, how to  
15 calculate the epistemic uncertainty, one of the issues  
16 that staff had was that potentially could result in an  
17 underestimation of the appropriate amount of  
18 epistemic uncertainty in those individual clusters.  
19 And that is something, then, that has been addressed  
20 subsequently, which we will talk about in a moment.

21 Now the weighting amongst the models is a  
22 bit more heterogeneous than was in the initial pass at  
23 doing this. That is a way that they attempted to  
24 address that.

25 Is there anything else on that you want to

1 say?

2 MR. MUNSON: No, I think that is good.

3 MR. AKE: To get to the question, the  
4 comment you had a moment ago, a number of these  
5 different models are by the same authors as  
6 previously, and they represent, in their view, updated  
7 and more applicable models than the models that were  
8 currently used in the model.

9 MEMBER BANERJEE: So, if you have these  
10 more or less algebraic models, you can actually run  
11 them very quickly --

12 MR. AKE: Yes.

13 MEMBER BANERJEE: -- and do uncertainty  
14 calculations?

15 MR. AKE: Yes.

16 MEMBER BANERJEE: If they are a little bit  
17 more, let's say, physically-based, they take a long  
18 time to run --

19 MR. AKE: Yes.

20 MEMBER BANERJEE: -- which is the  
21 difficulty you are facing, to get the uncertainties in  
22 the --

23 MR. AKE: Right.

24 MEMBER BANERJEE: Okay.

25 MR. AKE: And ultimately, where these are

1 going to be used is in the seismic hazard  
2 calculations. So, no matter what you do, no matter  
3 how physically-based you make it, at the end you are  
4 going to turn it into --

5 MEMBER BANERJEE: A reduced order model of  
6 some sort, yes.

7 MR. AKE: You are just going to turn it  
8 into an equation with some coefficients on it because  
9 you --

10 MEMBER BANERJEE: Or you can have a  
11 reduced order model. I mean, we do that in other  
12 fields, right?

13 MR. AKE: Yes. Yes.

14 MEMBER BANERJEE: To look at  
15 uncertainties?

16 MEMBER POWERS: It is going to get reduced  
17 a little more than that.

18 (Laughter.)

19 MR. AKE: Yes, because in a standard PSHA  
20 calculation, given the complexity, say, in the central  
21 and eastern U.S. model over all ranges and all  
22 distances and things like that, you will be doing that  
23 calculation, if you were even going to use a simple  
24 one, you would be doing it tens of tens of millions of  
25 times.

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1 MEMBER BANERJEE: Okay.

2 MR. AKE: So, you have to have, basically,  
3 it is something more or less just a lookup table.

4 MEMBER BANERJEE: So, there is no  
5 equivalent to non-parametric statistics in this area?  
6 I mean, you can't do something --

7 MEMBER POWERS: Well, there are some  
8 interesting statistical questions that arise, but not  
9 so much on this handling of modeling, but on handling  
10 of the other data, the aleatory nature of earthquakes,  
11 because it looks like Levy kinds of distributions are  
12 more appropriate than are those with nice variances  
13 associated with them, and things like that.

14 And that creates headaches because it is  
15 hard to interface Levy with everything that we would  
16 like. But, I mean, that addresses the part of the  
17 problem that he is treating totally empirically here.

18 MR. AKE: Yes.

19 MEMBER POWERS: I mean, he is doing a data  
20 regression, and it gets him out of that problem. This  
21 adding and how you confound expert opinions, and  
22 things like that, I think that is a fairly, I mean --

23 MEMBER BANERJEE: It gets rather --

24 MEMBER POWERS: -- it is known technology,  
25 but I don't call it, that doesn't mean it is trivial

1 technology.

2 MR. AKE: Right.

3 MEMBER POWERS: I mean, it is one of those  
4 problems. Yes, it can be done, but it is going to  
5 take somebody a long time to do it.

6 MR. AKE: Yes.

7 MEMBER POWERS: And it is, like you say,  
8 when your customer wants a 10-minute answer, you are  
9 a lot more approximate than when he wants a three-year  
10 answer.

11 (Laughter.)

12 MR. AKE: So this last, this slide here  
13 just basically summarizes the status of the Updated  
14 Ground Motion Model. EPRI and NEI produced a draft  
15 model and documentation in February of this year. We  
16 had a briefing on that. The NRC staff has been  
17 involved as observers at several of the calls. We  
18 listened-in on several of their calls. And then, we  
19 were present at their briefings with their peer review  
20 panel in mid-February of this year.

21 I should represent that there is, I should  
22 indicate that there is a formal peer review process  
23 that is going on for this project. This project is  
24 being conducted as a SSHAC Level 2 update, and it has  
25 a formal participatory peer review panel associated

1 with it.

2 At the time of the presentation in mid-  
3 February, the staff was unable to endorse this model,  
4 and it was really based on two different issues. One  
5 was the treatment of uncertainty, and to some extent  
6 that gets to the question you were asking a moment  
7 ago.

8 We were not entirely convinced that the  
9 amount of epistemic uncertainty that was arising in  
10 the new model was adequate, given the still sparse  
11 nature of the observational data, that we have in the  
12 central and eastern U.S. and the relatively-small  
13 number of new models that were available to use in  
14 this update.

15 And second, a very important part, was the  
16 documentation of the model. Obviously, the staff can  
17 only endorse something if the documentation is clear  
18 and transparent and in nearly-final form.

19 MEMBER POWERS: Do not downplay the  
20 importance of uncertainty here because the entire  
21 problem with seismic with respect to new plants is  
22 entirely a problem of uncertainty. Then, when you  
23 specify to me what kind of return vulnerability you  
24 are willing to tolerate, the problem is that it is  
25 going to be like 10 to the minus 5, 10 to the minus 6



1 kind of number, and you can't give me a feasible  
2 acceleration that I can design to because of your  
3 uncertainties.

4 MR. AKE: We can give you an estimate of  
5 the mean, but --

6 MEMBER SKILLMAN: Will that give you a  
7 number?

8 (Laughter.)

9 MEMBER POWERS: But the problem is --

10 MR. AKE: But your point is very well-  
11 taken. Recognizing that the uncertainty about that  
12 mean is significant is large.

13 MEMBER POWERS: Yes, the curves all go  
14 flat.

15 MR. AKE: And that is driven by epistemic  
16 uncertainty.

17 MEMBER POWERS: Yes, yes.

18 MR. AKE: And it is driven by two things,  
19 the aleatory variability and the epistemic  
20 uncertainty.

21 MEMBER POWERS: Yes.

22 MR. AKE: And that is the reason we  
23 focused so heavily on this. We try to do the best job  
24 we possibly can with characterizing the uncertainty  
25 there. And obviously, ultimately, our endorsement can

1 never be complete until we are satisfied that the  
2 documentation is in itself complete as well.

3 MEMBER POWERS: Yes. Yes, and you have to  
4 be very careful about people doing things that narrow  
5 the variance in their distributions.

6 MR. AKE: Right.

7 MEMBER POWERS: And especially when you  
8 have long-running models, they will do sampling  
9 methods that artificially narrow variances, and  
10 because it is published in some statistical --

11 MR. AKE: Right.

12 MEMBER POWERS: -- journal, this is a  
13 reliable technique. Yes, it is very reliable for  
14 getting means, but we are really, really interested in  
15 those variances.

16 MR. AKE: Right, exactly.

17 MEMBER POWERS: Really, really interested  
18 in them.

19 MEMBER BANERJEE: I am trying to still  
20 understand. The model takes into account, of course,  
21 what you know about faults and these sorts of things?  
22 It has to, right? So, that is important.

23 And so, there is a known structure there  
24 which underlies the model which is all the known  
25 faults, where they are, and all that sort of stuff.

1 But there has to be some uncertainty associated with  
2 what you don't know, right? So, the day after  
3 tomorrow, you might find another fault under the  
4 ground or something.

5 MR. AKE: Well, the problem is more  
6 profound than you think because, especially in the  
7 central and eastern U.S., we don't really know where  
8 the faults are that are going to produce future  
9 earthquakes, except in very few cases --

10 MEMBER BANERJEE: Right.

11 MR. AKE: -- perhaps around New Madrid,  
12 places in Oklahoma, Charleston maybe within --

13 MEMBER BANERJEE: And even the mechanism  
14 might be different, right?

15 MR. AKE: Right.

16 MEMBER BANERJEE: Yes.

17 MR. AKE: So, that is the reason that we  
18 feel that more simplified models are justified,  
19 because to go the next step would require us to try to  
20 characterize virtually every square, cubic kilometer  
21 of the central and eastern U.S. That ain't happening.

22 (Laughter.)

23 MEMBER BANERJEE: Right, right.

24 MR. AKE: Ever.

25 (Laughter.)

1                   MEMBER BANERJEE: And the model might be  
2 quite different, right?

3                   MR. AKE: Right.

4                   MEMBER BANERJEE: It could be a --

5                   MEMBER POWERS: We have got all these  
6 geology graduate students. What the hell are they  
7 good for, anyway?

8                   (Laughter.)

9                   MR. AKE: But, anyway, the EPRI and NEI  
10 presented the Updated Ground Motion Model at a public  
11 meeting here at NRC Headquarters on March 26th. And  
12 our assessment of the presentation that we saw at that  
13 time is that the updated model does appear to address  
14 most of the issues that were raised by the internal  
15 peer review panel of the project, as well as the NRC  
16 staff, and the DOE Defense Board staff, who also are  
17 conducting an independent review of this project as  
18 well.

19                  MR. MUNSON: So, just to emphasize what  
20 Jon just said, the model that we had issues with no  
21 longer exists. They have updated the model. There is  
22 a new updated model that we saw on March 26th. We  
23 haven't seen the documentation for it yet. So, that  
24 model looks promising going forward.

25                  MR. AKE: Yes, if we go to the next one,

1 we can just actually summarize just a tiny, little bit  
2 on what that is.

3 In particular, one of the questions that  
4 staff as well as the peer review panel identified was  
5 appropriately capturing the uncertainty in the scaling  
6 of the ground motions for larger earthquake magnitude.  
7 You know, thinking back to that plot we saw a few  
8 moments ago, we don't have much data up in those high-  
9 magnitude regions. So, understanding how that scaling  
10 goes from magnitude 4s to 5s to 6s to 7s, there is  
11 uncertainty to be sure. And the uncertainty in that  
12 scaling in the models has now been adjusted upward to  
13 more appropriately capture that.

14 And also, getting back to something that  
15 Dr. Powers mentioned earlier, where we looked at the  
16 little matrix of those models, the individual  
17 prediction equations for the old model, for the first  
18 draft of this model virtually all the weight was for  
19 a couple of different models. And they basically put  
20 a cap on the maximum amount of weight that individual  
21 models within each cluster could have. And because  
22 you are looking at the deviations, the weighted  
23 deviations from the data of those different models,  
24 that actually results in an increase in the within-in  
25 cluster epistemic uncertainty now.

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1                   And the other thing that we don't know for  
2                   sure, because we haven't see anything yet, but EPRI is  
3                   working on enhancing the documentation, and the peer  
4                   review panel, the DOE, and the NRC staff have tried to  
5                   indicate what types of documentation we think are  
6                   appropriate to include in this final model.

7                   And based on what we could see and, also,  
8                   the results of the peer review, the internal peer  
9                   review process that they have, they do definitely  
10                  appear to be meeting the objectives of the SSHAC  
11                  guidance in terms of representing, trying to represent  
12                  the so-called center, body, and range of the  
13                  technically-defensible interpretations.

14                 MEMBER SCHULTZ: Jon, can you describe  
15                 -- you mentioned, I think, two peer review teams?

16                 MR. AKE: Actually, only one.

17                 MEMBER SCHULTZ: One?

18                 MR. AKE: Yes, they have an internal peer  
19                 review panel.

20                 MEMBER SCHULTZ: "They" being?

21                 MR. AKE: The project, the EPRI project  
22                 itself has --

23                 MEMBER SCHULTZ: They have an internal  
24                 one?

25                 MR. AKE: Yes.

1 MEMBER SCHULTZ: And who is that?

2 MR. AKE: It is three, it is essentially  
3 four, four people. It is Bob, EPRI's --

4 MEMBER RAY: EPRI is now able to speak.

5 MR. AKE: Okay.

6 MEMBER RAY: We opened the line for them.

7 EPRI, do you want to answer that question?

8 MR. SALOMEN: Jon, this is Larry Salomen.  
9 Do you want me to help there?

10 MEMBER RAY: Please. Go ahead. The  
11 internal peer review.

12 MR. SALOMEN: It is Walt Arabaz, Richard  
13 Quittmeyer, Brian Chiou, and Bob Horton.

14 MEMBER RAY: Thank you.

15 MEMBER CORRADINI: Where are these people  
16 from?

17 MR. AKE: Walt Arabaz is a recently-  
18 retired professor at the University of Utah. He ran  
19 the Seismic Network and has been on a number of  
20 different commissions and panels and National Academy  
21 panels through the years.

22 Bob Horton is from southern --

23 MR. HORTON: South Carolina.

24 MR. AKE: Yes, okay.

25 MR. HORTON: Hi. Good morning.

1 I am Bob Horton with South Carolina  
2 Electric and Gas, and I have been involved at Summer  
3 Nuclear for 40-plus years, dealing with quite a few  
4 seismic and geologic issues over the history of the  
5 project.

6 The other participants are Dr. Quittmeyer  
7 from Rizzo Associates and Mr. Brian Chiou. He is a  
8 consultant on the West Coast.

9 MEMBER POWERS: How do you know that your  
10 peer review team adequately reflects the breadth of  
11 opinion within the relevant technical community?

12 MR. SALOMEN: This is Larry Salomen. I am  
13 the Project Manager.

14 MEMBER RAY: Go ahead.

15 MR. SALOMEN: Okay. It is really with a  
16 continuing process. Let me just summarize briefly.  
17 Even before this project started, we went out and  
18 engaged all the eligible seismologists and ground  
19 motion experts to see if there was merit to review the  
20 model. This was done from October 2011 to March 2012,  
21 when the project started.

22 We, then, in the project did an extensive  
23 literature search which will be part of the  
24 documentation that Jon has spoken about. And in  
25 addition to the literature search, we also had one-on-



1       one interviews with the known ground motion experts  
2       and seismologists who have developed the models. They  
3       gave us guidance with respect to which models, the  
4       existing '04 model could be replaced with a newer  
5       model.

6               And then, finally, we had a workshop,  
7       which is not normally part of due process. We had  
8       experts review the model in its preliminary form and  
9       to get their feedback.

10              And so, with those efforts, in addition to  
11       our project organization charts, we had only the CI  
12       team and the participatory peer review panel from day  
13       one, but we also invited observers to contribute  
14       (phone line interference).

15              We had productive cooperation with respect  
16       to the NGA-East, which is doing that SSHAC Level 2  
17       effort and, also, USGS, presently updating their  
18       ground motion maps for the next edition.

19              So, in summary, that is how we engaged the  
20       technical community.

21              MEMBER RAY: Okay. Thank you.

22              By the way, let me just advise you that  
23       whatever telephone device you are using, it omits  
24       about every third or fourth word that you speak. So,  
25       we will have to try to proceed here and finish up the

1 presentation.

2 MR. AKE: I think we are just about done.  
3 The last thing I would like to say, just to sort of  
4 clarify or finish off, I should say, what Larry was  
5 saying is all those different things were the  
6 mechanical things that the project did. But, in terms  
7 of the mantra that the peer review panel has as their  
8 charge, it is to make sure that that breadth and  
9 center, body, and range of the broader community's  
10 interpretations are captured as part of the project.  
11 That is the fundamental objective that they need to  
12 make sure that, ultimately, their letter that they  
13 will produce at the end, that is the fundamental thing  
14 that we look at as being something that the peer  
15 review panel has to successfully sign off on.

16 MEMBER SCHULTZ: Jon, you also mentioned  
17 DOE participants. Could you expand on who that was?

18 MR. AKE: Jeff Kimball, who is Senior  
19 Technical Advisor to the Defense Board and a very,  
20 very experience seismologist, has been also an  
21 observer on this project and provided peer review  
22 comments as well independently.

23 MEMBER BANERJEE: Did you involve Cal Tech  
24 and people like that who seem to have reasonably-good  
25 departments in this area?

1 MR. AKE: Most everyone that is involved  
2 in these projects --

3 MEMBER BANERJEE: I used to know Gene  
4 Schumaker, who, unfortunately, died.

5 MEMBER POWERS: But he worries about  
6 meteorite impacts --

7 MEMBER BANERJEE: I know.

8 MEMBER POWERS: -- and we have excluded  
9 those.

10 (Laughter.)

11 CHAIR ARMIJO: So far, we have.

12 (Laughter.)

13 MEMBER BANERJEE: Don't they have a good  
14 department at --

15 MR. AKE: Most of the major academic  
16 institutions are either directly represented as people  
17 that are developing models or serve as peer reviewers  
18 or the people that are on the TI teams, that is where  
19 they all got their PhDs at either Cal Tech or Berkeley  
20 or Stanford, MIT.

21 MEMBER RAY: Let me finish up. Can I?

22 CHAIR ARMIJO: Yes, please. Let's see if  
23 we can get back on track here.

24 MEMBER RAY: Okay.

25 MR. MUNSON: So, on the path forward --

1 next slide, yes -- industry is working on documenting  
2 the model. They have requested a six-month delay for  
3 the hazard submittals in response to the 50.54(f)  
4 letter from September to March. And during that six  
5 months, the staff review, when we get the model in  
6 June, we will be interacting and discussing the model  
7 for a couple of months. And then, if endorsed by the  
8 end of August, the team, the licensees will run the  
9 hazard for each of their sites and come up with a  
10 GMRS.

11 So, in summary, we feel that there is  
12 merit in extending the six-month delay, and this is  
13 the path we are taking so that we have the best  
14 characterization of the hazard for each of the  
15 licensees.

16 And that is our presentation.

17 MEMBER RAY: The report that you are  
18 looking at now isn't the final report, at least as I  
19 understood the letter from NEI. I take it you are not  
20 expecting any changes --

21 MR. MUNSON: That won't come until --

22 MEMBER RAY: -- in the final report?

23 MR. MUNSON: Right. That won't come until  
24 June, June 3rd.

25 MEMBER RAY: Okay. We have got, by the

1 schedule, still 10 minutes. And I wanted to afford  
2 EPRI a chance to speak more broadly to anything that  
3 they want to say or put on the record here.

4 I say again, we had difficulty hearing the  
5 last dialog. But if EPRI would like to speak to what  
6 they have heard and add anything to it, then now is  
7 the time to do that. Please proceed.

8 It sounds like we hung up on EPRI or put  
9 them back on mute.

10 MR. RICHARDS: This is John Richards on  
11 the phone from EPRI.

12 MEMBER RAY: Okay.

13 MR. RICHARDS: And Larry Salomen was  
14 talking previously on our behalf.

15 The only comment I would make is that Jon  
16 has done a wonderful job of presenting the background  
17 and summary of what is going on here, and we are  
18 moving forward with all due -- I wouldn't say "haste,"  
19 but with all the resources that we can move on this to  
20 meet the schedule that we have been discussing with  
21 Jon and Cliff through the public meetings. And so, we  
22 are moving on to get it done.

23 MEMBER RAY: Thank you.

24 Any other questions from members?

25 MEMBER SCHULTZ: I have one more general

1 one. Early in the introduction you mentioned that  
2 EPRI was also doing some site-specific evaluations or  
3 analysis. Could you describe that in a little more  
4 detail, what the outcome of that work will be?

5 MEMBER RAY: You are speaking to EPRI,  
6 Steve?

7 MEMBER SCHULTZ: Well, EPRI or to Cliff or  
8 Jon.

9 MR. MUNSON: So, that work is complete,  
10 actually. They went out to some of those stations  
11 that we showed on the map and made actual measurements  
12 at the stations. They used those measurements to  
13 correct the data in developing the models.

14 MEMBER SCHULTZ: Okay. So, when you said  
15 "site work," I thought you were talking about  
16 translation to sites.

17 MR. AKE: No. No.

18 MEMBER SCHULTZ: Okay.

19 MR. AKE: At this point, that is just to  
20 develop a rock/ground motion. So, we need to trust  
21 this data.

22 MEMBER SCHULTZ: Understood. Thank you  
23 for the clarification.

24 MEMBER RAY: And back out the effects of  
25 the soil amplification from the data that are

1       available.

2                   Other questions?

3                   (No response.)

4                   All right. I believe we are done, Mr.

5 Chairman. I will pass back to you.

6                   CHAIR ARMIJO: Okay. Thank you very much.

7 Thanks for the presentation.

8                   MEMBER RAY: I appreciate it very much.

9 The staff did an excellent job, I think.

10                  CHAIR ARMIJO: Yes, the tutorial on the  
11 seismic was beneficial for me at least. So, thank you  
12 very much.

13                  We are going to break for lunch, and we  
14 are going to reconvene at 1:15.

15                  (Whereupon, the foregoing matter went off  
16 the record for lunch at 12:06 p.m. and went back on  
17 the record at 1:14 p.m.)

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

2 1:14 p.m.

3 CHAIR ARMIJO: Okay. We are going to  
4 reconvene. I have got the gavel; I am going to use my  
5 power.

6 We will now start on the briefing on the  
7 selected chapters of the Safety Evaluation Reports  
8 with Open Items associated with the U.S. Advanced  
9 Pressurized Water Reactor Design Certification and,  
10 then, the Comanche Peak Combined License Application.

11 And John Stetkar will lead us through this  
12 briefing.

13 John?

14 VICE CHAIR STETKAR: Thank you, Mr.  
15 Chairman.

16 We have a lot of material to cover. So,  
17 I am going to try to keep this as brief as I can,  
18 which is not very good for me.

19 The purpose of this meeting is to brief  
20 the Committee on the current status of the reviews of  
21 the US-APWR Design Certification and the Combined  
22 License Application for Comanche Peak Units 3 and 4.  
23 The scope of today's meeting covers Chapters 4, 15,  
24 17, and 19 of the Design Certification, associated  
25 proprietary Topical Reports MUAP-07008, -07010,

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1 -07011, and -07013, and Chapters 4, 13, 15, 16, 17,  
2 and 19 of the Comanche Peak FSAR.

3 In this phase of the review process, the  
4 staff has issued Draft Safety Evaluation Reports, some  
5 with open items, on each of these Chapters and the  
6 Topical Reports. And as usual during these Design  
7 Certification proceedings, we plan to prepare letters  
8 that summarize our interim feedback to the staff on  
9 their reviews.

10 For the record, we held Subcommittee  
11 meetings on these topics in 2012 on July 9th and 10th,  
12 September 20th, and October 18th and 19th, and in 2013  
13 on January 15th and February 21st to 22nd.

14 We had, I would say, numerous questions  
15 during those Subcommittee meetings. MHI and Luminant  
16 have been very responsive to our questions. We get  
17 very good feedback from them. And we are working  
18 actively toward resolution of those issues through our  
19 continuing discussions at the Subcommittee level.

20 For this particular briefing, because of  
21 the scope of what we are covering, I have asked MHI,  
22 Luminant, and the staff to highlight some of the more  
23 focused technical issues that we have discussed and,  
24 of course, the open items from the staff reviews.

25 And with that introduction, I will turn it

1 over to Jeff Ciocco and see if you have any  
2 introductory remarks.

3 MR. CIOCCO: Yes. Thank you.

4 My name is Jeff Ciocco. I am the Lead  
5 Project Manager for the US-APWR Design Certification.  
6 As far as our staff introduction, sitting behind me  
7 and all around me, we brought our technical staff, as  
8 John said, for our four Chapters that we are going to  
9 present to the full Committee, which we are thankful  
10 for: Chapters 4, 15, 17, and 19 and five Topical  
11 Reports, two related to Chapter 4, MUAP-07008,  
12 MUAP-07009, and the three Topical Reports related to  
13 Chapter 15.

14 And with that, I think that is all. We  
15 certainly appreciate the opportunity, and we will have  
16 the opportunity to introduce technical staff as you  
17 have questions during our presentation as well.

18 VICE CHAIR STETKAR: Great. Thanks a lot,  
19 Jeff.

20 And I will turn it over to MHI.

21 Ryan, are you up here?

22 MR. SPRENGEL: It is me.

23 VICE CHAIR STETKAR: It is you.

24 (Laughter.)

25 MR. SPRENGEL: Good afternoon, everyone.

1 Ryan Sprengel, the DC Licensing Manager  
2 for MNES, representing MHI for the Design  
3 Certification here.

4 As it has been acknowledged, we have many  
5 good Subcommittee meetings over the past many, many  
6 months and before that. There have been several  
7 followups, and we are in discussion, some of them  
8 still active with the Subcommittee, providing some  
9 more additional information. And we will acknowledge  
10 that in the presentation here.

11 We do have lots of information to cover.  
12 That was addressed with the four Chapters and the five  
13 Topical Reports. And we will break those out  
14 basically by Chapter and, then, the Topical Reports  
15 associated with those Chapters.

16 Here with me I do have Masatoshi Nagai,  
17 Rebecca Steinman, and Kevin Lynn, and they will be  
18 presenting individual Chapter sections. And then, we  
19 also have additional Mitsubishi representation in the  
20 audience to support any needed discussion.

21 At previous meetings that we have had with  
22 the full Committee covering several Chapters, they are  
23 acknowledged back in 2011 and 2012. And I also wanted  
24 to identify that we do have some significant upcoming  
25 submittals, and they are, again, targeted throughout

1 the presentation, on the Fuel Seismic Closure Plan  
2 tied to Chapter. We have an upcoming QAPD revision,  
3 although it is small. It is just an organizational  
4 change. And then, also, PRA Closure Plan for Chapter  
5 19.

6 So, now I will turn it over to Nagai-san  
7 to go through Chapter 4.

8 MR. NAGAI: Good afternoon.

9 My name is Masatoshi Nagai. I am the  
10 Licensing Engineer for Chapter 4.

11 Chapter 4, titled "Reactor," this  
12 describes US-APWR's fuel system, nuclear and thermal  
13 hydraulic designs and reactor materials and reactor  
14 controls, system functional design.

15 And the ACRS Subcommittee was held in  
16 October 2012. There are about 17 open items in the  
17 Safety Evaluation, and we have identified closure  
18 paths for almost all of them. The open items that are  
19 still open include the ones tied to the two reports  
20 listed on the slides. One of them is Topical Report  
21 MUAP-07034, and the other is Technical Report 08007,  
22 which describes the results of fuel seismic response  
23 analysis.

24 VICE CHAIR STETKAR: Nagai-san, just for  
25 the record for the full Committee, the Subcommittee

1 has not yet met on those issues. We haven't met on  
2 -07034 or the supporting Technical Reports or the  
3 seismic analyses. We don't have it currently on our  
4 agenda, but we won't be discussing those issues in our  
5 letter, in our interim letter.

6 MR. NAGAI: Thank you very much.

7 VICE CHAIR STETKAR: I just wanted to make  
8 sure that we had that on the record.

9 MR. NAGAI: Okay. Thank you very much.

10 So, these open items are still open  
11 because the grid deformation issue we have been  
12 working on. We have had several meetings with the NRC  
13 staff to discuss this issue, and now we are preparing  
14 the Closure Plan for this issue. Other open items  
15 have alignment with NRC staff and a closure path for  
16 them.

17 Okay. MUAP-07008 is a Topical Report on  
18 the fuel rod and assembly design criteria, as well as  
19 the fuel rod design methodology applied to US-APWR  
20 fuel design.

21 ACRS Subcommittee meeting was held in  
22 October 2012, and there was no significant comment  
23 from the meeting. And there are no remaining action  
24 items.

25 CHAIR ARMIJO: I guess I have to take

1 exception to that. I submitted some specific  
2 questions that have not been answered. So, I will  
3 just leave it at that.

4 So, please continue.

5 MR. NAGAI: Okay. Our next one,  
6 MUAP-07009, is also a Topical Report that addresses  
7 methodology for DNB and transient fuel temperature  
8 analysis. The Subcommittee meeting was held in this  
9 January, and no actions remain from the meeting.

10 MR. SPRENGEL: Okay. Now we will proceed  
11 to Chapter 15 with Rebecca Steinman.

12 MS. STEINMAN: Hello. I am Rebecca  
13 Steinman, the License Engineer for Chapter 15, which  
14 covers the transient and accident analyses for the  
15 US-APWR.

16 My first slide here will discuss the DCD.  
17 We had our ACRS Subcommittee meeting last summer in  
18 July, and we had some questions that came out of that  
19 meeting. We provided an additional response to those  
20 questions in December of last year, briefly discussed  
21 those in January of this year, and we have revised one  
22 of those responses based on the discussion in January  
23 of this year. And I believe that those particular  
24 questions from the July meeting are closed at this  
25 point, unless we receive additional -- oh, you have an

1 additional question?

2 MEMBER REMPE: Well, actually, I was going  
3 to wait until you finished the whole slide. But it is  
4 not an issue; I just would like some clarification.  
5 In your response back on one item, you discuss a  
6 penalty with respect to loop seal clearing.

7 MS. STEINMAN: Uh-hum.

8 MEMBER REMPE: And that is the first time  
9 I had seen that occurring. And I would just like a  
10 little more background on when was this penalty taken.  
11 I don't believe it was in your original documentation  
12 for Chapter 15, was it? And so, I don't know if you  
13 want to talk about that today here or if you want to  
14 talk about it at a subsequent meeting.

15 MS. STEINMAN: I think we would like to  
16 talk about that at a subsequent meeting --

17 MEMBER REMPE: Okay.

18 MS. STEINMAN: -- when we have some of the  
19 technical people here who could answer --

20 MR. SCHMIDT: Excuse me. This is Jeff  
21 Schmidt from the NRC.

22 Are you referring to the response to the  
23 ACRS Subcommittee on it? That is not in their  
24 submittal. That is just an example of how, if you  
25 were to penalize the loop seal clearing, what it would

1 look like. They are not saying they should penalize  
2 it. They are just giving you an example of what it  
3 looks like.

4 MEMBER REMPE: Okay. So, if it is okay --  
5 again, stop me if I am saying too much, and I  
6 shouldn't be discussing it here -- but they basically  
7 have said, above a certain break size, that it may not  
8 clear, that a clearing may not occur, right?

9 MR. SCHMIDT: No, they say, at the higher  
10 break sizes -- yes, it is other way around.

11 MEMBER REMPE: Actually, I had it the  
12 other way; I said it wrong.

13 MR. SCHMIDT: Right.

14 MEMBER REMPE: And so, they have taken a  
15 penalty to reflect that, but it will never be -- it is  
16 not required by the staff. It is just --

17 MR. SCHMIDT: It is just an example to  
18 show that, if you were to take a penalty, it still  
19 doesn't affect the overall results.

20 MEMBER REMPE: Okay. Because I know other  
21 vendors sometimes do that.

22 MR. SCHMIDT: Yes. The basic premise is  
23 that the limiting loop seal breaks are so large that  
24 you don't have to artificially stop the loops from  
25 clearing.



1 MEMBER REMPE: Okay.

2 MR. SCHMIDT: And they are just giving you  
3 a sensitivity to that.

4 MEMBER REMPE: Okay. I appreciate having  
5 an opportunity to discuss it. Thank you.

6 MS. STEINMAN: No problem.

7 When we came last July, we had several  
8 open items in Chapter 15. Many of those items have  
9 been closed. GSI-185 was one area where we had been  
10 working. The technical aspects of that have  
11 essentially been closed, although we do still have a  
12 few remaining open items open: boron precipitation  
13 and the effects on long-term core cooling.  
14 Specifically, with the impact due to debris after an  
15 accident is one area where we are still working to  
16 close out the open item.

17 We also have a revision to our Reload  
18 Methodology Report that needs to be reviewed by the  
19 staff to make sure that we are consistent with  
20 everything that is in the current version of Chapter  
21 15.

22 And then, we have several other open items  
23 that are tied to closures of issues, either in another  
24 Chapter or another particular Topical Report. I  
25 provided some examples here.

1           Accumulator is one example where the  
2 Chapter 15 open item simply says, you know, make sure  
3 that the Accumulator Topical Report is approved, but,  
4 obviously, there are technical issues that are being  
5 handled as part of that as well.

6           GSI-191 is another example, both the LOCA  
7 and Non-LOCA Topical Reports -- there are two LOCA  
8 reports, actually -- have open items written against  
9 them, but those are obviously things that we are  
10 working through.

11           So, these are mostly administrative open  
12 items from the purpose of Chapter 15, except for  
13 accumulator. It has the potential to come back and  
14 feed into one of the Chapter 15 analyses.

15           VICE CHAIR STETKAR: Rebecca, are there  
16 open items -- and maybe ask the staff -- on those LOCA  
17 and Non-LOCA Topical Reports?

18           MS. STEINMAN: It is a single statement.  
19 The open item on the LOCA and Non-LOCA Topical  
20 Reports, it is a single open item that I consider to  
21 be an administrative open item in Chapter 15 for the  
22 report.

23           VICE CHAIR STETKAR: I didn't --

24           MR. SCHMIDT: This is Jeff Schmidt.

25           I'm sorry, I didn't really catch the

1 beginning of the conversation.

2 VICE CHAIR STETKAR: Well, Rebecca said  
3 that there are open items on the LOCA and Non-LOCA  
4 Topical Reports, and I didn't recall --

5 MS. STEINMAN: They are administrative, is  
6 what I would consider those open items to be.

7 MR. SCHMIDT: Which?

8 VICE CHAIR STETKAR: Okay. Well, we will  
9 work that out.

10 MS. STEINMAN: We can, okay, yes.

11 MR. SCHMIDT: I don't think there are any  
12 open items on the Topical Reports.

13 VICE CHAIR STETKAR: I didn't think so,  
14 either.

15 MS. STEINMAN: Well, no. No, not on the  
16 Topical Report. It is an open item for the closure of  
17 the Topical Report for receiving --

18 MR. SCHMIDT: Oh, yes. Yes, yes, right,  
19 right.

20 MS. STEINMAN: It is an administrative  
21 open item.

22 VICE CHAIR STETKAR: Oh, okay.

23 MR. SCHMIDT: It is administrative. It is  
24 confirmatory.

25 MS. STEINMAN: It says don't forget to

1 make sure that we take care of accumulator E3,  
2 LOCA/Non-LOCA.

3 MR. SCHMIDT: Yes. Right, right.

4 VICE CHAIR STETKAR: The only reason I  
5 wanted to make sure we understand that is, as a result  
6 of this meeting, we will be issuing a letter report  
7 from the ACRS. With regard to the Topical Reports, if  
8 there are no open items, that letter report will be  
9 our final input to the staff on the Topical Reports.  
10 For any of the other DCD Chapters, we will have  
11 another shot in the next phase of the review --

12 MR. SCHMIDT: Right.

13 VICE CHAIR STETKAR: -- when the SERs with  
14 no open items are issued. So, that is the only reason  
15 I wanted to make sure, from our perspective, that the  
16 Committee understood the status of those Topicals.

17 MR. CIOCCO: Correct, and that is  
18 consistent with what I will say whenever I --

19 VICE CHAIR STETKAR: Okay. Good. Good.  
20 Thanks. Thanks. Good.

21 I was just surprised to hear that --

22 MS. STEINMAN: Well, yes, I consider those  
23 to be administrative open items --

24 VICE CHAIR STETKAR: Okay. Yes. Okay.  
25 Thanks.

1 MS. STEINMAN: -- for keeping track of the  
2 Topical Reports.

3 We do also have a few confirmatory items  
4 that were in the Draft SE, and our intention is to  
5 close those with DCD Revision 4, which for the US-APWR  
6 is currently planned for August of this year.

7 We currently have no outstanding RAIs in  
8 Chapter 15 that are in progress.

9 And that is all I have for the DCD, if we  
10 don't have any other questions.

11 (No response.)

12 All right. Moving on, this slide, there  
13 are three Topical Reports that are associated with  
14 Chapter 15. MUAP-07013 and MUAP-07011 are associated  
15 with the small-break and large-break LOCA,  
16 respectively. Those Topical Reports were discussed at  
17 the July 2012 Subcommittee meeting. We had a lot of  
18 discussion on those two reports at that Subcommittee  
19 meeting. And as a result, MHI prepared responses to  
20 a number of questions. Those responses were submitted  
21 to the ACRS in February of this year. Drafts and a  
22 little bit of discussion about those occurred in  
23 January of this year, but they were formally submitted  
24 to the ACRS in February.

25 And one of the outstanding items with

1 respect to those questions is whether or not the ACRS  
2 needs any additional information from us based on  
3 those responses or whether we are ready to move on to  
4 different areas.

5 And, of course, one of the outstanding  
6 issues for both the small-break LOCA and large-break  
7 LOCA Topical Reports is to verify that there is no  
8 impact on these reports from the Accumulator Topical  
9 Report when that report comes to closure.

10 VICE CHAIR STETKAR: And again, for the  
11 benefit of the full Committee, we are not including  
12 that subject in our current letter. We currently have  
13 a Subcommittee meeting scheduled for September, I  
14 believe, on Chapter 6 of the DCD and the Accumulator  
15 Topical Report.

16 MS. STEINMAN: That is correct.

17 VICE CHAIR STETKAR: So, it will be a  
18 while before we get to that.

19 Thank you.

20 MS. STEINMAN: And then, the last Topical  
21 Report that is associated with Chapter 15 is MUAP-010.  
22 That is our non-LOCA Topical Report. That was  
23 discussed at the October meeting last year. We also  
24 received a few questions on that, although the  
25 discussion was a little bit less than what we had for

1 the LOCA Topical Reports. And we submitted responses  
2 to those questions in December of last year. At this  
3 point, we believe that there are no additional actions  
4 for the non-LOCA Methodology Topical Report.

5 That concludes my --

6 VICE CHAIR STETKAR: Do members have  
7 anything else on Chapter-15-related issues?

8 (No response.)

9 If not --

10 MR. SPRENGEL: Okay. The last two  
11 Chapters, 17 and 19, will be covered by Kevin Lynn.

12 MR. LYNN: Thanks, Ryan.

13 I am Kevin Lynn, the Licensing Engineer  
14 for Chapter 17 and 19.

15 We will start with Chapter 17, which is  
16 the quality assurance and reliability assurance. That  
17 chapter has just gone to the ACRS recently, a month  
18 ago, in February, at the end of February. There were  
19 no open items in the SE for Chapter 17. There were  
20 several confirmatory items, but all of those will be  
21 closed when we submit our DCD Revision 4, which, as  
22 Rebecca mentioned, will be in August of this year.

23 There are no current RAIs in Chapter 17.  
24 The only real issue remaining in Chapter 17 is a  
25 potential audit for the DRAP list or the list of risk-

1 significant SSCs. This was discussed at the meeting  
2 in February, mentioned by the ACRS staff.

3 And we had a public meeting with the NRC  
4 staff at the end of March to discuss whether or not  
5 the staff was thinking of going forward with that.  
6 The staff indicated that they did plan to have an  
7 audit related to that, and the audit is proposed for  
8 fall of this year. They plan to provide us a Draft  
9 Audit Plan in May of this year to support that and  
10 give us time to understand what exactly they are going  
11 to look for.

12 So, that is one current issue in Chapter  
13 17. The other item, which Ryan mentioned earlier, was  
14 an upcoming submittal. The QA program description is  
15 an approved Topical Report already in support of  
16 Chapter 17, but we will be revising that in May. And  
17 the only purpose is an administrative, it is an  
18 organizational change within MHI that needs to be  
19 reflected to the QA program description. So, it  
20 shouldn't be anything significant. So, that will be  
21 submitted in May for the staff to review.

22 And then, we will update DCD Chapter 17 to  
23 reflect the newest revision of that. And that,  
24 hopefully, will be part of the Revision 4 of the DCD.  
25 And so, that should resolve that issue.



1 VICE CHAIR STETKAR: You said that change  
2 will be reflected in substance in the Topical, right,  
3 the Topical Report?

4 MR. LYNN: Yes.

5 VICE CHAIR STETKAR: Yes.

6 MEMBER SKILLMAN: What is the  
7 organizational change, please?

8 MR. LYNN: What exactly is the  
9 organizational change?

10 MR. SPRENGEL: It is a -- let's see, how  
11 do I say this? -- there is no impact on any real  
12 functionality within MHI. It is just a renaming of  
13 one of the functional groups within MHI and a slight  
14 change in terms of the organizational kind of tree.  
15 And the QAPD basically spells out the  
16 responsibilities. So, most of the impact is just  
17 because of the naming, changing from the AP Promoting  
18 Department to a new acronym, of course. So, it will  
19 just be updating, basically, the names corresponding  
20 to the new organization name within MHI, but no  
21 functional impacts.

22 MEMBER SKILLMAN: Thank you.

23 MR. LYNN: So, move on to Chapter 19,  
24 which is the PRA and Severe Accident Evaluation. That  
25 was also covered in the ACRS Subcommittee meeting

1 which we had in February of this year.

2           There were several open items. I think  
3 there are about 20 open items in Chapter 19. Since we  
4 just had the Subcommittee meeting, we have not closed  
5 all of those, obviously, since then because it has  
6 been a short time.

7           But several have closed. There are a few  
8 remaining. And I think the staff has those listed in  
9 their presentation. We don't have them listed here,  
10 but we did have a meeting with the NRC staff at the  
11 end of March, a public meeting, to go over each of  
12 those items and discuss the status and the plan,  
13 whether we needed to submit additional material or was  
14 the staff planning on asking a followup, those types  
15 of questions.

16           Based on the results of that meeting, MHI  
17 is going to submit a PRA Closure Plan which will  
18 identify the remaining items that we need to handle  
19 for Chapter 19. So, that Closure Plan will address  
20 the topics discussed on this slide, which are the open  
21 items and confirmatory items from the SE; any other  
22 Chapter 19 RAIs, which at this time there are none  
23 that are separate from the open items; any actions  
24 from our February meeting, ACRS meeting, which  
25 includes question that the staff asked that we were

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1 not able to address at that time. And it will also  
2 address the schedule for the next revision of the PRA  
3 Technical Report, which is MUAP-07030. And so, MHI  
4 will be revising their PRA report and submitting that  
5 to the NRC. And so, the schedule for all of those  
6 activities will be included in this Closure Plan.

7 VICE CHAIR STETKAR: So, this one, of  
8 everything that we are discussing today, is a bit more  
9 in flux than the others.

10 MR. LYNN: Because it is probably the  
11 newest, I guess.

12 VICE CHAIR STETKAR: Yes, yes, yes.

13 MEMBER CORRADINI: Can I ask a question?  
14 What does SE Open mean? Is it what I think it is?

15 MR. LYNN: It is the Safety Evaluation  
16 from the staff, the open items that they identified in  
17 their Safety Evaluation.

18 MEMBER CORRADINI: So, like what?

19 MR. LYNN: I mean, an example would be an  
20 RAI that they asked that we had not adequately  
21 addressed. And so, they considered it an open item  
22 when they performed their Safety Evaluation.

23 MEMBER CORRADINI: Well, I am not a member  
24 of the Subcommittee. So, I guess I am --

25 VICE CHAIR STETKAR: I suspect, Jeff, we

1 will hear about those.

2 MR. CIOCCO: Yes, I will go through --

3 VICE CHAIR STETKAR: Maybe not all of  
4 them.

5 MR. CIOCCO: -- the open items and I will  
6 cover kind of the technical areas of each one --

7 MEMBER CORRADINI: Okay.

8 MR. CIOCCO: -- where we are at status-  
9 wise.

10 MR. LYNN: So, I discussed the Closure  
11 Plan for this area, and that will be submitted at the  
12 end of April of this year. So, the staff will have  
13 that at the end of the month.

14 There are no significant issues remaining  
15 in Chapter 19 that we haven't already identified as  
16 part of this Closure Plan. And so, we feel we have a  
17 path forward, especially after the meeting with the  
18 staff at the end of March.

19 And there is this one note that, when we  
20 covered Chapter 19 at the ACRS meeting, we did not  
21 cover the seismic and containment performance portions  
22 of Chapter 19. As you mentioned earlier, that will be  
23 covered at a separate meeting.

24 So, there was one followup item. We added  
25 a slide here based on our discussion with the NRC

1 staff at the March 28th meeting. We don't necessarily  
2 need to go over this in a lot of detail, but there was  
3 a question from one of the ACRS members about a  
4 comparison of the MAAP code to other codes.

5 And MAAP is the code used by MHI for the  
6 PRA success criteria evaluation. We wanted to point  
7 out that there were some comparisons of MAAP between  
8 other design basis codes used and that was documented  
9 in Table 19.1-15 of the DCD.

10 Also, we provided the NRC staff some  
11 information about EPRI report comparisons involving  
12 MAAP. But, based on the discussion with the NRC, it  
13 is clear that the request of the ACRS is more focused  
14 on a US-APWR-specific comparison.

15 MEMBER REMPE: Right. In fact, I was glad  
16 to have the slides last night because Table 19.1-15  
17 has one entry for WCOBRA/TRAC, and the rest of the  
18 entries are all MAAP. All it has in there is the peak  
19 cladding temperature is below 2200 F.

20 Again, what I am really looking for is  
21 human error occurs. Is there possibly a problem in  
22 the way the MAAP model was constructed? So, I would  
23 like to see the time for it to depressurize to the top  
24 of the core, and to see if that time is similar,  
25 seeing the depressurization -- the pressure is a

1 function of time -- for MAAP versus either WCOBRA or  
2 RELAP, whichever way you want to do it for various  
3 sizes. Okay?

4 MR. LYNN: So, I think we have an  
5 understanding of that issue now, and we are going to  
6 address that as part of the Closure Plan. I think,  
7 also, based on discussions with the NRC staff, they  
8 may be asking, actually, an RAI to address that  
9 information, in which case it will obviously be part  
10 of the Closure Plan for Chapter 19.

11 MEMBER REMPE: Okay. And in fairness to  
12 you, it was a verbal discussion. We didn't write it  
13 down.

14 MR. SPRENGEL: Yes, I think we clearly  
15 understand the request, and we will continue to work  
16 with the staff. Like Kevin mentioned, we do expect an  
17 RAI to be issued, and we will follow through with that  
18 with the staff.

19 MEMBER REMPE: Okay. Thank you.

20 VICE CHAIR STETKAR: Thank you.

21 MR. SPRENGEL: That is the end of our  
22 presentation.

23 VICE CHAIR STETKAR: Do any of the members  
24 have any questions for MHI on any of these Chapters?  
25 I know it went pass pretty quickly for those of you

1 who have not slogged through the Subcommittee  
2 meetings.

3 (No response.)

4 If not, I would like to thank you. You  
5 have assembled the material very efficiently, as  
6 always. We appreciate that a lot.

7 We will have the staff come up for the DCD  
8 review. We are going to have a little bit of musical  
9 chairs here today because of the COL, DCD, and  
10 different staff members involved in each of the  
11 reviews.

12 Jeff, are you ready?

13 MR. CIOCCO: I am ready. So, the musical  
14 chairs is really singular here. It is one chair.

15 (Laughter.)

16 VICE CHAIR STETKAR: That is what I like  
17 to see, a manager who is intimately involved to the  
18 extent you can handle it.

19 MR. CIOCCO: Absolutely not. Because we  
20 have our technical staff here who actually do the  
21 reviews and write the SERs and really do the heavy  
22 lifting, and they are all here to support me. So,  
23 that is why I can be up here singularly.

24 MEMBER CORRADINI: But they are not up in  
25 front with you.

1 MR. CIOCCO: No, they are not. They are  
2 smarter than I am.

3 (Laughter.)

4 Okay. My name is Jeff Ciocco. I am the  
5 Lead Project Manager for the US-APWR Design  
6 Certification.

7 Thank you for having us.

8 I am going to go through where the staff  
9 is in relation to the current status on Chapters 4,  
10 15, 17, and 19. I will be giving you a non-  
11 proprietary presentation. Obviously, all the material  
12 behind this, the open items, is mostly proprietary  
13 information, which you have all our Technical Reports,  
14 the SERs with Open Items, Technical Reports, RAIs, et  
15 cetera.

16 Okay. On slide 2, what I thought is to  
17 kind of start with where we are as far as our entire  
18 Design Certification review. We are making  
19 significant progress in our review. What you see here  
20 on the slide is slightly different from what you have  
21 in your handout. There is one correction made, and  
22 that is Phase 6, the final SER with No Open Items.  
23 The correct date is September 2015. Your handouts,  
24 which I noticed this morning, have September 2016.  
25 Phase 6 will be completed before the rulemaking is

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1 completed. So, let's note that for the record, and I  
2 will give Girija this presentation for the record.

3 So, we are making significant progress.  
4 This schedule was last updated about back in February.  
5 Based on our critical path for this licensing review,  
6 it is the seismic and structural areas in Chapter 3.  
7 We are looking to give you a presentation on Chapter  
8 3, except 3.7, 3.8, to the ACRS Subcommittee later  
9 this year, I think in October. And then, we will come  
10 back and present Chapter 3.7 and 3.8 as well as the  
11 seismic portion of Chapter 19 and the containment  
12 portion, which MHI talked about back with 3.7, 3.8.

13 So, just going through the schedule  
14 briefly, Phase 1 is completed. That is where we  
15 basically do the reviews and write the first round of  
16 RAIs.

17 Next, we have, actually, three phases  
18 going on simultaneously. Phases 2, 3, and 4 are going  
19 on in parallel. As far as Phase 2, there are  
20 essentially six Chapters which we are completing now.  
21 We have taken, I believe, 13 Chapters through the  
22 ACRS, including the four today. So, we will have six  
23 Chapters still to complete in Phase 2: Chapters 1; 3;  
24 6, which is our sump design, the biggest portion;  
25 Chapter 7, digital I&C, which is coming down in two

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1 weeks to the Subcommittee; Chapter 14 and Chapter 18,  
2 which is the human/systems interface and human factors  
3 engineering. We still need to schedule that date.  
4 And then, we also have the aircraft impact assessment  
5 which staff is working on, as well as the Fukushima  
6 evaluation.

7 VICE CHAIR STETKAR: Yes. We may  
8 schedule, just for the record, another Subcommittee  
9 meeting specifically on GSI-191 to tie together all of  
10 the bits and pieces of that.

11 MR. CIOCCO: Okay.

12 VICE CHAIR STETKAR: I haven't decided  
13 that yet.

14 MR. CIOCCO: Okay. Very good.

15 So, Phases 2, 3, and 4, Phase 2 is  
16 certainly where the majority of the work goes. We try  
17 to make sure, whenever we do have open items coming  
18 out of Phase 2, that we have a path to closure; we  
19 know how we are going to close it. So, when we come  
20 out of Phase 4, we have an Advanced SER with No Open  
21 Items. We will address your issues as well whenever  
22 we come back in Phase 5 to the ACRS.

23 So, basically, within the next two years  
24 is really when we expect to get the majority or all of  
25 our technical work done on the project through the end

1 of Phase 4. Phase 5 is coming through here. And  
2 then, we will write the final SER and, then, go into  
3 the rulemaking phase and propose in final rulemaking.

4 VICE CHAIR STETKAR: Before you get into  
5 more details of the review, Jeff, if questions do come  
6 up, in particular, on the Topicals because those are  
7 proprietary, that you feel you need to respond to with  
8 proprietary information, we can close the meeting. I  
9 would like to hold those until the end, so we don't --

10 MR. CIOCCO: Okay. Certainly.

11 VICE CHAIR STETKAR: -- run into  
12 open/close, open/close. I don't know whether any  
13 will, but I just wanted to alert you to the fact that  
14 we can do that.

15 MR. CIOCCO: Okay. That is good. And  
16 the way that I have done my presentation, I kind of,  
17 in ascending order, Chapters 4 through 19, and then,  
18 I had the five Topical Reports at the very end. MHI  
19 did tie to the Chapters.

20 Okay. So, that is where we are schedule-  
21 wise, ending up in February 2016.

22 Next, on slide 3, I will just kind of tell  
23 you that we have issued our Safety Evaluation Reports.  
24 Since the last full Committee, we now have these next  
25 four Chapters, 4, 15, 17, and 19, which have all been

1 through the Subcommittee. We certainly are very  
2 interested in getting your full Committee interim  
3 letter, if you will, on these Chapters, as well as our  
4 Topical Reports.

5 There are five Topical Reports. I think  
6 John summarized those at the beginning. Two related  
7 to Chapter 4, three related to Chapter 15. The FINES  
8 Topical Report, we don't have a date yet, whenever  
9 that is going to be presented to the Committee. So,  
10 we are seeking your approval on the Topical Reports as  
11 well.

12 Next, I will start with Chapter 4, kind of  
13 give you an idea of where we are. Yes?

14 VICE CHAIR STETKAR: Just be careful with  
15 your paper.

16 MR. CIOCCO: Okay.

17 VICE CHAIR STETKAR: When it hits that  
18 microphone --

19 MR. CIOCCO: Okay. Thank you.

20 VICE CHAIR STETKAR: -- it really creates  
21 havoc over here. Thanks.

22 MR. CIOCCO: Sure.

23 On Chapter 4, we are certainly in  
24 agreement with Mitsubishi on the remaining work. This  
25 addresses the fuel system, nuclear and thermal

1       hydraulic design, the reactor materials, and the  
2       reactivity control system functional design.

3               The first two items are what MHI presented  
4       in relation to the fuel seismic response issue. The  
5       Topic Report is the FINES, the Fuel Seismic Analysis,  
6       as well as the Technical Report MUAP-08007. Those  
7       will be addressed. As MHI talked about, they are  
8       working on a Closure Plan now for the Fuel Seismic  
9       Analysis.

10              An open item which is related to the  
11       RAI 994-7007 is a new RAI that we issued since our  
12       Subcommittee meeting. I have a copy I can give  
13       Girija. It has to do with the RTDP, the Revised  
14       Thermal Design Procedure, and the DNBR limit. We  
15       wrote an RAI. We saw some inconsistencies, we  
16       thought. We wanted some explanation from MHI. MHI  
17       has given us a response on March 19th, which is  
18       currently under staff review. It is a proprietary RAI  
19       response. So, we will certainly address this whenever  
20       we come back in Phase 5. But, in the meantime, I can  
21       give Girija a copy of the RAI and the RAI response.

22              So, that is really where we are at. The  
23       main work is in the fuel seismic response area, those  
24       two open items.

25              And the numbers that you see here are tied

1 directly into the Safety Evaluation Report. You will  
2 see those numbers, and each open item is tied to an  
3 RAI number as well.

4 Okay. The next I have is Chapter 15. It  
5 is the transient and accident analysis. We presented  
6 in July of 2012 to the Subcommittee. It addresses the  
7 analysis of the plant's responses to postulated  
8 disturbances and postulated equipment failures or  
9 malfunctions.

10 We see it as pretty much three open items  
11 are remaining. The first one is really a consistency,  
12 as Mitsubishi talked about it. It is with the  
13 Technical Report. It is the reload methodology. MHI  
14 is currently submitting very soon. It will be  
15 Revision 3 of this Topical Report, and it is for  
16 consistency.

17 The next two, as MHI indicated, are about  
18 the boron. It is the timing of the boron  
19 precipitation when we have continued operation of the  
20 ECCS and the borated water from the refueling water  
21 storage pit to remove decay heat and to keep the core  
22 subcritical. We have two open items regarding the  
23 precipitation, and I have the RAI questions there.

24 So, staff are still working on these issues. We  
25 are doing an internal analysis as well, and we will

1       come back whenever we see you in Phase 5 with this  
2       issue closed, we expect. And then, as MHI mentioned,  
3       they have other responses to the specific Subcommittee  
4       questions. So, we think we have a very narrow focus  
5       left on Chapter 15.

6               Next is Chapter 17. We came to the  
7       Subcommittee back in February, along with Chapter 19.  
8       Chapter 17 addresses the quality assurance and the  
9       reliability assurance. As MHI said, and we agree,  
10      there are no open items. MHI is going to update the  
11      Quality Assurance Program Description, the QAPD  
12      document, because of the organizational changes. And  
13      staff is going to perform an audit of the Reliability  
14      Assurance Program related to the identification of the  
15      risk-significant system structures and components. We  
16      want to look at the processes used by the expert  
17      panel. So, we are going to go and do an audit of  
18      that.

19             Okay. And then, finally, I am going to  
20      give you the status of Chapter 19, the probabilistic  
21      risk assessment and severe accident evaluation. We  
22      were here, along with Chapter 17, back in February  
23      2013.

24             As MHI said, they are currently writing  
25      the PRA Closure Plan, which is going to have a lot of

1 information for us. I'm sorry, slide 7. So, whenever  
2 we get that Closure Plan, we are going to really see  
3 where we are at in regards to the open items.

4 As MHI said, we had the public meeting on  
5 March 28th to go over all of these open items. And I  
6 will kind of give you a status of where we are on each  
7 of these technical areas, just kind of a high-level,  
8 because we do expect to be issuing additional RAIs in  
9 several of these technical areas.

10 VICE CHAIR STETKAR: Jeff, before you get  
11 into the details, MHI mentioned that part of the  
12 closure plan -- and I don't see it in your slides  
13 here, but I might have missed it -- they are going to  
14 be issuing another revision of the PRA itself.

15 MR. CIOCCO: Yes, they are.

16 VICE CHAIR STETKAR: Okay.

17 MR. CIOCCO: I think it is Rev 4.

18 VICE CHAIR STETKAR: Yes, it would be Rev  
19 4.

20 MR. CIOCCO: Yes.

21 VICE CHAIR STETKAR: Do you have any idea  
22 what the timing of that is? Or you haven't worked out  
23 the --

24 MR. CIOCCO: Well, I think in the Closure  
25 Plan, MHI is going to identify --



1 VICE CHAIR STETKAR: Okay.

2 MR. CIOCCO: I mean, MHI is --

3 VICE CHAIR STETKAR: They are still  
4 working on that?

5 MR. CIOCCO: -- going to make their  
6 commitments as to when it is going to come in, but we  
7 will certainly consider that when we look at the  
8 overall timing of the completion of Phase 4, that we  
9 get the latest revision to the PRA far enough in  
10 advance of our completion of the --

11 VICE CHAIR STETKAR: Yes, that is a bit of  
12 the concern.

13 MR. CIOCCO: -- SE in Phase 4. So, maybe  
14 Ryan wants to --

15 VICE CHAIR STETKAR: It should twist  
16 (referring to microphone).

17 MR. SPRENGEL: This is Ryan Sprengel.

18 Through our discussions with the staff,  
19 our main goal of the upcoming PRA revision is to  
20 include as much as we can, obviously, and then, also,  
21 support their review schedule.

22 VICE CHAIR STETKAR: Okay.

23 MR. SPRENGEL: So, through our  
24 discussions, we have identified May of 2014 as our  
25 current --

1 VICE CHAIR STETKAR: '14?

2 MR. SPRENGEL: -- yes, as our current  
3 target date for that submittal.

4 VICE CHAIR STETKAR: Okay.

5 MR. SPRENGEL: So, this is part of Chapter  
6 19's Phase 4.

7 VICE CHAIR STETKAR: I was going to say,  
8 so that clearly moves it into Phase 4 space.

9 MR. SPRENGEL: Yes.

10 VICE CHAIR STETKAR: Okay. Thanks.

11 MR. CIOCCO: Okay. So, if you look back  
12 at the schedule, that is before the completion of  
13 Phase 4. So, what do I have as a date for Phase 4?  
14 It is February of 2015.

15 VICE CHAIR STETKAR: Yes.

16 MR. CIOCCO: So, it is far in advance of  
17 the completion of that. Chapter 19 will probably be  
18 one of the later Chapters to finish in Phase 4.

19 And those dates are the completion dates  
20 of a particular phase. Everything is finished, is  
21 staggered up to that date.

22 All right. So, getting into the open  
23 items on Chapter 19, the first of the PRAs, success  
24 criteria. The issue is the systematic investigation  
25 to demonstrate the robustness of the assumed PRA

1 success criteria. As a result of the March 28th  
2 meeting, MHI is going to provide a revised RAI  
3 response, and there is certainly a potential for  
4 followup RAIs from the technical staff in that area.

5 The second open item is the treatment of  
6 the I&C, Instrumentation and Controls, and software  
7 for the common-cause failures. As a result of the  
8 public meeting, MHI is going to provide a revised RAI  
9 response, and we expect potential followup RAIs in  
10 that area as well.

11 The next slide, verification of the PRA,  
12 technical adequacy in accordance with the PRA  
13 standards. The same with this one, RAI 967-6790, MHI  
14 is going to provide a revised response as an outcome  
15 of the meeting and our discussions with them. And we  
16 have a potential followup RAI in that area as well.

17 The next technical area is the hydrogen  
18 buildup in the RWSP to clarify modeling of the  
19 DC-powered hydrogen igniters in the PRA. In this  
20 case, we haven't seen the official response. MHI is  
21 going to give us a date soon when they are going to  
22 submit the official response. Staff is going to  
23 review it for its acceptability.

24 And I think all of the remaining open  
25 items are regarding the low-power shutdown. First is

1 the emission of the LOCAs when the refueling cavity is  
2 flooded and the temporary fuel racks used during the  
3 plant Operational Stage 5, 6, and 7. Followup RAIs in  
4 this area certainly, and they may actually occur in  
5 some of the other Chapters as well.

6 Next is the auto-isolation function of the  
7 RCS letdown on the low hot leg level and prevention of  
8 vortexing. This is also tied to Section 547, which is  
9 the RHR vortexing. We have an issue that we are  
10 working out there as well. So, this issue is also  
11 open with our Reactor Systems. It is kind of there is  
12 an ongoing dialog with folks in Chapter 5 regarding  
13 Section 547.

14 In that area --

15 MEMBER REMPE: So, Jeff, are you done with  
16 Chapter 19 yet or you have another slide, don't you?

17 MR. CIOCCO: I have one more slide.

18 MEMBER REMPE: Go ahead and finish.

19 MR. CIOCCO: Yes.

20 MEMBER REMPE: And then, I have a  
21 question.

22 MR. CIOCCO: Oh, sure. And three more on  
23 the low-power shutdown that we have open items.

24 Next is the auto-isolation of the letdown  
25 on the low hot leg level, the manual isolation. For

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1 RAI 924-6352, MHI is going to provide a revised  
2 response, and we expect potential followup RAIs in  
3 there as well.

4 Next is the feasibility of the closed  
5 containment during reduced inventory operations,  
6 consistent with GL 88-17. Staff expects to issue an  
7 RAI on this one soon. And it will be related to  
8 probably a follow-on RAI, 899-6281.

9 And then, our last one that I have listed  
10 here, it is the lack of a tech spec for the standby  
11 RCS injection and containment closure during the  
12 reduced inventory operation. This tied to the  
13 Criterion 4 in 50.36 on the tech specs.

14 Staff actually wrote this up as a letter,  
15 issued a letter to MHI on February 28th, in regards to  
16 the tech specs that we are asking for. This actually  
17 has tentacles in Chapter 16. There is an RAI, as well  
18 as one in Chapter 19. MHI is going to provide a  
19 response to us at the end of April of this year, April  
20 30th, regarding the tech spec issue, and in response  
21 to our letter to MHI.

22 MEMBER BLEY: Mr. Stetkar, once all of  
23 these things are closed, is this going to come up  
24 again in the Subcommittee?

25 VICE CHAIR STETKAR: Yes. Well, that is

1 one of the reasons -- we will need to talk to the  
2 staff and MHI about, I am expecting at least one more  
3 Subcommittee meeting on Chapter 19.

4 MEMBER BLEY: Okay.

5 VICE CHAIR STETKAR: Now the timing of  
6 that, that is one of the reasons I asked about when  
7 Rev 4 of the PRA comes in, because we need to be a bit  
8 careful about having a Subcommittee meeting and, then,  
9 being told that, well, we won't see that until Rev 4  
10 of the PRA. So, we will have to work on that.

11 MR. SPRENGEL: This is Ryan Sprengel  
12 again.

13 I guess the assumption is correct about  
14 our likely next planned Subcommittee meeting would be  
15 following the PRA revision after the end of Phase 4  
16 into Phase 5. But I know that MHI would be willing to  
17 support any additional kind of interim discussions to  
18 discuss --

19 VICE CHAIR STETKAR: Yes, we may want to.

20 MR. SPRENGEL: -- these specific items.

21 VICE CHAIR STETKAR: We will have to talk  
22 among ourselves at the Subcommittee level to decide  
23 whether we want to do that. Certainly, I would expect  
24 one more Subcommittee meeting at a minimum after we  
25 have Rev 4 of the PRA, but, as Ryan said, that is

1 looking like a year and a couple of months from now.

2 MR. CIOCCO: Correct. Yes, staff would be  
3 more than happy to support that, just as we did, I  
4 think, on -- you mentioned the FINES Topical Report,  
5 MUAP-07034, where we don't have the SE done, but I  
6 think we have given you probably at least two  
7 informational briefings --

8 VICE CHAIR STETKAR: That is right.

9 MR. CIOCCO: -- to the Subcommittee on  
10 that topic, on the Topical Report.

11 VICE CHAIR STETKAR: And it has been the  
12 same; the accumulator also, we have had a couple of  
13 informational --

14 MR. CIOCCO: Yes, and the accumulator,  
15 certainly. So, we would certainly entertain that.

16 VICE CHAIR STETKAR: MHI and the staff  
17 have been very accommodating in terms of setting up  
18 meetings for us.

19 MR. CIOCCO: And I see our Branch Chief,  
20 Lynn Mrowca, shaking her head back there as well,  
21 supporting Chapter 19.

22 VICE CHAIR STETKAR: Good. Thank you.

23 MR. CIOCCO: Yes. You're welcome.

24 MEMBER REMPE: To follow up, then, on  
25 Chapter 19 also, I heard MHI say today that the staff

1 will be issuing an RAI about comparisons of MAAP  
2 depressurization results. And I just wanted to hear  
3 that was true from the staff also.

4 MR. CIOCCO: Yes, yes, yes. Let's say  
5 yes. Yes.

6 VICE CHAIR STETKAR: Lynn, you have come  
7 up to the microphone.

8 MEMBER REMPE: Yes, that was my  
9 understanding from informal meetings.

10 MR. CIOCCO: We will, yes. The answer is,  
11 yes, we will, yes. And that is a good point. MHI  
12 covered it in its slides. I just listed the open  
13 items that were in our SER at the time, but we will  
14 follow up with a specific public RAI --

15 MEMBER REMPE: All right. Thank you.

16 MR. CIOCCO: -- on that topic.

17 So, that is all that I have for Chapter  
18 19.

19 Next, I go through the Topical Reports.  
20 As MHI said, these, MUAP-07008, which is the Fuel  
21 Design Topical Report on the FINE code, we don't have  
22 any issues to be discussed. It is an SER. We don't  
23 have any open items identified. And the same with the  
24 thermal design methodology, MUAP-07009, which is the  
25 VIPRE code.

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1 CHAIR ARMIJO: Jeff, related to  
2 MUAP-07008, I would like to get on the record  
3 repeating that, on the issue of a potential for PCI  
4 fuel failures during AOOs, there was quite a bit of  
5 discussion during the Subcommittee meetings.

6 MR. CIOCCO: Yes, sir.

7 CHAIR ARMIJO: I asked some very specific  
8 questions, which I provided also in writing. And I  
9 have yet to receive any response on that. So, as far  
10 as I am concerned, I haven't gotten my questions  
11 responded to.

12 MR. CIOCCO: Okay. We can -- Jeff, do you  
13 want to talk about the PCI at all?

14 I know we had that discussion at the  
15 Subcommittee. When you say "in writing," are you  
16 talking about a letter to the staff or --

17 CHAIR ARMIJO: I provided some input to  
18 Girija and --

19 MR. CIOCCO: Yes.

20 VICE CHAIR STETKAR: This is one of those  
21 transmittals, you know, that we have had at the  
22 Subcommittee level.

23 MR. CIOCCO: Oh, okay. Okay.

24 CHAIR ARMIJO: Yes.

25 MR. CIOCCO: Yes, and we did get your

1 White Paper. There was a White Paper, I think.

2 CHAIR ARMIJO: Yes, that was just  
3 background.

4 MR. CIOCCO: Yes.

5 CHAIR ARMIJO: But the specific questions  
6 were very short and sweet, you know, asking for some  
7 specific information, which I believe MHI already has.  
8 They had to do this. But it was never responded to.  
9 And so, I am just telling you I take exception to that  
10 statement. I don't need to hold everybody up on that.

11 MR. CIOCCO: Okay. No, no, no.

12 MR. SPRENGEL: Okay. Real quick, this is  
13 Ryan Sprengel.

14 I would like to address that we did follow  
15 up on the question. And our followup was that we  
16 could not proceed with any analysis because there was  
17 no existing guidance nor criteria to perform the  
18 evaluation. And I guess now I would turn it over to  
19 any staff followup. That was our response. So, we  
20 have followed up and --

21 VICE CHAIR STETKAR: Yes, we did, in our  
22 February meeting --

23 CHAIR ARMIJO: Well, a response that says  
24 go pound sand is not an adequate response -- okay? --  
25 at least not to me.

1 (Laughter.)

2 So, I consider it not responded to. So,  
3 I just want to get that on the record.

4 MR. CIOCCO: Okay.

5 MR. SCHMIDT: Yes, I mean, we have looked  
6 into some of the concerns, and we are prepared to talk  
7 about them. I am not sure this is the right forum.  
8 But we have done some FRAPCON calculations against the  
9 criteria that we got from Research. And basically,  
10 what we are showing is the stresses are below for  
11 AOOs, for --

12 CHAIR ARMIJO: Well, see, that would have  
13 been very helpful.

14 MR. SCHMIDT: Well, we didn't have it at  
15 the time.

16 CHAIR ARMIJO: Okay.

17 MR. SCHMIDT: We have done it since our  
18 last Subcommittee meeting.

19 CHAIR ARMIJO: Okay.

20 MR. SCHMIDT: So, if you want to get into  
21 the details of that --

22 VICE CHAIR STETKAR: I was going to say,  
23 maybe what we can do on this, so we don't take up  
24 necessarily the full Committee's time today, is to --  
25 I don't know what the schedule is for the Seismic

1 Topical Report on the fuel. We don't have a  
2 Subcommittee scheduled for that.

3 MR. SCHMIDT: This is Jeff Schmidt again.

4 We are just going to get the Closure Plan  
5 at the end of this month. So, I am not sure what  
6 the --

7 VICE CHAIR STETKAR: Yes, okay. So, that  
8 is going to be out in the future. We may want to  
9 allocate an hour or two, or whatever it would take, at  
10 one of our upcoming Subcommittee meetings to try to  
11 get closure on this.

12 CHAIR ARMIJO: Yes, close that out.

13 VICE CHAIR STETKAR: It is just a matter  
14 of getting the right people together. So, let's try  
15 to handle that at the Subcommittee level first and see  
16 where we go from there.

17 CHAIR ARMIJO: Okay.

18 MR. SPRENGEL: I guess, respectfully, I  
19 don't think this is a US-APWR-specific Subcommittee  
20 issue.

21 CHAIR ARMIJO: No, you are correct. It  
22 has got a lot of generic -- it is generic. But I  
23 think it is amenable. And frankly, I thought you had  
24 the opportunity to provide a pretty clean answer, if  
25 you had actually tried. But you didn't.

1 And it looks like the staff is addressing  
2 the problem. I haven't seen their results. Maybe  
3 they can close it out.

4 MR. SCHMIDT: Well, this is Jeff Schmidt  
5 again from the NRC.

6 You know, I will say, to Ryan's point, you  
7 know, the criteria is not well-established. I mean,  
8 we attempted to establish our criteria based on  
9 experimental data. It is not in our regulatory  
10 guidance right now, but we did try to make an effort  
11 to evaluate it as best we could.

12 CHAIR ARMIJO: Yes, I just want to see it.  
13 You know, I have yet to see any --

14 MR. SCHMIDT: Understandable.

15 CHAIR ARMIJO: Yes.

16 MR. CIOCCO: So, I guess whenever we come  
17 back with the FINES Topical Report, SE, or at some  
18 other time --

19 VICE CHAIR STETKAR: Well, it depends on  
20 the timing. I mean, I don't want this necessarily to  
21 be lingering out for a long time.

22 MR. CIOCCO: Yes.

23 VICE CHAIR STETKAR: It is obviously an  
24 issue of concern that Dr. Armijo has. I think we may  
25 have a path forward to getting it resolved. We don't

1 need to discuss it --

2 CHAIR ARMIJO: I am sure we do. I am sure  
3 we do, but --

4 VICE CHAIR STETKAR: -- here at the full  
5 Committee, but it is obviously something that we will  
6 need to follow up on.

7 MR. SPRENGEL: Okay. MHI will support any  
8 additional discussion, but I hesitate to schedule that  
9 as part of a US-APWR-specific discussion. We should  
10 also include other industry representatives.

11 VICE CHAIR STETKAR: We appreciate that.

12 CHAIR ARMIJO: It is a good suggestion.

13 All right. Let's move on.

14 MR. CIOCCO: All right. So, and then,  
15 finally, we have the three Topical Reports on the non-  
16 LOCA, large-break LOCA, and small-break LOCA. We have  
17 no issues to discuss on any of these. You have the  
18 Safety Evaluation Reports on all three of these. And  
19 with your approval, we would certainly go final with  
20 our SE and get an approved Topical Report on these.

21 And I think that concludes my presentation  
22 on the four Chapters and the five Topical Reports.

23 VICE CHAIR STETKAR: Any members have any  
24 questions of the staff? And again, I will reiterate,  
25 in particular, on the Topical Reports because our

1 letter, this letter is our only opportunity to weigh-  
2 in on the Topicals.

3 CHAIR ARMIJO: That is why I raised my  
4 point.

5 VICE CHAIR STETKAR: Anything else?

6 (No response.)

7 If not, thank you, sir.

8 MR. CIOCCO: Okay. Thank you.

9 VICE CHAIR STETKAR: And we will have  
10 Luminant come up and hear about the COL.

11 Don, it is yours.

12 MR. WOODLAN: All right. Thank you.

13 You know, we took two people. I can't run  
14 slides and talk at the same time like Jeff does it.

15 Good afternoon.

16 My name is Don Woodlan. I am the  
17 Licensing Manager for Luminant for the new-build  
18 projects.

19 We are here to talk about six Chapters,  
20 Chapters 4, 13, 15, 16, 17, and 19, and to update the  
21 full Committee on the status of the reviews thus far.

22 Next slide, please.

23 The agenda: we will have a brief  
24 introduction, and I will kind of summarize overall  
25 where we stand in the project and the ACRS briefings.

1 And then, four of the Chapters, there were some  
2 discussions during the Subcommittee that I am just  
3 going to identify what the discussions were. We  
4 really didn't identify anything we thought were  
5 significant issues, but there were some discussions,  
6 and I thought it would be worth be mentioning to the  
7 full Committee what those discussions were.

8 Next slide.

9 So, the introduction -- and like I said,  
10 this kind of applies across the board, but with  
11 talking about all these Chapters, it is a good time to  
12 summarize them again.

13 The first bullet talks about incorporated  
14 by reference. We have employed that approach  
15 throughout our application. Many of our Chapters are  
16 essentially just incorporated by reference. Many  
17 others, the bulk of it is incorporated by reference,  
18 but we do add site-specific information.

19 I have already mentioned the Chapters we  
20 are talking about today. We take no departures in any  
21 of those chapters in the Comanche Peak application.  
22 As of now, that is correct for the entire application.  
23 We are not taking any departures. It is one of our  
24 goals in this process to not have any departures.

25 MEMBER SKILLMAN: When you do add site-



1 specific information, is that a Tier 2 departure or is  
2 that a supplement?

3 MR. WOODLAN: It is normally either a  
4 supplement or it is providing COL item information  
5 that the DCD said the Applicant needs to provide this  
6 information.

7 MEMBER SKILLMAN: Okay. Thank you. Got  
8 it.

9 MR. WOODLAN: And there is one other  
10 example there, as information in the standard  
11 application that we call CDI. What does it stand for?  
12 Conceptual Design Information, and it is identified  
13 specifically as typical, but not required information  
14 in the Tier 2, and the Applicant is expected to either  
15 adopt that or provide their own information.

16 VICE CHAIR STETKAR: An example would be  
17 the design of the cooling towers, for example.

18 MR. WOODLAN: Yes.

19 VICE CHAIR STETKAR: The condenser  
20 circulating water cooling towers.

21 MR. WOODLAN: And a lot of numbers. They  
22 had to have a number to make the DCD read well and be  
23 complete, but it varies from plant to plant. So, they  
24 put it in brackets.

25 MEMBER SKILLMAN: Okay. Thank you. Okay.

1 MR. WOODLAN: Thus far on the application,  
2 there are no contingents pending before the ASLB. We  
3 do have a number of confirmatory items during the  
4 review. All of those currently are scheduled to be  
5 included in our Revision 4 of our application, which  
6 we have now scheduled as soon as we get the exemption  
7 approved by the staff, to submit in November of 2013.

8 There are a number of open items during  
9 the Phase 2 review here. Of the Chapters that we have  
10 here, and actually of all the Chapters that have been  
11 through Phase 2 thus far, we have provided responses  
12 to all those open items. Most of them are questions  
13 that came up and were asked by RAIs during the review.  
14 They weren't complete at the time the Safety  
15 Evaluation was written. So, they turned over to open  
16 items.

17 We have responded to all of those except  
18 for two. And for those two, we do have schedules to  
19 provide the information in the future.

20 And as I mentioned earlier, we have  
21 identified no outstanding issues in the SERs for these  
22 Chapters we are covering today.

23 Next slide.

24 Okay. Now I have a couple of slides here  
25 to talk about some of the topics that came up when we

1 did the Subcommittee briefings on some of these  
2 Chapters.

3 Starting with Chapter 13, we talked a  
4 little bit about the projected minimum staffings  
5 versus the actual staffings that we expect to have on  
6 the plant. And we discussed, to some degree, what the  
7 standard practices for Luminant, what kind of  
8 requirements we have in our procedures, and we  
9 compared that to the minimum staffing, so there was a  
10 better understanding of the type of staffing we  
11 project having for Units 3 and 4.

12 As part of that discussion, we talked  
13 about the fire brigade staffing and how that is  
14 included under the minimum staffing discussions, and  
15 how Luminant currently deals with that really on a  
16 shift-by-shift basis, and using procedures to ensure  
17 that we do have the staffing necessary to support the  
18 fire brigade.

19 VICE CHAIR STETKAR: Before you go to  
20 EOPs, one of the items that we did have considerable  
21 discussion, in particular, on the staffing was the --  
22 why am I not remembering; I used to be one -- Shift  
23 Technical Advisor and Radiation Protection Technician.  
24 There you said that your projected staffing, indeed,  
25 was in line with the minimum staffing, that you would

1 have one STA shared between the two units and one on  
2 shift, at least on back shifts anyway, one Rad  
3 Protection Technician shared between the two units.  
4 That is still consistent, is that right?

5 MR. WOODLAN: I am looking for a head  
6 going up and down in the audience, and it is going up  
7 and down. Yes, that is correct.

8 VICE CHAIR STETKAR: Thank you. Nodding  
9 is fine. As long as they are silent, they don't have  
10 to come to the microphone.

11 (Laughter.)

12 Okay. Thanks.

13 MR. WOODLAN: Okay. The third bullet  
14 there under Chapter 13, we talked about the EOPs and  
15 the value and the importance of the EOPs in many  
16 activities, including things like PRA and training,  
17 and our plans and our schedules for developing the  
18 EOPs versus what our minimum commitments are. And  
19 when you just look at the minimum commitments, you  
20 wonder whether there is sufficient time to really  
21 incorporate it and review the EOPs. So, we discussed  
22 what our actual schedules are as compared to the  
23 minimum commitments, so that it was clear that we were  
24 allowing time for those kind of reviews.

25 The next bullet, we talked about -- and I

1 think we will talk about it more later on in the month  
2 -- about firewalls in our cyber security arena and the  
3 use of hardware versus software firewalls to ensure  
4 that our cyber security was adequate. And like I say,  
5 there will be more details later. My understanding is  
6 we rely only on hardware-type firewalls and not  
7 software.

8 MEMBER BROWN: One observation, just to  
9 comment on that, is it is really control of access in  
10 accordance with IEEE 603. I think it is Section 5.9,  
11 where it talks controlling access from various  
12 general, the generic throughout the plant.

13 Cyber security is really dealing with  
14 radiological consequences of this, that, and the other  
15 thing, and preventing whatever, which is tied up in  
16 all that, but the point being that it is a point of a  
17 control of access, just like you control access to the  
18 systems, the instrumentation, et cetera, the  
19 administrative controls, you know, opening doors or  
20 having locks and controls, and all that type of stuff.  
21 Here is a matter of access.

22 So, I don't want to get wrapped up in what  
23 I would call this overall cyber security plan, because  
24 that is not part of a plan; this is part of an  
25 architecture to allow the implementation or execution

1 of control of access at one of the vulnerable  
2 locations.

3 And I am not criticizing because that has  
4 always been the context, but the real point is it is  
5 control of access --

6 MR. WOODLAN: Okay.

7 MEMBER BROWN: -- not necessarily tied up  
8 in all the minutia of whatever your all's cyber  
9 security plan is.

10 Is that crisp enough?

11 VICE CHAIR STETKAR: That is fine, and as  
12 Don well anticipated, I am sure we will have  
13 discussions on this --

14 MEMBER BROWN: Oh, yes. Oh, no.

15 VICE CHAIR STETKAR: -- in two weeks,  
16 under Chapter 7, for the Subcommittee.

17 MR. WOODLAN: And I see people in the  
18 audience taking notes. So, I am sure that will be  
19 considered.

20 VICE CHAIR STETKAR: They are cringing and  
21 running out the door.

22 (Laughter.)

23 MEMBER BROWN: The interest is in ensuring  
24 that the control of access is covered under the  
25 licensing circumstance, so that it cannot be

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1       compromised in some other design circumstance; that's  
2       all.

3                   MR. WOODLAN:   Okay.

4                   MEMBER BROWN:   So, thank you.

5                   MR. WOODLAN:   Okay.

6                   MEMBER BROWN:   I appreciate you including  
7       it on the bullet, though.   You got points for that.

8                   (Laughter.)

9                   MEMBER SKILLMAN:   Don, let me ask this.

10                  MR. WOODLAN:   Yes.

11                  MEMBER SKILLMAN:   The NRC review time for  
12       EOPs, what is the end-state of that review activity?  
13       Does the NRC agree or approve the EOP or just opine on  
14       it?

15                  MR. WOODLAN:   I don't believe I know the  
16       answer.   My memory is they don't approve the EOPs, but  
17       they are provided with a time gap for their review.  
18       And then, they are taken into consideration during the  
19       various inspection and followup activities they do in  
20       that timeframe, when procedures are being written,  
21       operators are being trained, and before we actually  
22       load fuel.   I don't recall that there is any approval  
23       on the EOPs.

24                  VICE CHAIR STETKAR:   Right.   Steve, do you  
25       have anybody here for clarification on that, just for

1 the record?

2 MEMBER BLEY: Or is there any formal  
3 agreement with INPO or something in this area?

4 VICE CHAIR STETKAR: I mean, the EOPs are  
5 included in the plant licensing basis through the tech  
6 specs.

7 MEMBER BLEY: Oh, and they are in the  
8 license, too.

9 MEMBER SKILLMAN: They are part of the  
10 license, yes.

11 MR. MONARQUE: Stand by. We are  
12 conferring with tech staff.

13 VICE CHAIR STETKAR: Okay. Well, we will  
14 wait until you come up, and then, you can answer. You  
15 know, Don can speak slowly for two slides.

16 (Laughter.)

17 MEMBER BROWN: But let me make one other  
18 point on the previous bullet, just to clarify. When  
19 I say IEEE 603, that is because it is under 10 CFR  
20 50.55(hh), which is whatever the rule, not regulations  
21 or Reg Guides, but under the rule, which, then,  
22 addresses, identifies IEEE 603, and that is where the  
23 control of access. Whereas, cyber security comes  
24 under the 73.54, or whatever it is, the Cyber Security  
25 Plan. So, there are two different rules that govern

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1 here. I just wanted to make sure that was clear.

2 VICE CHAIR STETKAR: Now, with regard to  
3 the EOP review time, my recollection from the  
4 Subcommittee meeting was we were sort of  
5 questioning -- I think the official schedule is to  
6 submit them to the staff within, and I might be wrong  
7 on the time, 18 months, is it, of fuel load? And we  
8 were questioning whether that is sufficient timing to  
9 make sure that you have EOPs integrated with your  
10 human factors engineering and all that goes into  
11 training the operators and designing the control room.

12 MEMBER BLEY: And the PRA.

13 VICE CHAIR STETKAR: And the PRA. But  
14 that was the issue that we raised in terms of timing,  
15 not necessarily so much of formal staff  
16 reviews/signoff, as kind of a functional integration  
17 with a lot of other things that need to be done and  
18 closed out by the time they load fuel.

19 MR. WOODLAN: I do know from previous  
20 experience --

21 VICE CHAIR STETKAR: We will hear back.  
22 We will hear back from the staff. There are people,  
23 I am sure, scurrying around.

24 MR. WOODLAN: -- there is a review, and  
25 there is a lot of back-and-forth discussion on them.

1           Okay. I have one more bullet here, and it  
2 really was tied to the other discussions as well. We  
3 got into a discussion on important to safety, which we  
4 have on several different Chapters. In this case, the  
5 discussion was focused around cyber security and how  
6 we were identifying within the scope of cyber security  
7 what is important to safety and how we were  
8 controlling that.

9           I am ready to move to Chapter 16. In  
10 Chapter 16, I only have one bullet, and it really kind  
11 of relates to Chapter 19 as well. We had a good  
12 discussion about how PRA supports the risk-informed  
13 tech specs. And it was apparent to everybody that the  
14 PRA, which is just being presented to get licensed and  
15 the DCD's PRA to get certified, works well for the  
16 licensing and certification process, but doesn't  
17 really support risk-informed tech specs.

18           And so, we had a discussion about what  
19 Luminant is going to do after they get their license  
20 and before they actually start operating to use risk-  
21 informed tech specs in the way of upgrading the PRA.

22           VICE CHAIR STETKAR: And I think upgrading  
23 or enhancing --

24           MR. WOODLAN: Enhancing.

25           VICE CHAIR STETKAR: -- is where a lot of

1 our discussion focused, because there is a requirement  
2 that you need to, if I call it update the PRA, you  
3 need to bring in any site-specific, plant-specific  
4 systems into the PRA as part of the transition from  
5 the Design Certification PRA to whatever you want to  
6 call it, the site PRA.

7 That is one issue, but that was actually  
8 the lesser of the discussion that we had. It was more  
9 updating and enhancing or upgrading and enhancing the  
10 quality of the PRA to support those risk-informed  
11 applications.

12 MR. WOODLAN: And we pointed out that the  
13 steps we intend to follow, the enhancements we intend  
14 to make are still allowed in the methodology document  
15 that is referenced by the tech spec program. So, it  
16 is all there documented.

17 And then, we discussed the schedule that  
18 we plan on using, which really isn't in those  
19 documents.

20 VICE CHAIR STETKAR: For the members who  
21 haven't participated in the Subcommittee meetings,  
22 refresh your memory that this is the only one of the  
23 Design Centers that Luminant has made a commitment as  
24 part of their combined license application to  
25 implement risk-informed technical specifications. So,

1 this is the only one of the Design Centers that we  
2 have seen so far that has that additional emphasis  
3 placed on the PRA, above and beyond just providing the  
4 assurances in Chapter 19 of the Design Certification  
5 and the COLA. So, that is one of the reasons why we  
6 paid a little more attention in this case than in  
7 others.

8 MR. WOODLAN: Okay. I am ready for the  
9 next slide and Chapter 17.

10 We have several discussions there, too,  
11 and they kind of tie to what we were just talking  
12 about on 16, the first bullet. And that is the  
13 ability of the application PRA to support certain  
14 other programs, and we just mentioned risk-informed  
15 technical specifications, but we also talked about, as  
16 the next bullet points out, DRAP and ORAP and  
17 eventually our Maintenance Rule programs, where we do  
18 need up-to-date, plant-specific, enhanced PRAs to  
19 ensure that we are controlling all of those programs  
20 and supporting those programs properly.

21 And then, in the last one, we talked  
22 somewhat about what kind of quality is applied to some  
23 of the non-safety-related SSCs. The discussions stem  
24 from the DRAP program, where it is recognized that  
25 there are some SSCs in the DRAP that are not safety-

1 related. When it is safety-related, we all know  
2 Appendix B will be applied to those components. When  
3 they are not safety-related, it wasn't clear. So, we  
4 had a discussion, and we did point out that we will  
5 have specific quality controls, as appropriate, for  
6 those non-safety-related components.

7 VICE CHAIR STETKAR: And some of the  
8 discussion was back to, let's say, the level of  
9 refinement of the PRA itself; that if the PRA is used  
10 to inform that process -- for example, the main  
11 feedwater system is simply a line item right now,  
12 which is not something going forward from the DRAP to  
13 an implemented operational program that you can  
14 necessarily manage in the real world. Because, you  
15 know, by implication, any vent and drainline off of  
16 any piece of pipe anywhere in the main feedwater  
17 system, as it is currently listed, would be subject to  
18 those additional controls because it is listed in the  
19 DRAP just as main feedwater system. So, we had some  
20 discussion about that, which I think is the genesis of  
21 that --

22 MR. WOODLAN: Yes.

23 VICE CHAIR STETKAR: -- part of the  
24 genesis of that third sub-bullet there.

25 MR. WOODLAN: And we threw around multiple

1 terms like special treatment, automated QA --

2 VICE CHAIR STETKAR: Special treatment,  
3 there is a lot, ORAP, DRAP, RAP, whatever.

4 MR. WOODLAN: Yes.

5 VICE CHAIR STETKAR: Yes.

6 MR. WOODLAN: Okay. Next I have Chapter  
7 19. We had a lot of discussions on Chapter 19, some  
8 of which we have already talked about today. But one,  
9 in particular, was the use of industry standards.  
10 There was a question about, you know, exactly how are  
11 we going to do this PRA, how are we going to do the  
12 enhancements. And we did point out that our  
13 methodology does reference specific industry  
14 standards. We intend on employing those as we do  
15 these enhancements.

16 And then, we also had a discussion on the  
17 LOLA, Loss of Large Area, a very high-level  
18 discussion, but we did discuss Luminant's strategies  
19 and how Luminant has incorporated this already in our  
20 application. We are addressing the issues, and we  
21 have provided a complete product to the NRC, which  
22 will, of course, be enhanced by the Fukushima followup  
23 activities.

24 VICE CHAIR STETKAR: We will have another  
25 Subcommittee meeting scheduled specifically on the

1 post-Fukushima issues once we get that scheduled, and  
2 from the Design Certification, their assessment of the  
3 aircraft impact analysis, which is a security-related  
4 issue.

5 MR. WOODLAN: And that concludes my  
6 presentation, unless the staff wants to talk about  
7 EOPs or wait until their presentation.

8 MR. MONARQUE: We are not ready to address  
9 EOPs.

10 VICE CHAIR STETKAR: Well, you are going  
11 to come up.

12 MR. MONARQUE: Yes.

13 VICE CHAIR STETKAR: We will let the  
14 musical chairs happen.

15 MR. WOODLAN: Okay.

16 VICE CHAIR STETKAR: Any members have any  
17 questions for Luminant, in particular, on any of those  
18 items?

19 (No response.)

20 If not, Don, thank you very much.

21 MR. WOODLAN: Thank you, John.

22 VICE CHAIR STETKAR: More efficient than  
23 normal even, and you are normally very efficient. So,  
24 we appreciate that.

25 We will have the staff come up.

1 And, Steve, you can address the EOPs  
2 first, and then get into your presentation.

3 I do note, while he is doing this, that  
4 the staff is, indeed, multi-talented.

5 (Laughter.)

6 MR. MONARQUE: Good afternoon.

7 My name is Steve Monarque.

8 I want to thank the ACRS full Committee  
9 for giving me the opportunity to present our seven  
10 Chapters today for the Committee. This is our second  
11 presentation before a full Committee with regards to  
12 Comanche Peak.

13 The Chapters I will be presenting today  
14 will be Safety Evaluation Reports with Open Items,  
15 Chapters 4, 13, 15, 16, 17, and 19, including LOLA.

16 And to get back on the question regarding  
17 emergency operating procedures, I need to take it back  
18 as an action item. We will get back to you on that,  
19 because we are still researching that.

20 VICE CHAIR STETKAR: Okay. Thanks.

21 MR. MONARQUE: Thanks.

22 Okay. As I said before, today I am  
23 presenting seven Chapters before the full Committee,  
24 and I have identified significant issues for Chapters  
25 16 and 19 that I want to discuss in detail.



1                   Okay. Chapter 4. Chapter 4 addresses the  
2                   fuel system, nuclear and thermal hydraulic designs,  
3                   reactor materials, reactivity control system,  
4                   functional design. We presented this, our Safety  
5                   Evaluation, to the full Committee last October. This  
6                   was 100-percent IBR, no issues to be discussed.

7                   Okay. Chapter 13, Conduct of Operations,  
8                   addresses organizational structure of Applicant  
9                   training, emergency planning, operational program  
10                  implementation, plant procedures, and cyber security.  
11                  Physical security and fitness for duty are still under  
12                  review. And I should note that Luminant has submitted  
13                  their proposed implementation for the new emergency  
14                  planning rule, and the staff will be evaluating that.

15                  And also, the staff is waiting for  
16                  Luminant to provide their response for Fukushima as it  
17                  relates to emergency planning.

18                  Okay. And we presented Chapter 13, Safety  
19                  Evaluation, to the --

20                  VICE CHAIR STETKAR: Steve, in terms of  
21                  Fukushima, you mentioned emergency planning. Is there  
22                  also Fukushima-related action items, or I don't know  
23                  how they are cast for the Applicants, related to  
24                  thinks like Near-Term Task Force Recommendation 8  
25                  regarding integration of emergency operating

1 procedures, SAMGs, organizational requirements for  
2 multi-unit accidents? Is that covered under Chapter  
3 13, Fukushima issues? I mean, you specifically  
4 highlighted emergency planning.

5 MR. MONARQUE: Correct. I know the  
6 Applicant is going to provide a response.

7 Dan, can you --

8 VICE CHAIR STETKAR: But I was curious how  
9 that NTTF Recommendation 8 topic affected the COL  
10 Applicants, because we do have a COLA for a multi-unit  
11 site here now, 3 and 4.

12 MR. TAKACS: Right. This is Mike Takacs,  
13 Project Manager for 13.

14 I can't answer 8, but for 9.3 --

15 VICE CHAIR STETKAR: 9.3, I get it.

16 MR. TAKACS: You get that, but --

17 VICE CHAIR STETKAR: Yes.

18 MR. TAKACS: -- 8 I can't answer right  
19 now. I will follow up.

20 VICE CHAIR STETKAR: Because, in  
21 principle, that comes under 13, well, I mean  
22 functionally.

23 MR. TAKACS: For the SAMGs?

24 VICE CHAIR STETKAR: Well, EOPs, SAMGs,  
25 and in terms of staffing for multi-unit, because that

1 is also part of 8, right? Well, I mean, it is 8 and  
2 10 and --

3 MR. TAKACS: It is the Near-Term Task  
4 Force, 8, yes, correct.

5 VICE CHAIR STETKAR: Yes, and then 9.  
6 Yes.

7 MR. TAKACS: And I will have to follow up  
8 on that for you.

9 VICE CHAIR STETKAR: Okay. As I said, we  
10 will have a separate Subcommittee meeting to find out  
11 how they are addressing all of the --

12 MR. TAKACS: The 9.3 will be a license  
13 condition, as you know.

14 VICE CHAIR STETKAR: Yes. Yes, that is  
15 clear.

16 MR. TAKACS: Okay.

17 MR. CIOCCO: John, Steve has issued the  
18 RAIs related to the Fukushima Near-Term Task Force.  
19 MHI hasn't submitted its Fukushima evaluation yet.

20 Is that correct, Don?

21 MR. MONARQUE: Well, they haven't  
22 submitted their complete -- go ahead, Don.

23 MR. WOODLAN: I assume you mean Luminant  
24 hasn't submitted it yet.

25 VICE CHAIR STETKAR: Luminant hasn't,

1 correct.

2 (Laughter.)

3 MR. WOODLAN: No, we have not. We  
4 submitted a very high-level, brief response,  
5 recognizing that there were three issues that were  
6 picked up as being issues required to be addressed for  
7 licensing, and we are working on those. We are  
8 supposed to have responses to those as well as kind of  
9 an overall Fukushima evaluation thus far in the August  
10 timeframe of this year.

11 VICE CHAIR STETKAR: Okay. And I hope  
12 Recommendation No. 8 is part of whatever you are  
13 working on.

14 MR. WOODLAN: Well, you probably know that  
15 the Commission and the staff have developed kind of a  
16 sequencing of which ones are to be addressed for new  
17 plants as part of licensing --

18 VICE CHAIR STETKAR: Yes, yes.

19 MR. WOODLAN: -- which ones prior to fuel  
20 load, and things like that. I don't remember where 8  
21 falls.

22 VICE CHAIR STETKAR: Yes, and I honestly  
23 don't remember exactly where that one is in this. So,  
24 thanks.

25 MR. MONARQUE: Okay. With that, I will go

1 to Chapter 15. Chapter 15 addresses the analysis of  
2 the plant's responses to postulated disturbances and  
3 postulated equipment failures or malfunctions. We  
4 presented this to the Subcommittee in July of last  
5 year. This was IBR with the exception of design basis  
6 accident radiological consequences analysis. We do  
7 not have any open items, and I didn't identify any  
8 issues to be discussed today.

9 Okay. I am going out of order now because  
10 I am going to present 16 and 19 at the end, where I  
11 have issues.

12 Chapter 17 addresses the Quality Assurance  
13 and Reliability Assurance programs and the Applicant's  
14 program for implementing 10 CFR Maintenance Rule,  
15 50.65. We presented the Safety Evaluation to the  
16 Subcommittee in February of this year. There are no  
17 issues to be discussed.

18 And LOLA, also large areas of the plant  
19 due to explosions or fires, I gave a synopsis of the  
20 rule in 10 CFR 50.54(hh)(2), where the Applicant has  
21 to develop and implement guidance and strategies  
22 intended to maintain or restore core cooling,  
23 containment, and spent-fuel capabilities associated  
24 with LOLA, Loss of Large Areas of the plant due to  
25 explosions or fire. We presented the Safety

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1 Evaluation to the Subcommittee in February 2013. No  
2 issues were identified.

3 Chapter 16, we identify an issue regarding  
4 implementation of risk-managed tech specs,  
5 Surveillance Frequency Control Program. Comanche Peak  
6 Units 3 and 4 are adopting the risk-managed tech  
7 specs, technical specifications, and Surveillance  
8 Frequency Control Program, using risk information with  
9 specific PRA requirements.

10 Since the Comanche Peak PRA reflecting the  
11 as-built, as-to-be-operated plant will not be  
12 available at the time of the COL issuance, when tech  
13 specs is complete, a tech spec methodology is needed  
14 in accordance with Option 3 of the Interim Staff  
15 Guidance 08, for completing a PRA that is adequate for  
16 risk-managed tech specs and Surveillance Frequency  
17 Control Program applications.

18 Risk-managed tech specs and Surveillance  
19 Frequency Control Programs require programs in the  
20 Comanche Peak tech spec admin control section  
21 referencing the approved NEI Topical Reports 04-10 and  
22 06-09 methodology documents. The Comanche Peak tech  
23 spec methodology is referenced in the tech spec admin  
24 control section along with the two NEI Topical  
25 Reports.

1 Any questions before I go to 19?

2 (No response.)

3 Chapter 19, I have identified two areas  
4 for discussion. The first one is external events.  
5 Reg Guide 1.200, Section 1.2.5, Screening and  
6 Conservative Analysis of Other External Hazards,  
7 Technical Elements, it is recognized that for those  
8 new reactor designs with substantially low-risk  
9 profiles, the quantitative screening value should be  
10 adjusted according to the relative baseline risk  
11 value, consistent with a list of external hazards  
12 identified in ASME/ANS RA-Sa-2009, Appendix 6-1, List  
13 of External Hazards Requiring Consideration.

14 The staff's acceptance of Chapter 19,  
15 External Hazards, will be contingent in part on the  
16 completion of the review of SER COL Chapter 2 and  
17 Chapter 3.

18 VICE CHAIR STETKAR: For those of you who  
19 don't speak all of this stuff, it means you ought not  
20 to screen out something because it is less than 10 to  
21 the minus 6, if your total core damage frequency is  
22 0.5 times 10 to the minus 7.

23 MR. MONARQUE: The last one, the last  
24 issue we brought up, we want to bring up before the  
25 full Committee is application of the risk-informed

1 technical specifications. In response to the staff's  
2 RAI, Luminant has made the following commitments  
3 regarding the use of PRA to support risk-informed tech  
4 specs:

5 Site-specific models will be included in  
6 the first of PRA upgrades.

7 Emergency operating procedures and  
8 detailed design information will be reflected in the  
9 PRA during the second series of PRA upgrades.

10 Uncertainties on PRA model will be  
11 identified and addressed during the PRA upgrade.

12 And peer review will be performed and  
13 findings will be resolved prior to initial fuel load.

14 Okay. The last slide, regarding the risk-  
15 informed tech specs, in its response to the RAI 32-87,  
16 Question 19.3, the Applicant provided the following  
17 statements:

18 "The PRA for risk-managed tech specs must  
19 basically meet Capability Category 2 for the  
20 supporting requirements of the ASME/ANS internal  
21 events at-power PRA standard.

22 "The scope of the PRA model must include  
23 Level 1 plus an early large release frequency.

24 "Contributions from external events,  
25 internal flooding events, and internal fire events

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1 must also be considered.

2 "The PRA for risk-managed tech specs will  
3 be updated to satisfy the PRA technical adequacy  
4 described in the NEI guideline, and will be available  
5 one year prior to fuel load."

6 VICE CHAIR STETKAR: Stephen, because we  
7 haven't faced this type of application before, because  
8 the PRA will be used for risk-informed application,  
9 does the staff review the PRA for its adequacy to  
10 perform, to support that application? In other words,  
11 do you perform a formal review of the PRA? Because in  
12 other Design Centers there are words that say the PRA  
13 must be consistent with as-built, as-operated plants,  
14 consistent with, you know, the procedures, and that  
15 has to be accomplished one year prior to fuel load --

16 MR. MONARQUE: Right.

17 VICE CHAIR STETKAR: -- according to  
18 whatever standards are in place, and all of that.

19 But, at that point, the PRA is only, from  
20 the staff's perspective, as I understand it, the staff  
21 can go audit that PRA, but there is no requirement for  
22 the staff to review the PRA.

23 MR. MONARQUE: Yes.

24 VICE CHAIR STETKAR: Because it is not  
25 actually being used for anything at that point.

1 MR. MONARQUE: We have Lynn Mrowca here,  
2 the Branch Chief.

3 VICE CHAIR STETKAR: Hi, Lynn.

4 MS. MROWCA: Hi.

5 MR. MONARQUE: Go ahead, Lynn.

6 MS. MROWCA: I am Lynn.

7 John, you're right --

8 VICE CHAIR STETKAR: Actually, for the  
9 record, your last name also.

10 MS. MROWCA: For the record, I am Lynn  
11 Mrowca --

12 VICE CHAIR STETKAR: Thank you.

13 MS. MROWCA: -- from the NRC.

14 And that is true, John, that we don't have  
15 any requirements to audit that PRA, but there has been  
16 precedent to perform an implementation inspection  
17 after they do implement the risk-informed tech specs.  
18 So, I think that is one way that we have precedent to  
19 do that, to look at the PRA as it has been  
20 implemented. It doesn't mean that we won't do  
21 something else, but that is a precedent that has  
22 already been set.

23 MEMBER BLEY: Once that PRA is finished,  
24 though, Reg Guide 1.200 requires the same thing, that  
25 they have to do a peer review of the complete base PRA

1 as completed at that point, not rely on the peer  
2 reviews, or whatever, of the DCD PRA which wasn't  
3 complete.

4 MS. MROWCA: That is correct. So, they  
5 will have a peer review.

6 VICE CHAIR STETKAR: But there is no  
7 requirement that the staff, then --

8 MS. MROWCA: No.

9 VICE CHAIR STETKAR: -- independently --

10 MS. MROWCA: That is correct.

11 MEMBER BLEY: But you can audit both --

12 VICE CHAIR STETKAR: Can audit.

13 MEMBER BLEY: -- the peer review and the  
14 PRA itself.

15 MS. MROWCA: Yes, we can audit it when it  
16 is ready.

17 VICE CHAIR STETKAR: Good. Thank you.

18 MEMBER SKILLMAN: Let me ask this, please:  
19 with, if you will, the risk-informed or risk  
20 management tech specs, there is an even heightened  
21 requirement for configuration control in that plant,  
22 such that if there is a physical change or an  
23 operating procedure change or an emergency procedure  
24 change that tilts the risk, what has been assumed to  
25 be acceptable in the tech specs may no longer be as

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1 acceptable as it once was.

2 What consideration has been given to, if  
3 you will, the tightness of the configuration control  
4 programs at the site to ensure that there isn't a  
5 fading of crispness for the accuracy of the risk-  
6 managed tech specs?

7 MS. MROWCA: If Bob Tjader wants to add to  
8 this, fine. But, basically, in their tech specs, they  
9 commit to the NEI documents to provide guidance, and  
10 there are requirements in there for controlling your  
11 configuration, make sure your PRA is updated, those  
12 types of things.

13 MEMBER SKILLMAN: Thank you.

14 MR. MONARQUE: The other thing is I should  
15 add to supplement your answer, we do have a mechanism  
16 in place where they would have to do 50.59 screening  
17 and come in for a license amendment if there was a  
18 configuration change.

19 VICE CHAIR STETKAR: That has a  
20 significant affect on risk --

21 MR. MONARQUE: Right, risk.

22 VICE CHAIR STETKAR: -- under Reg Guide  
23 1.174. Otherwise --

24 MR. MONARQUE: Or they would have to come  
25 in for staff approval.

1 VICE CHAIR STETKAR: Yes, staff approval  
2 only if they have a significant effect on risk, right.  
3 Otherwise, the process is they can make the changes  
4 under a 50.59-like approach, and the staff -- you  
5 know, it is available for audit --

6 MR. MONARQUE: Yes.

7 VICE CHAIR STETKAR: -- but the staff  
8 doesn't review it.

9 MEMBER BLEY: Something I am not clear  
10 about, because I don't know if it is under regulations  
11 or agreements, or where it came up, but over the years  
12 staff has developed, through its contractor labs,  
13 their own PRA models for operating plants that have  
14 been, at least to some extent, validated against the  
15 licensee's own PRAs.

16 For new plants coming along, is there a  
17 requirement or how does this happen for the new  
18 plants? Does it happen for the new plants?

19 MS. MROWCA: Yes. Yes, we have already  
20 been working on development of them. In fact, for  
21 this design, we do have an internal events SPAR model  
22 for the APWR. And as we get closer to fuel load, we  
23 plan to have a full scope here, internal fires,  
24 internal floods, all those SPAR-model modules  
25 available, so that we can use them for the

1 significance determination process in the ROP.

2 MEMBER BLEY: Can you tell us a little bit  
3 about how those get validated against the owner's  
4 PRAs?

5 MS. MROWCA: Well, currently, we haven't  
6 been able to do that. I think for the internal --  
7 well, actually, at fuel load, when we have the site-  
8 specific PRA available, that is when we will do that.

9 MEMBER BLEY: That is a year, at least a  
10 year before fuel load.

11 MS. MROWCA: Yes, we can do it at any time  
12 when they are ready. I mean, our plan is to have  
13 those available prior to fuel load. And so, we could  
14 do that comparison at any time, the benchmarking to  
15 ensure that our SPAR models will give pretty much the  
16 same results as the licensee's --

17 MEMBER BLEY: So, you gain confidence in  
18 their own --

19 MS. MROWCA: Uh-hum.

20 MEMBER BLEY: Okay. Thanks.

21 MR. MONARQUE: Okay. And this concludes  
22 my presentation.

23 VICE CHAIR STETKAR: Anything else for the  
24 staff on Comanche Peak?

25 (No response.)

1 If not, Stephen --

2 MR. MONARQUE: Okay. Thank you.

3 VICE CHAIR STETKAR: -- you covered a lot  
4 of ground very well. And again, I appreciate it.

5 And to everybody this afternoon, you  
6 managed to squeeze an awful lot of information into  
7 more than efficient time management. So, we  
8 appreciate that.

9 Mr. Chairman, it is back to you.

10 CHAIR ARMIJO: Well, congratulations,  
11 John. I think we are well ahead of schedule.

12 We will take a 15-minute break and  
13 reconvene at three o'clock, and we will start on  
14 letter-writing.

15 (Whereupon, at 2:45 p.m., the Open Session  
16 was concluded.)

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# ABWR Fuel LTR – WCAP-17116-P

## Westinghouse BWR ECCS Evaluation Model: Supplement 5 – Application to the ABWR

Presentation to ACRS

04/11/2013



# Agenda

---

- Attendees
- Introduction
- Westinghouse Methodology
- Important Features of ABWR
- ABWR Evaluation Model
- Break Spectrum and Results
- LOCA Methodology Summary
- Response to Question from ACRS Subcommittee Meeting
- Conclusions

# Attendees

---

- Scott Head                      NINA Manager, Regulatory Affairs, STP 3&4
- James Tomkins                NINA Licensing, STP 3&4
- John Blaisdell                Westinghouse
- Robert Quinn                Westinghouse
- Bradley Maurer               Westinghouse

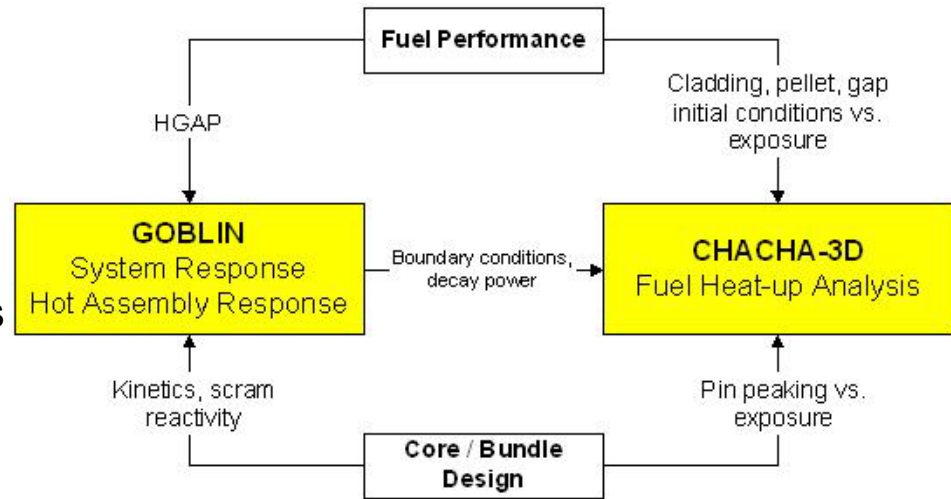
# Introduction

---

- Purpose of the ABWR ECCS Topical
  - Demonstrate that the Westinghouse App. K methodology is acceptable for the ABWR
  - Provide additional qualification
    - Reactor Internal Pump (RIP) model
    - Prediction of dryout

# Westinghouse Methodology

- GOBLIN Code Series
- Appendix K-based Evaluation Model
- Approved in U.S. for BWR/2 through BWR/6
  - Applications include: Columbia, Hope Creek, Quad Cities 1 & 2, Dresden 2 & 3
- Applied in Europe for external loop plants (similar to BWR/2), BWR/6, internal pump designs (similar to ABWR)
  - Applications include Oskarshamn 1, 2 & 3, Barsebäck 1 & 2, Ringhals 1, Forsmark 1, 2 & 3, TVO 1 & 2, and Leibstadt



- **No GOBLIN or CHACHA code changes required for ABWR application**

# Westinghouse Methodology

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- GOBLIN Code Has 4 Main Sections

1. Hydraulic Model – Solves mass, energy and momentum equations together with the equation of state for each control volume. Uses empirical correlations for calculation of pressure drops, two-phase energy flow (drift flux), two-phase level tracking, spray-fluid interaction, and critical flow rate
2. System Models – Includes models for steam separators, dryers, reactor level measurement, reactor trip, depressurization systems, recirculation pumps, and emergency core cooling
3. Thermal Model – Calculates heat conduction and heat transfer from the fuel rods, pressure vessel, and internal structure to the coolant
4. Power Generation Model – Calculates the heat generation due to fission (point kinetics), decay heat, and metal water reaction

# Important Features of the ABWR

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- Recirculation System

- 10 Reactor Internal Pumps (RIPs) vs. 2 external loops / jet pumps
- Lower inertia leads to faster coastdown time constant ( < 1s vs. ~ 5s)

- No Large Breaks Below Top of Active Fuel (TAF)

Break	Area	Elev. Above TAF
BWR Recirculation Line Break (double-ended)	7.23 ft <sup>2</sup>	-16.7 ft
ABWR Steam Line Break (after MSIV isolation)	1.06 ft <sup>2</sup>	20.4 ft
ABWR FW Line Break (vessel side)	0.90 ft <sup>2</sup>	7.6 ft
ABWR RHR Suction Line Break	0.85 ft <sup>2</sup>	5.8 ft
ABWR HPCF Line Break	0.10 ft <sup>2</sup>	3.2 ft
ABWR Bottom Drain Line Break	0.02 ft <sup>2</sup>	-30.0 ft

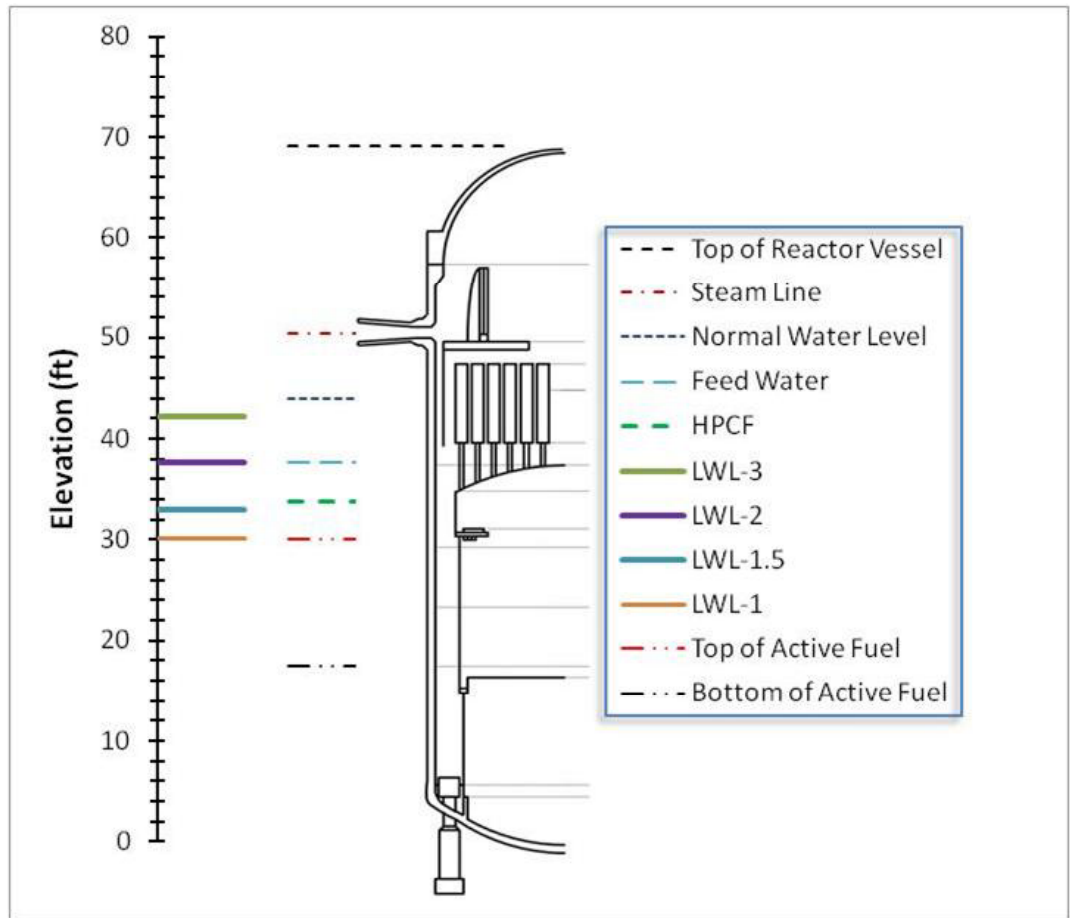
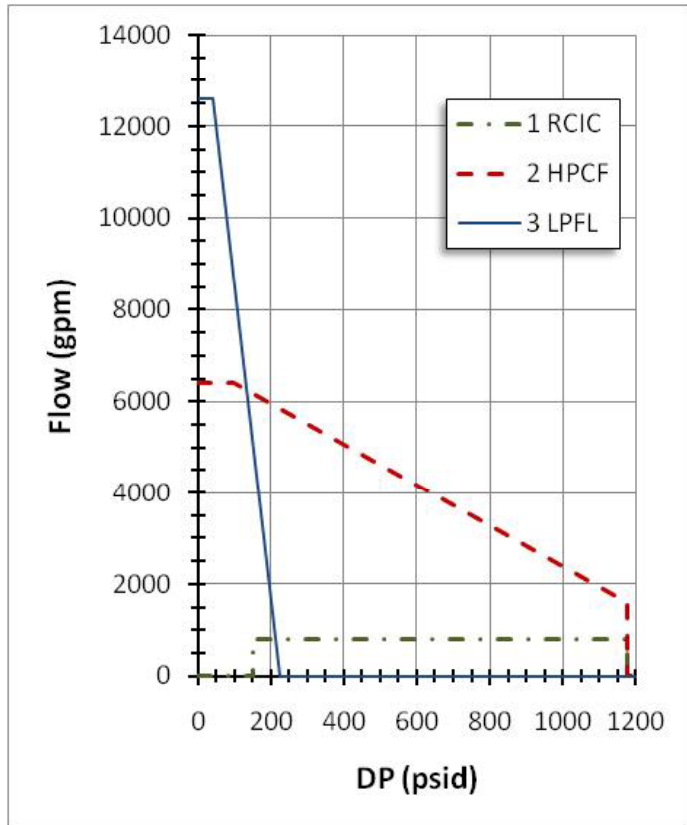
# Important Features of the ABWR

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## ● ABWR ECCS

- Reactor Core Isolation Cooling (RCIC) – 1 steam-driven turbine drives pump; discharges to 1 feed water (FW) line; actuates on high drywell pressure or LWL-2
- High Pressure Core Flooder (HPCF) – 2 loops powered by different emergency power sources; discharges into upper plenum; actuates on high drywell pressure or LWL-1.5
- Low Pressure Flooder (LPFL) – 3 loops powered by different emergency power sources; 1 loop discharges to 1 FW line; 2 loops discharge directly to downcomer; actuates on high drywell pressure or LWL-1
- Automatic Depressurization System (ADS) – 8 Safety Relief Valves (SRVs); open 30s after high drywell pressure and LWL-1

# Important Features of the ABWR





# ABWR Evaluation Model

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## ● Evaluation Model Assumptions

- Hot assembly power in GOBLIN established by using a very conservative definition of the hottest node
- Initial core flows considered minimum and maximum permissible at rated power
- Loss of offsite power assumed concurrent with LOCA
- Feed water flow rate ramped to zero in 1s
- Steam line isolated by turbine control valve (TCV) closure (fast / slow)
- RIPs connected to MG sets not credited (all 10 lose power at  $t=0$ )
- Reactor scram on narrow range water level  $< \text{LWL-3}$
- MSIVs close on LWL-1.5 or high steam flow (4.5s + response time)

# ABWR Evaluation Model

---

- **Major Conservatisms in App K Evaluation Model**

- Decay heat
- Initial hot assembly power
- Pump coastdown
  - Time constant
  - No credit for MG sets
- Bounding ECCS performance and delay times
- Critical flow model
- No rewet after dryout

# ABWR Evaluation Model

---

- Modeling Considerations

- Fast Coastdown of RIPs Expected to Result in Early Dryout
  - Core nodding and pump modeling expected to be important in prediction of dryout
  - Benchmarked FRIGG Transient Dryout Experiments
    - Determined that additional axial nodes were necessary for conservative prediction of decreasing flow tests
  - Used minimum moment of inertia for RIPs
    - Matched minimum pump coastdown time constant

# Break Spectrum

---

Break Location	Available ECCS				Failure
	RCIC	HPCF	LPFL	ADS	
HPCF Line	1	0	2	8	Failure of 1 EDG
MS Line (RCIC side)	--	1	2	8	Break + Failure of 1 EDG
FW Line (RCIC side)	--	1	2	8	Break + Failure of 1 EDG
FW Line (LPFL side)	1	1	1	8	Failure of 1 EDG
RHR Suction Line	1	1	2	8	Failure of 1 EDG
RHR Injection Line	1	1	1	8	Break + Failure of 1 EDG
Drain Line	1	1	2	8	Failure of 1 EDG

# Break Spectrum Results

---

<u>Break Location</u>	<u>PCT °F</u>	<u>Minimum Inventory (Mlb)</u>
HPCF Line	1306	0.291
MS Line (inside containment)	1213	0.358
MS Line (outside containment)	1234	0.532
FW Line	1310	0.272
RHR Suction Line	1310	0.291
RHR Injection Line	1305	0.470
Drain Line	1306	0.545

\* PCTs occur during pump coastdown before actuation of ECCS; PCT Limit 2200°F

# LOCA Methodology Summary

---

- Evaluation model is very conservative:
  - Hot assembly power
  - RIP coastdown
  - Other App. K requirements
- PCT occurs before actuation of ECCS
  - ABWR LOCA is a benign event, similar to 'loss of flow'
- Core uncover limited to some low power assemblies for HPCF break only but does not lead to PCT
- The model is applicable to the ABWR

# Response Question from ACRS Subcommittee Meeting

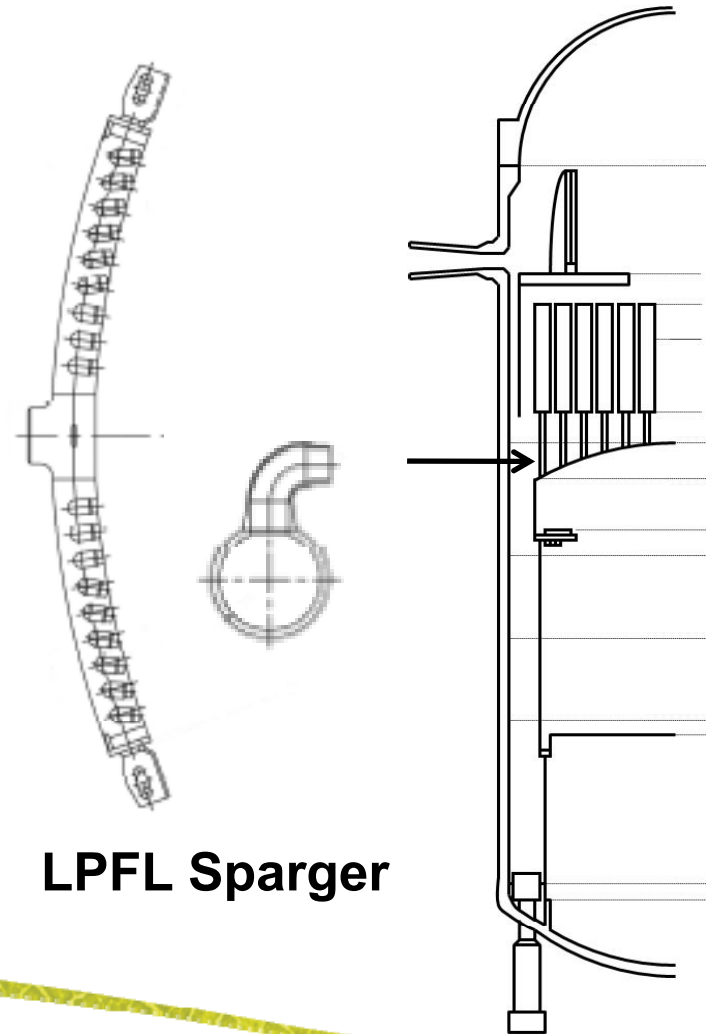
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- HPCF Line Break

- Results in partial uncover of some low power assemblies
- LPFL injects into steam environment after ADS actuation
- GOBLIN, a thermal equilibrium code, forces complete condensation at the injection location
- *ACRS SC Question: Could incomplete condensation result in asymmetric subcooling at core inlet and result in more uncover?*

# Response Question from ACRS Subcommittee Meeting

- LPFL injection:
  - Into one of the two FW lines (3 spargers per line) and one of the two LPFL spargers
  - Injection toward the shroud head dome
  - Injection velocity  $\sim 5 - 25$  ft/s, depending on the sparger
  - Injection made along a minimum of  $180^\circ$  of circumference



**LPFL Sparger**



# Response Question from ACRS Subcommittee Meeting

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- LPFL Injection Interaction
  - Injected water will impact the shroud dome and separator standpipes, flow downward along the shroud dome and shroud, and into the boiling mixture in the lower downcomer
  - The water then flows downward through the idle RIPs and into the boiling water in the lower plenum
  - Any water in the lower plenum that remains subcooled will settle to the bottom due to its higher density, where it will subsequently be heated by the reactor vessel and the control rod structures filling the lower plenum

# Response Question from ACRS Subcommittee Meeting

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- LPFL Injection Interaction
  - Core flow is driven by two-phase natural circulation
    - Very unlikely that coolant entering the core would be subcooled (RIPs are idle and flow rates are very low)
  - However, water entering the boiling mixture in the lower downcomer might be subcooled due to incomplete condensation / heatup
    - Mixing would reduce the boiling in the lower plenum
  - A sensitivity study was performed to assess this effect
    - The LPFL injection location was moved to a location below the two-phase mixture in the downcomer assuming no heatup

# Response Question from ACRS Subcommittee Meeting

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- Results of the study:

- The hot assembly is unaffected – PCT (1306°F) occurs during pump coastdown and there is no subsequent uncover
- Some low power assemblies might see ~ 1 ft additional uncover due to reduced two-phase swell caused by the mixing of subcooled water with the boiling mixture in the lower plenum and downcomer
- The peak cladding temperature in the low power assemblies (~ 660°F) remains well below the PCT in the hot assembly, which is well below the LOCA limit (2200°F)
- Ultimately the core is recovered as the injection flow exceeds the break flow

# Conclusions

---

- Evaluation model is very conservative
- Potential for subcooled water entering the core is unlikely
- Effect of assuming subcooled water entering the mixture in the downcomer has some effect on local results, but does not change overall results
  - PCT occurs in hot assembly before actuation of ECCS
- The model is applicable to the ABWR



# **Presentation to the ACRS Full Committee**

## **Loss of Coolant (LOCA) Accident Code Applicability Report for ABWR WCAP-17116-P**

### **Safety Evaluation**

April 11, 2013

# Staff Review Team



## NRO Technical Staff

- **Project Managers**
  - ♦ **Michael Eudy**
- **Fred Forsaty**
- **James Gilmer**
- **George Thomas**
- **NRC Office of Nuclear Regulatory Research**
  - ♦ **Scott Krepel**
  - ♦ **Peter Yarsky**
- **Contractor Support**
  - ♦ **Parvin Sawant** Energy Research, Inc. (ERI)
  - ♦ **Mohsen Khatib-Rahbar** (ERI)

# Background

- Original Goblin Code approval, WCAP-11284-P-A, “Westinghouse Boiling Water Reactor Emergency Core Cooling System Evaluation Model: Code Description and Qualification,” in October 1989
- Supplemental Topical Report Approvals:
  - WCAP-15682-P-A (March 2003) for improved fuel clad rupture criteria
  - WCAP-16078-P-A (October 2004) for application to SVEA-96 Optima2 fuel
- WCAP-17116-P, “Westinghouse BWR ECCS Evaluation Model”, addresses the applicability of WCAP-11284-P-A to the ABWR

# Regulatory Basis and Acceptance Criteria

Acceptance criteria for ECCS evaluation is CFR 50.46(a)(1) which requires that it be shown with a high probability that none of the criteria of paragraph 50.46(b) will be exceeded.

- ♦ Peak clad temperature (PCT) < 1204 °C (2200 °F)
- ♦ Maximum Local Cladding Oxidation (LCO) < 0.17 initial cladding thickness
- ♦ Core Wide Oxidation (CWO) < 1% of maximum possible
- ♦ Core Remains in a Coolable Geometry
- ♦ Assurance of Long Term Decay Heat Removal

SRP 15.0.2, Review of Transient and Accident Analysis Methods



# Review Process

- ♦ Basic thermal-hydraulic phenomena during LOCA is the same for ABWR and BWR. Review has focused only on those elements of the evaluation model that are unique for ABWR for compliance with Appendix K requirements.
- ♦ NRC staff submitted 33 Requests for Additional Information (RAIs) and 13 follow-up RAIs
- ♦ Site audit was conducted in February 2011.
- ♦ NRC Staff performed independent confirmatory calculations using TRACE Version 5.0 Patch 3

# **ECCS Evaluation Model for ABWR**

- Computer Codes
  - Same as used for BWR applications
    - GOBLIN – system performance, hot assembly response
      - Performs the analysis of the LOCA blowdown and reflood thermal hydraulic transient for the reactor, including interactions with various control and safety systems
      - One dimensional, drift-flux, thermal equilibrium, point kinetics
    - CHACHA – nodal heatup calculation
      - Performs detailed fuel rod mechanical and thermal response analysis at a specified axial level within the hot assembly

# Difference between ABWR and BWR

## ♦ Design Difference

- External recirculation loops and jet pumps replaced by 10 reactor internal pumps (RIPs)
- Except for a small bottom drain line, all RPV penetrations are above the top of active fuel
- Largest break size in ABWR main steam line break (MSLB) is only 15% of the maximum double-ended recirculation line in BWRs

# **Difference between ABWR and BWR (Continue)**

## ♦ LOCA Behavior

- Rapid coastdown of RIPs results in early boiling transition
- Typical extended core uncover phase common for BWR LOCAs does not occur in ABWR
- Peak Clad Temperature (PCT) occurs before actuation of ECCS (due to boiling transition)

# **Difference between ABWR and BWR (Continue)**

- ♦ ABWR Model differences
  - New GOBLIN nodalization to reflect physical differences
  - DRAGON option for parallel hot channel analysis not used. Use of multiple parallel control volumes representing the average core and the hot channel in GOBLIN eliminated the need for DRAGON option
  - Number of nodes in active core increased to better capture the early boiling transition caused by the RIP faster coastdown

# Confirmatory Analyses

- TRACE /Version 5.0 Patch 3:
  - TRACE is a best estimate code, however, it incorporates some of the Appendix K evaluation code modeling
  - TRACE has been extensively benchmarked for the TH phenomena for the BWRs.
  - Agreed well overall with the GOBLIN Reference Case
  - Presentation by Office of Research

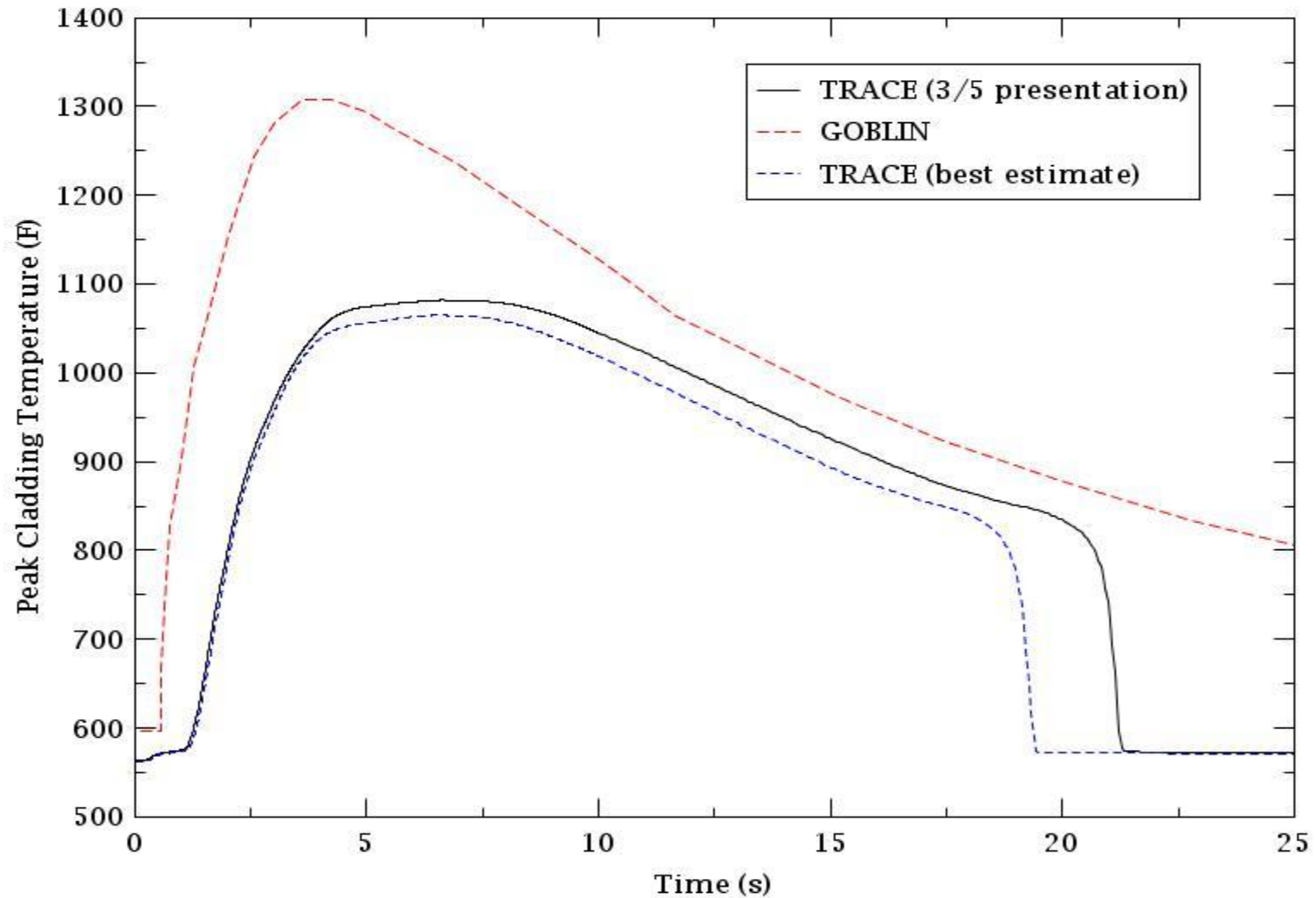
# **RES Staff LOCA Analysis Results**

RES staff performed confirmatory analyses using TRACE v5.0 Patch 3, and presented the findings at the March 5, 2013 ACRS T-H subcommittee meeting:

- ♦ High pressure core flood injection line break
- ♦ Feedwater line break
- ♦ Steam line break (inside and outside containment)

The results confirmed that there is no core heat-up after post-scrum natural circulation flow is established. Therefore, the limiting PCT is directly attributable to the pump coastdown resulting from the Loss Of Offsite Power event at the beginning of the transient. Comparison between TRACE and GOBLIN show that the predicted maximum PCTs are reasonable and that significant margin exists between the highest predicted PCT and regulatory limits.

# Representative PCT Results (High Pressure Core Flooder Injection Line Break Scenario)





## **Conditions and Limitations:**

- 1- The DRAGON option shall not be used for hot channel analysis without prior review and approval by the NRC staff.
- 2- The modeling of longitudinal feedwater line breaks shall be restricted to sizes greater than 50% of the size of the double ended guillotine break in the feedwater break line
- 3- Compensation factors used for wide range level should include pressure effects
- 4- Restrictions on 1-D nodalization of upper plenum

## **Conclusion:**

The current conservative calculated PCT of 710 °C (1350 °F) shows significant margin to Acceptance Criteria 1204 °C (2200 °F)

Westinghouse WCAP-17116-P, “Westinghouse BWR ECCS Evaluation Model”, is acceptable for calculating PCT, hydrogen generation, and fuel cladding surface oxidation for the ABWR design, with the conditions and limitations delineated above



# **Presentation on Seismic Ground Motion Model Update for the CEUS**

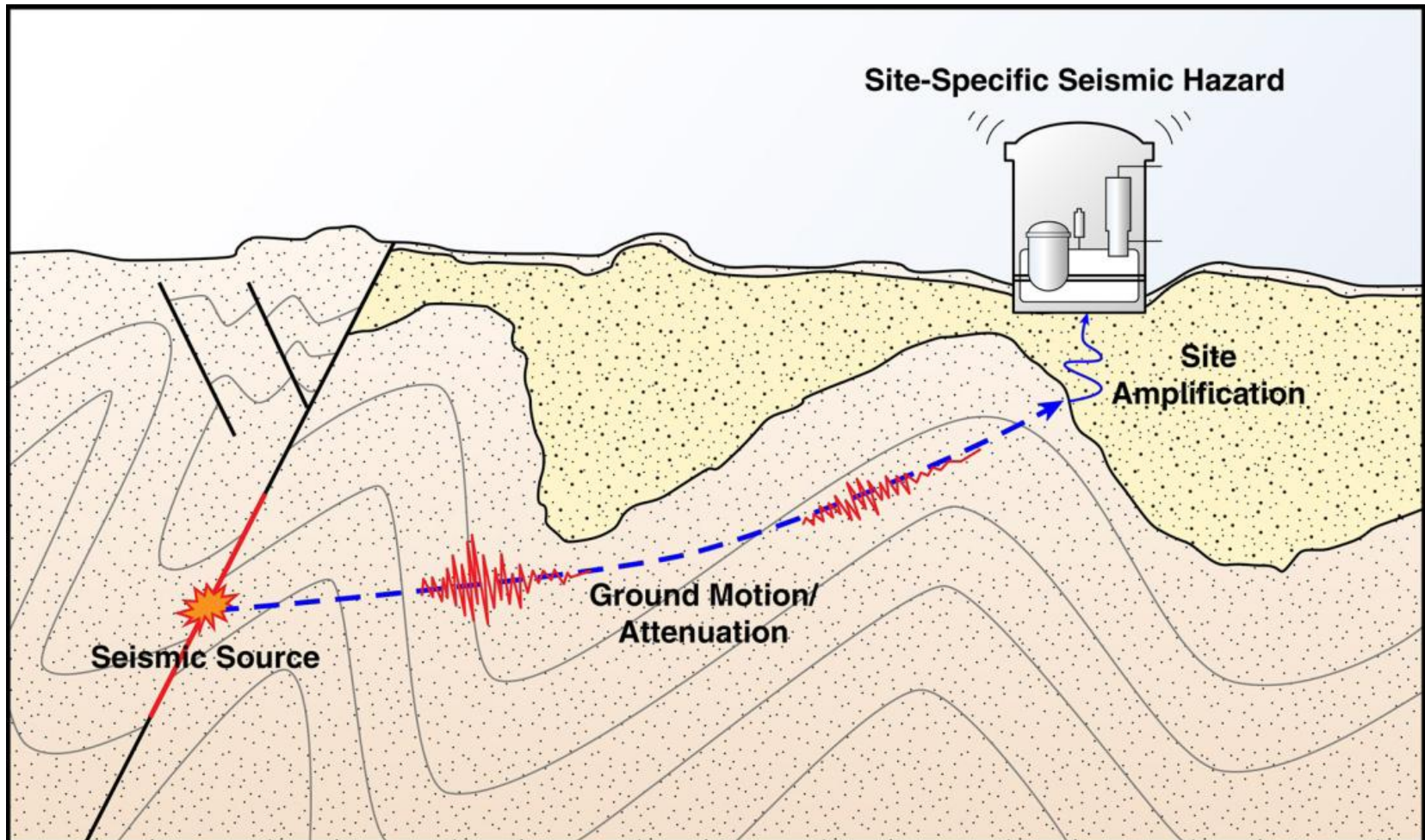
**April 11, 2013**

**Clifford Munson, Senior Advisor, DSEA, NRO**  
**Jon Ake, Senior Seismologist, DE, RES**  
**Vladimir Graizer, Seismologist, DSEA, NRO**  
**Yong Li, Seismologist, DE, NRR**

# Outline of Presentation

- Background
- EPRI (2004, 2006) Ground Motion Model
- Update of Model
- Path Forward

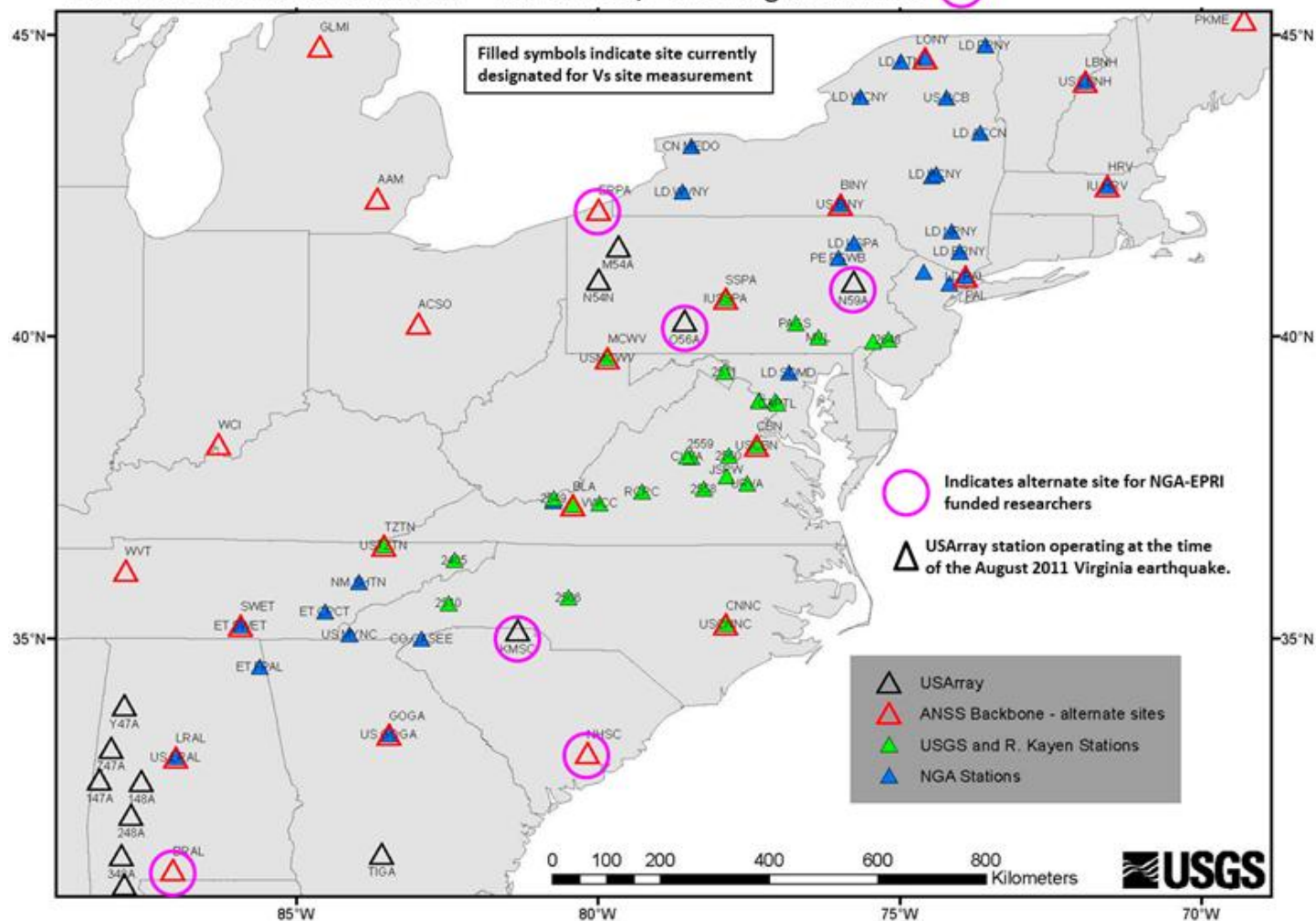
# Site-Specific Seismic Hazard Development



# Ground Motion Models for Stable Continental Regions

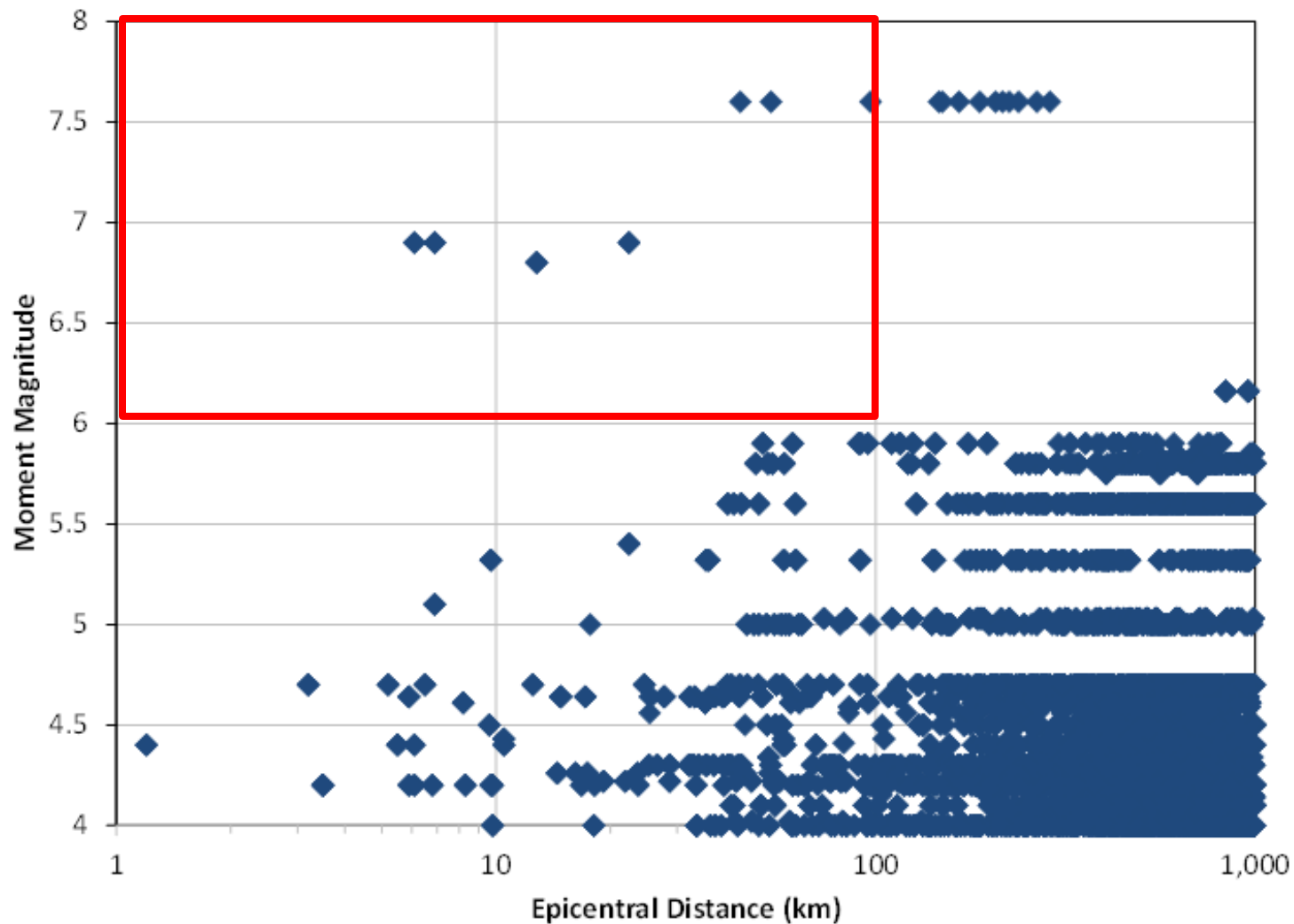
- Ground motion parameters (peak ground acceleration, spectral acceleration) estimated using prediction equations
  - Earthquake magnitude
  - Source-to-site distance
  - Local site conditions
- Ground motion data sparse in magnitude-distance range of engineering interest
- Stochastic approaches used rather than empirical methods

## 2012 Vs Site Characterization – Eastern US; showing alternates





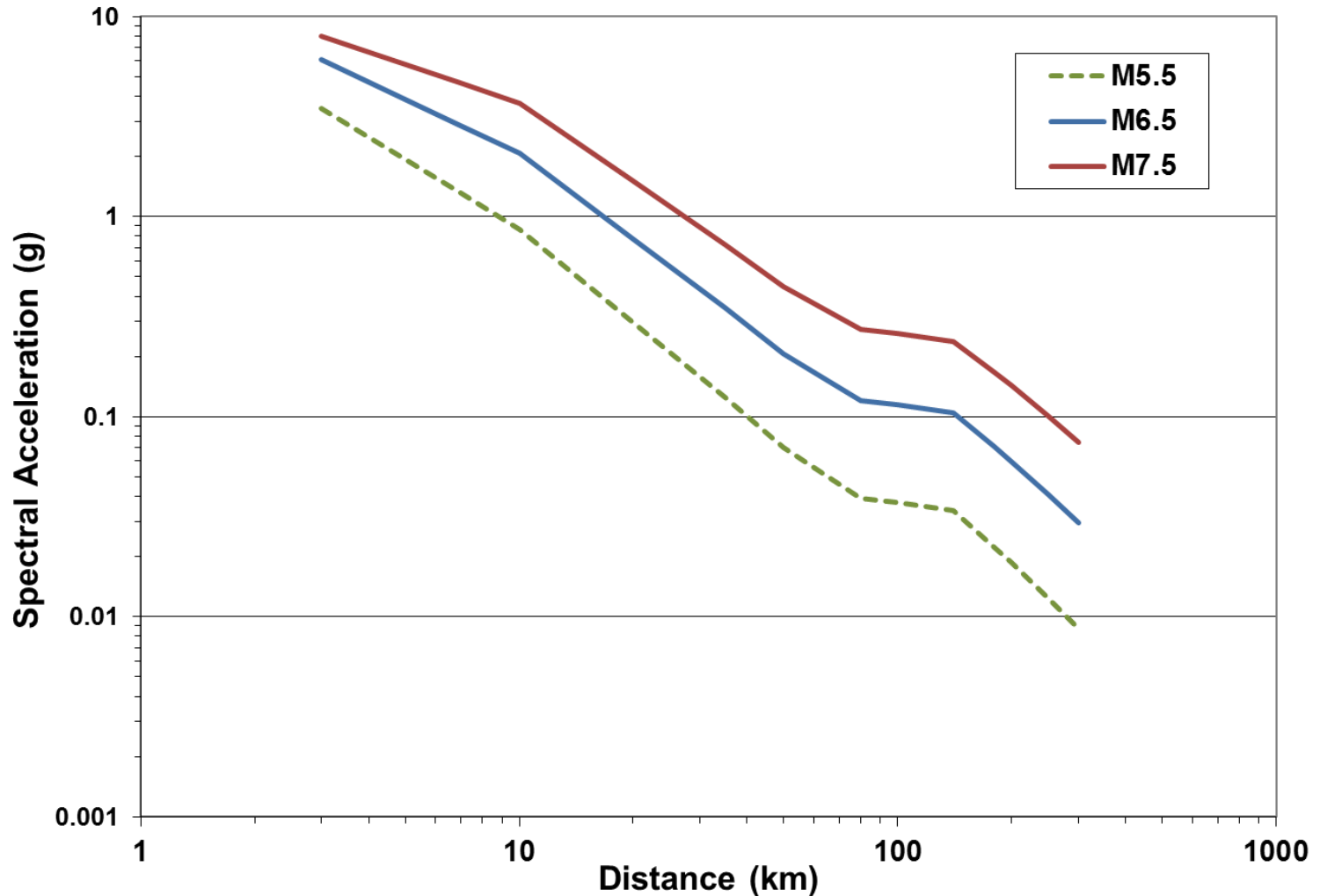
# MAGNITUDE-DISTANCE PLOT





# Example Ground Motion Model

**Median 10Hz Spectral Acceleration: M=5.5, 6.5, 7.5**  
**Atkinson and Boore (2006)**



## EPRI CEUS GMM (2004, 2006)

Cluster	Model Type	Models
1	Single Corner Stochastic	Hwang and Huo (1997) Silva et al (2002) - SC-CS Silva et al (2002) - SC-CS-Sat Silva et al (2002) - SC-VS Toro et al. (1997) Frankel et al. (1996)
2	Double Corner Stochastic	Atkinson and Boore (1995) Silva et al (2002) DC Silva et al (2002) DC – Sat
3	Hybrid	Abrahamson & Silva (2002) Atkinson (2001) & Sadigh et al. (1997) Campbell (2003)
4	Finite Source /Greens Function	Somerville et al. (2001)

## **CEUS Ground Motion Models**

- EPRI (2004, 2006) used by ESP & COL applicants
- NRC, DOE, and industry initiated NGA-East in 2009
  - Multi-year SSHAC Level 3 project
  - Scheduled to finish in 2015
- EPRI (2004, 2006) specified in 50.54(f) letter
- EPRI decided to update (2004, 2006) model for use in NTTF R2.1 hazard reevaluations

# Rationale for Update

- Significant amount of new data
  - 80% of records from earthquakes since 2002
  - Notable earthquakes
    - 2008 M5.3 Mt. Carmel, IL
    - 2010 M5.0 Val des Bois, Quebec
    - 2011 M5.8 Mineral, VA
    - 2011 M5.6 Sparks, OK
- Measurements at recording stations
- Some older models superseded by newer models

# EPRI CEUS GMM Update

Cluster	Model Type	Models
1	Single Corner Brune Source	Silva et al (2002) - SC-CS-Sat Silva et al (2002) - SC-VS Toro et al (1997) Frankel et al (1996)
2	Complex/Empirical $\sim R^{-1}$ Geometrical spreading	Silva et al (2002) DC – Sat Atkinson (2008')
3	Complex/Empirical $\sim R^{-1.3}$ Geometrical spreading	Atkinson & Boore (2006') Pezeshk et al (2011)
4	Finite Source /Green's Function	Somerville et al. (2001)

# Updated EPRI Ground Motion Model

- EPRI produced draft model and documentation in Feb 2013
- Staff unable to endorse
  - Treatment of uncertainty
  - Documentation of model
- EPRI presented updated GMM at public meeting on March 26
- Updated model appears to address issues raised by peer reviewers and staff

# Updated EPRI Ground Motion Model

- Added treatment of uncertainty for scaling ground motions for increased earthquake magnitudes
- Places a cap on weights for individual models within each cluster
- EPRI working on enhancing documentation
  - Details of database
  - Meeting objectives of SSHAC guidance

# **CEUS EPRI Ground Motion Model (GMM)**

## **Path Forward**

- Industry requested 6 month delay for CEUS hazard submittals (Sept 2013 to March 2014)
  - Documentation of model complete by June 2013
  - Staff review and interactions complete by Aug 2013
  - If endorsed, updated model to be used by licensees for hazard reevaluations





# US-APWR Design Certification Application

Chapters 4, 15, 17, 19  
Topical Reports supporting Chapters 4 and 15

**ACRS Full Committee Presentation**  
**April 11, 2013**  
**Mitsubishi Heavy Industries, Ltd.**

➤ **Ryan Sprengel**

✓ DCD Licensing Manager

➤ **Masatoshi Nagai**

✓ DCD Licensing Engineer, Ch 4

➤ **Rebecca Steinman**

✓ DCD Licensing Engineer, Ch 15

➤ **Kevin Lynn**

✓ DCD Licensing Engineer, Ch 17 and 19

## ➤ **Previous ACRS Full Committee meetings**

- ✓ September 9, 2011- Chapters covered: 2, 5, 8, 10, 11, 12, 13, 16
- ✓ September 6, 2012- Chapter 9 covered

## ➤ **Significant upcoming submittals**

- ✓ Chapter 4 – Fuel Seismic Closure Plan
- ✓ Chapter 17 – QAPD Revision
- ✓ Chapter 19 – PRA Closure Plan

- **ACRS Subcommittee meeting held October 2012**
- **Remaining SE Open Items**
  - ✓ Fuel Seismic Response Analysis
    - Grid deformation issue:
      - Discussion ongoing with the NRC Staff
      - Closure plan to be submitted
    - Review of:
      - Topical Report MUAP-07034, FINDS: Mitsubishi PWR Fuel Assemblies Seismic Analysis Code
      - Technical Report MUAP-08007, Evaluation Results of US-APWR Fuel System Structural Response to Seismic and LOCA Loads
  - ✓ Other open items have alignment with NRC Staff and closure paths identified

### ➤ **MUAP-07008, Mitsubishi Fuel Design Criteria and Methodology (FINE)**

- ✓ Fuel rod and assembly design criteria applied to the US-APWR fuel design
- ✓ ACRS Subcommittee meeting held October 2012
- ✓ No actions remain

### ➤ **MUAP-07009, Thermal Design Methodology**

- ✓ Methodology for DNB and transient fuel temperature analysis
- ✓ ACRS Subcommittee meeting held January 2013
- ✓ No actions remain

- **ACRS Subcommittee meeting held July 2012**
  - ✓ Initial MHI response to ACRS questions submitted December 2012
  - ✓ Revised response submitted January 2013
- **Remaining SE Open Items**
  - ✓ Boron precipitation / LTCC
  - ✓ Reload methodology report consistent with Ch 15
  - ✓ Other Open Items tied to closure of either an issue in another chapter or approval of Topical Reports (e.g. ACC, GSI-191, D3, Non-LOCA, & LOCA)
- **SE Confirmatory Items to be closed following DCD Rev 4 submittal, August 2013**
- **No current RAIs**

### ➤ **MUAP-07013, SB LOCA Methodology and MUAP-07011, LB LOCA Code Applicability**

- ✓ ACRS Subcommittee meeting held July 2012
- ✓ MHI responses to July ACRS meeting questions submitted February 2013
- ✓ Verify no impacts from ACC topical report closure

### ➤ **MUAP-07010, Non-LOCA Methodology**

- ✓ ACRS Subcommittee meeting held October 2012
- ✓ MHI responses to October ACRS meeting questions submitted December 2012
- ✓ No actions remain

- **ACRS Subcommittee meeting held February 2013**
- **No SE Open Items**
- **SE Confirmatory Items to be closed following DCD Rev 4 submittal**
- **No current RAs**
- **Only current issue in Chapter 17 is about the potential audit for D-RAP:**
  - ✓ ACRS mentioned at February SC meeting
  - ✓ Public meeting with NRC staff held 3/28/2013
  - ✓ NRC staff to provide draft audit plan in May 2013
  - ✓ NRC staff proposed audit for fall 2013
- **MHI to revise QA Program Description in May to reflect organizational changes**



- **ACRS Subcommittee meeting held February 2013**
- **Based on 3/28 public meeting between MHI and NRC staff, MHI will create “PRA Closure Plan”**
- **Closure plan will address following topics:**
  - ✓ SE Open and Confirmatory Items
  - ✓ Other Chapter 19 RAIs
  - ✓ Actions items from February ACRS SC meeting
  - ✓ Schedule for next revision to PRA technical report (MUAP-07030 Rev. 4)
- **Closure plan will be submitted by the end of April 2013**
- **No significant issues remain**

Note: seismic and containment performance portions of Chapter 19 are still in Phase 2

### ➤ Follow-up on one item from February ACRS Subcommittee meeting:

- ✓ MAAP is used by MHI for PRA success criteria evaluation
- ✓ Comparison between MAAP and WCOBRA/TRAC(M1.0) was performed for LLOCA (DCD Table 19.1-15)
- ✓ ACRS requested additional comparison between MAAP and other safety analysis codes specific to US-APWR



**Luminant**



# **LUMINANT GENERATION COMPANY**

## **Comanche Peak Nuclear Power Plant, Units 3 and 4**

**603<sup>rd</sup> ACRS Meeting**



**FSAR Chapters  
4, 13, 15, 16, 17, 19**

**April 11, 2013**



**Luminant**



## **Agenda**

- ❑ Introduction**
- ❑ Topics of Discussion with Subcommittee**
  - Chapter 13**
  - Chapter 16**
  - Chapter 17**
  - Chapter 19**



## Introduction

- ❑ **R-COLA uses “Incorporated by Reference” methodology**
- ❑ **FSAR Chapters 4, 13, 15, 16, 17, and 19 take no departures from US-APWR DCD**
- ❑ **No contentions pending before ASLB**
- ❑ **All confirmatory items to be incorporated in FSAR on or before Rev 4 (Nov 2013)**
- ❑ **Luminant has responded to all Open Items except two**
- ❑ **No outstanding issues identified in SERs**



## Topics of Discussion with Subcommittee

### ❑ Chapter 13

- Actual projected staffing versus “minimum staffing”
- Fire brigade staffing
- NRC review time for EOPs – actual versus committed development time
- Use of any software-based firewall to ensure cyber security
- Definition and use of “important to safety” (ITS); early identification of ITS equipment; impact on design, procedures, programs (from cyber security discussion)

### ❑ Chapter 16

- Luminant schedule for enhancing/updating PRA to support RITS



## **Topics of Discussion with Subcommittee (cont'd)**

### **□ Chapter 17**

- **Ability of application PRA to support certain programs**
- **Maintenance and enhancement of DRAP and ORAP equipment lists post-COL**
- **“Special treatment” or nonsafety-related SSC quality controls for non-safety DRAP equipment**

### **□ Chapter 19**

- **Use of industry standards to enhance PRA for RITS**
- **Luminant’s strategies for addressing LOLA**



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## Acronyms

<input type="checkbox"/> ASLB	Atomic Safety and Licensing Board
<input type="checkbox"/> COL	Combined License
<input type="checkbox"/> DCD	Design Control Document
<input type="checkbox"/> DRAP	Design Reliability Assurance Program
<input type="checkbox"/> EOP	Emergency Operating Procedure
<input type="checkbox"/> FSAR	Final Safety Analysis Report
<input type="checkbox"/> ITS	Important to Safety
<input type="checkbox"/> LOLA	Loss of Large Areas
<input type="checkbox"/> ORAP	Operations Reliability Assurance Program
<input type="checkbox"/> PRA	Probabilistic Risk Assessment
<input type="checkbox"/> R-COLA	Reference Combined License Application
<input type="checkbox"/> RITS	Risk-Informed Technical Specifications
<input type="checkbox"/> SER	Safety Evaluation Report
<input type="checkbox"/> US-APWR	United States Advanced Pressurized Water Reactor





# **Presentation to the ACRS Full Committee – 603<sup>rd</sup> Meeting**

**United States – Advanced Pressurized Water Reactor (US-APWR)  
Design Certification**

**Safety Evaluation Report with Open Items  
for  
Chapters 4, 15, 17, and 19**

**Safety Evaluation Report  
for  
Topical Reports Fuel Design, Thermal Design, SBLOCA, LBLOCA, NONLOCA**

**Jeffrey Ciocco  
US-APWR Design Certification Lead Project Manager**

**April 11, 2013**

# US-APWR Design Certification Review Schedule

	COMPLETION DATE
Phase 1 – Preliminary Safety Evaluation Report (SER)	Completed
Phase 2 – SER with Open Items	May 2014
Phase 3 – ACRS Review of SER with Open Items	August 2014
Phase 4 – Advanced SER with No Open Items	February 2015
Phase 5 – ACRS Review of Advanced SER with No Open Items	April 2015
Phase 6 – Final SER with No Open Items	September 2015
Rulemaking	February 2016

# Summary of the US-APWR Safety Evaluation Reports

- The staff has issued Safety Evaluation Reports (SERs) with Open Items for Chapters 4, 15, 17, and 19 and these chapters have been presented to the United States – Advanced Pressurized Water Reactor (US-APWR) ACRS Subcommittee.
- The staff has also issued SERs with no issues for five US-APWR Topical Reports.

# US-APWR Chapter 4 Reactor

- Chapter 4 addresses the fuel system, nuclear, and thermo-hydraulic designs; reactor materials; and the reactivity control system functional design
- **Open Item 4.2-1**, Topical Report MUAP-07034, "FINDS: Mitsubishi PWR Fuel Assemblies Seismic Analysis Code."
- **Open Item 4.2-2**, MUAP-08007, "Evaluation Results of US-APWR Fuel System Structural Response to Seismic and LOCA (Loss-Of-Coolant Accident) Loads."
- **Open Item RAI 994-7007**, Revised Thermal Design Procedure and Approved Departure from Nucleate Boiling Ratio (DNBR) limit.
- On March 29<sup>th</sup>, 2013, MHI provided responses to ACRS questions from the October 18, 2012, meeting.

# US-APWR Chapter 15

## Transient and Accident Analyses

- Chapter 15 addresses the analyses of the plant's responses to postulated disturbances and postulated equipment failures or malfunctions. There are three open items remaining:
- **Open Item 15.00-3, Reload Methodology**  
Technical report MUAP-07026 describes the reload evaluation process, including identification of key safety parameters for each transient. RAI 882-6237, question 15-37.
- **Open Item 15.6.5-11, Long -Term Cooling, Boron Precipitation**  
The staff questioned the boric acid precipitation calculation and the timing of the switchover to hot leg injection. RAI 861-6062, question 15.6.5-93.
- **Open Item 15.6.5-14 , Long-Term Cooling, Boron Precipitation, with Debris** The staff questioned the impact of fuel blockage by debris in the reactor coolant on the US-APWR boric acid precipitation in the core. RAI 861-6062, question 15.6.5-100.

# **US-APWR Chapter 17**

## **Quality Assurance and Reliability Assurance**



- Chapter 17 addresses the quality assurance and reliability assurance programs, and the applicant's program for implementing 10 CFR 50.65, 'The Maintenance Rule.'
- There are no open items.
- The staff will perform an audit of the reliability assurance program (RAP) during Phase 4 related to the identification of risk-significant Structures, Systems, and Components by the expert panel.

# **US-APWR Chapter 19**

## **Probabilistic Risk Assessment (PRA)**

### **and Severe Accident Evaluation**

- Chapter 19 describes the methodologies used in performing the PRA and severe accident evaluations, and presents the analytical results and safety insights derived from those analyses. This chapter also addresses strategies for severe accident management and potential design improvements for risk reduction.
- **Open Item 19.1-LEVEL 1, PRA Success Criteria**  
Systematic investigation to demonstrate the robustness of the assumed PRA success criteria for all “success” sequences. RAI 40-610, Questions 19-97 and 19-98, RAI 423-2710, Question 19-364.
- **Open Item 19.1-LEVEL 1, Treatment of Instrumentation & Controls (I&C)**  
Treatment of I&C hardware and software Common Cause Failures (CCFs). RAI 750-5675, Question 19-515.

# **US-APWR Chapter 19**

## **PRA and Severe Accident Evaluation**

### **(continued)**

- **Open Item 19.1-LEVEL 1, Verification of PRA**

Verification of PRA technical adequacy in accordance with PRA standards .  
RAI 967-6790, Question 19-575.

- **Open Item 19.1-LEVEL 2, Hydrogen Build-up**

Clarify modeling of dc-powered hydrogen igniters in PRA. RAI 871-6121,  
Question 19-560.

- **Open Item 19.1-Low Power Shut Down (LPSD)**

Omission of LOCAs, when refueling cavity flooded and temporary fuel racks  
used, during plant operational states (POSs) 5, 6, and 7 from the LPSD  
PRA. RAI 899-6281, Question 19-565.

- **Open Item 19.1-LPSD**

Auto-isolation function of RCS letdown on low hot leg level and prevention  
of vortexing in the hot leg which affects the calculated overdrain frequency.  
RAI 681-5257, Question 19-495.



# **US-APWR Chapter 19**

## **PRA and Severe Accident Evaluation**

### **(continued)**



- **Open Item 19.1-LPSD**

Auto-isolation of letdown on low hot leg level, manual isolation of letdown, and RCS hot leg level indication. RAI 924-6352, Question 19-568.

- **Open Item 19.1-LPSD**

Feasibility to close containment during reduced inventory operations consistent with staff guidance in Generic Letter GL 88-17. RAI 899-6281, Question 19-566.

- **Open Item 19.1-LPSD**

Lack of TS for standby RCS injection and containment closure during reduced inventory operation in reference to 10 CFR50.36(c)(2)(ii)(D) Criterion 4. RAI 669-5219, Question 19-494.

# **US-APWR Topical Reports**

- **MUAP-07008 Mitsubishi Fuel Design Criteria & Methodology**
  - ♦ Topical Report requests approval for the Mitsubishi fuel design criteria and methodology and the FINE fuel rod design code.
  - ♦ No issues to be discussed.
  - ♦ On March 29<sup>th</sup>, 2013, MHI provided responses to ACRS questions from the October 18, 2013, meeting.
  
- **MUAP-07009 Mitsubishi Thermal Design Methodology**
  - ♦ Topical Report requests approval of VIPRE-01M, a Mitsubishi version of the approved VIPRE-01 code.
  - ♦ No issues to be discussed.
  - ♦ On March 4<sup>th</sup> and March 26<sup>th</sup>, 2013, MHI provided responses to ACRS questions from the January 15, 2013 meeting.

# **US-APWR Topical Reports (continued)**

- **MUAP-07010 Non-LOCA (Loss-of-Coolant Accident) Methodology**
  - ♦ Describes the computer codes and methodologies adopted by Mitsubishi for the analysis of all non-LOCA events in chapter 15, except LOCA and dose evaluation, for pressurized water reactors such as US-APWR.
  - ♦ No issues to be discussed.
- **MUAP-07011 Large Break LOCA Code Applicability Report for US-APWR**
  - ♦ Describes the acceptability of using analysis codes and methodologies approved for conventional pressurized water reactors in their application to the US-APWR during a LBLOCA.
  - ♦ On February 28<sup>th</sup>, 2013, MHI provided responses to ACRS questions from the July 2012 meeting.
- **MUAP-07013 Small Break LOCA Methodology for US-APWR**
  - ♦ Describes the analysis methodology and evaluation of emergency core cooling system performance for design-basis SBLOCAs in the US-APWR.
  - ♦ On February 28<sup>th</sup>, 2013, MHI provided responses to ACRS questions from the July 2012 meeting.



# **Presentation to the ACRS Full Committee – 603<sup>rd</sup> Meeting**

**Comanche Peak Nuclear Power Plant, Units 3 and 4 Combined License Application**

**Safety Evaluation Report with Open Items  
For Chapters 4, 13, 15, 16, 17, 19, and Loss of Large Areas of the Plant due to Explosions or Fire (LOLA)**

**Stephen Monarque  
Comanche Peak Combined License Lead Project Manager**

**April 11, 2013**

# **Summary of Chapters 4, 13, 15, 16, 17, 19, and LOLA SERS with Open Items**

- The staff has issued SERs with Open Items for Chapters 4, 13, 15, 16, 17, 19, and LOLA and these chapters have been presented to the US-APWR ACRS Subcommittee.
- There are several significant issues for Chapters 16 and 19.

# Chapter 4 Reactor

- Chapter 4 addresses the fuel system, nuclear, and thermo-hydraulic designs; reactor materials; and the reactivity control system functional design
- Presented to the subcommittee in October 2012
- No issues to be discussed

# Chapter 13 Conduct of Operations

- Chapter 13 addresses organizational structure of applicant, training, emergency planning, operational program implementation, plant procedures, and cyber security. Physical security and fitness for duty are still under review.
- Presented to the subcommittee in September 2012
- No issues to be discussed

# **Chapter 15**

## **Transient and Accident Analysis**

- Chapter 15 addresses the analyses of the plant's responses to postulated disturbances and postulated equipment failures or malfunctions.
- Presented to the subcommittee in July 2012
- No issues to be discussed



# **Chapter 17 Quality Assurance and Reliability Assurance**

- Chapter 17 addresses the Quality Assurance and Reliability Assurance Programs, and the Applicant's Program for Implementing 10 CFR 50.65, 'The Maintenance Rule.'
- Presented to the subcommittee in February 2013
- No issues to be discussed

# **Loss of Large Areas of the Plant due to Explosions or Fire**

- 10 CFR 50.54(hh)(2), develop and implement guidance and strategies intended to maintain or restore core cooling, containment, and spent fuel pool capabilities associated with loss of large areas of the plant due to explosions or fire . . .
- Presented to the subcommittee in February 2013
- No issues to be discussed

# Chapter 16 Technical Specifications

- Comanche Peak Units 3 & 4 are adopting Risk-Managed Technical Specifications (RMTS, NEI-06-09)(aka Risk-informed Completion Times) and Surveillance Frequency Control Program (SFCP, NEI 04-10)(for licensee control of surveillance frequency adjustments) using risk information with specific PRA requirements.
- Since the CPNPP PRA reflecting the as-built/as-to-be-operated plant is not available at time of COL issuance, when TS must be complete, a TS methodology is needed per Option 3 of ISG-08 for completing a PRA that is adequate for the RMTS & SFCP applications.
- RMTS & SFCP require programs in CPNPP 3&4 TS Admin Controls section, referencing approved NEI 04-10 (SFCP) and NEI 06-09 (RMTS) methodology documents. The CPNPP TS methodology is referenced in the TS Admin Controls along with the NEI 06-09 & NEI 04-10 documents.

# **Chapter 19 Probabilistic Risk Assessment (PRA) and Severe Accident Evaluation – External Events**

- RG 1.200, Section 1.2.5 “Screening and Conservative Analysis of Other External Hazards Technical Elements”

*“It is recognized that for those new reactor designs with substantially lower risk profiles (e.g., internal events CDF below  $1E-6/\text{yr}$ ), the quantitative screening value should be adjusted according to the relative baseline risk value.”*

- Consistent with the list of external hazards identified in ASME/ANS RA-Sa-2009, Appendix 6-1 “List of External Hazards Requiring Consideration”
- Staff's acceptance of Chapter 19 external hazards will be contingent, in part, on the completion of the review of FSAR Chapters 2, “Site Characteristics” and 3, “Design of Structures, Systems, Components, and Equipment”

# **Chapter 19 PRA and Severe Accident Evaluation – Risk Informed Technical Specifications (TS)**

- In response to staff's RAI, Luminant made the following commitments regarding the use of PRA to support RITS (response to RAI 3287, Question 19-3):
  - ♦ Site-specific models will be included in the first series of PRA upgrades
  - ♦ Emergency operating procedures and detailed design information will be reflected in the PRA (during the second series of PRA upgrades)
  - ♦ Uncertainties on PRA model will be identified and addressed (during the PRA upgrades)
  - ♦ Peer review will be performed and findings will be resolved prior to initial fuel load

# Chapter 19 PRA and Severe Accident Evaluation – Risk Informed TS

- In its response to RAI 3287, Question 19-3, the applicant provided the following statements/commitments:

*“The PRA for RMTS must basically meet Capability Category 2 for the supporting requirements of the ASME/ANS internal events at power PRA standard. The scope of the PRA model must include Level 1 (CDF) plus large early release frequency (LERF). Contributions from external events, internal flooding events, and internal fire events must also be considered. The PRA for RMTS will be updated to satisfy the PRA technical adequacy described in the NEI guideline and will be available one year prior to fuel load.”*