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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

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ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

J. SAM ARMIJO, Chairman

JOHN W. STETKAR, Vice Chairman

HAROLD B. RAY, Member-at-Large

SAID ABDEL-KHALIK, Member

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

MICHAEL L. CORRADINI, Member

DANA A. POWERS, Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

STEPHEN P. SCHULTZ, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GORDON R. SKILLMAN, Member

NRC STAFF PRESENT:

ZENA ABDULLAHI, Designated Federal Official

JON AKE

JEFF CIOCCO

NILESH CHOKSHI

MICHAEL EUDY

STEPHEN MONARQUE

LYNN MROWCA

CLIFFORD MUNSON

JEFF SCHMIDT

MIKE TAKACS

ALSO PRESENT:

BOB HORTON

KEVIN LYNN

JOHN RICHARDS *

LARRY SALOMEN *

RYAN SPRENGEL

REBECCA STEINMAN

DON WOODLAN

*Present via telephone

C-O-N-T-E-N-T-S

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

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.

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

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

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

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

MEMBER BANERJEE: Thank you, Mr. Chairman.

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

(Laughter.)

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

(Laughter.)

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

(Laughter.)

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

(Laughter.)

In any case, to proceed --

MEMBER SHACK: The Charleston, yes.

MEMBER BANERJEE: The Charleston.

(Laughter.)

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

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

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

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

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

calculations which support the conclusions.

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

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

MEMBER BANERJEE: Okay.

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

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

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

I will turn it over to South Texas or --

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

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

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

MEMBER BANERJEE: Right now?

MR. HEAD: Yes.

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

Do we have a bridge line open?

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

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

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

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

Okay. Thanks. Fifteen minutes, 1-5.

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

CHAIR ARMIJO: Okay. We are back in

session.

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

MEMBER RAY: Thank you, Mr. Chairman.

There have been enough jokes about this already.

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

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

The March 2011 50.54(f) letter states that

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

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

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

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

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

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

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

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

MR. CHOKSHI: Thank you.

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

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

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

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

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

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

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

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

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

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

So, I will turn it over to Jon.

MR. AKE: Next slide, please.

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

MR. AKE: Yes.

MEMBER RYAN: Thank you.

MR. AKE: Sorry about that.

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

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

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

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

Next slide, please.

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

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

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

MR. AKE: They do, yes.

MEMBER POWERS: It is not there.

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

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

And that is part of what --

MEMBER POWERS: Absorption or scattering or both?

MR. AKE: All of the above. It is

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

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

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

Next slide, please.

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

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

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

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

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

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

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

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

And the final bullet says that we are

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

Next slide, please.

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

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

(Laughter.)

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

(Laughter.)

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

here.

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

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

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

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

CHAIR ARMIJO: For all locations?

MR. AKE: Yes.

CHAIR ARMIJO: Yes. Great.

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

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

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

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

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

CHAIR ARMIJO: Surface?

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

MEMBER RAY: Okay.

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

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

MR. AKE: Yes, right.

MEMBER RAY: -- and down-hole measurements.

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

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

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

CHAIR ARMIJO: They are not so different?

MR. AKE: No.

CHAIR ARMIJO: Okay.

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

CHAIR ARMIJO: Variables?

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

Anything else you wanted to say about this one?

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

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

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

Next slide, please.

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

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

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

MR. AKE: Yes.

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

MR. AKE: Yes.

MEMBER SKILLMAN: And you do not have that data.

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

MR. MUNSON: Not from those stations, but

for others.

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

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

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

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

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

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

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

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

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

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

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

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

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

MR. AKE: It probably is.

MR. MUNSON: Yes.

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

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

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

So, in some cases we have imported a

little bit of data duty-free.

(Laughter.)

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

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

MR. AKE: Yes.

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

MR. AKE: Yes.

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

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

CHAIR ARMIJO: It ignores depth?

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

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

MR. AKE: Yes.

CHAIR ARMIJO: Okay.

MR. AKE: It is surface distance, yes.

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

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

(Laughter.)

MEMBER POWERS: You think you are the straight man.

(Laughter.)

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

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

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

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

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

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

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

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

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

MR. AKE: Yes, and our models --

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

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

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

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

MR. AKE: Yes.

MEMBER BLEY: Okay.

MR. AKE: Yes.

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

MR. AKE: No.

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

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

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

MR. AKE: About 5.8.

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

MR. AKE: The very large events?

CHAIR ARMIJO: Yes.

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

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

MR. AKE: Yes.

MR. MUNSON: We don't --

CHAIR ARMIJO: You just make an assumption that --

MR. MUNSON: -- discriminate on borders.

(Laughter.)

MR. AKE: Yes.

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

MR. AKE: Right.

CHAIR ARMIJO: -- from equivalent geological sites?

MR. AKE: Yes, geological and tectonic settings.

CHAIR ARMIJO: Okay. Okay.

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

CHAIR ARMIJO: So, you just import them

here and plug them in?

MR. AKE: Yes.

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

(Laughter.)

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

MR. AKE: Right.

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

MR. AKE: Right, at the time.

MEMBER POWERS: Yes.

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

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

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

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

MR. AKE: Yes.

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

MR. AKE: Yes, exactly.

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

CHAIR ARMIJO: Yes.

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

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

CHAIR ARMIJO: No, I understand it now.

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

just the rate is low.

CHAIR ARMIJO: Okay.

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

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

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

VICE CHAIR STETKAR: Jon is doing it.

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

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

MR. AKE: Right.

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

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

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

MR. AKE: Right.

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

MR. AKE: Right.

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

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

MEMBER POWERS: Right.

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

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

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

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

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

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

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

MR. AKE: Right.

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

MR. AKE: No, it isn't.

MEMBER POWERS: Or is it something else?

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

MEMBER POWERS: It should not, no.

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

MEMBER POWERS: I mean, the reason it

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

MR. AKE: Yes.

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

MR. AKE: Right.

MEMBER POWERS: That the continued acceleration --

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

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

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

look at to make sure it is long enough.

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

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

MEMBER POWERS: May I see those publications?

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

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

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

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

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

MEMBER SHACK: Cumulative absolute velocity --

CHAIR ARMIJO: Yes, yes.

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

CHAIR ARMIJO: Yes, yes.

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

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

MEMBER SHACK: Right, but they have a

predictive model that they sort of use.

MR. CHOKSHI: You can.

MEMBER SHACK: Yes.

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

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

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

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

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

MR. AKE: Right, right.

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

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

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

equations characterize different parts of the problem.

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

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

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

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

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

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

MEMBER BANERJEE: So, what is this greens function?

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

(Laughter.)

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

MR. AKE: It is linear.

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

MR. AKE: It is given a --

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

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

MEMBER BANERJEE: A point.

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

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

MR. AKE: Yes.

MEMBER BANERJEE: Is that a reasonable assumption?

MR. AKE: Yes.

MEMBER POWERS: Yes, that is not bad.

MR. AKE: Yes.

MEMBER BANERJEE: So, you can superpose a solution?

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

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

MR. AKE: Well, it is --

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

MR. AKE: Right.

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

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

MEMBER BANERJEE: So, it is elastic.

MEMBER POWERS: Elastic, yes.

MR. AKE: It is a linear elastic --

MEMBER BANERJEE: You can assume

elasticity. There is no plasticity definitely.

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

MEMBER BANERJEE: Right, but that is the source.

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

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

MR. AKE: Yes. Yes.

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

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

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

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

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

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

MEMBER POWERS: I am a little confused maybe.

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

(Laughter.)

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

MR. AKE: Right.

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

MR. AKE: Yes.

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

MR. AKE: Right.

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

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

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

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

MEMBER POWERS: Uh-huh.

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

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

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

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

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

MR. AKE: Hold that question.

(Laughter.)

MEMBER POWERS: I am already holding two.

(Laughter.)

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

MEMBER POWERS: And then, the other

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

MR. AKE: Yes.

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

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

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

(Laughter.)

MR. AKE: I know.

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

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

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

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

MR. AKE: Yes.

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

MR. AKE: Prediction equations.

MEMBER BANERJEE: -- whatever these are --

MR. AKE: Yes.

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

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

MEMBER BANERJEE: It is just algebraic?

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

MR. AKE: No, these are purely --

MEMBER BANERJEE: These are purely empirical?

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

MEMBER BANERJEE: Okay.

MR. AKE: They are simple regression equations.

MEMBER BANERJEE: So, they are just empirical?

MR. AKE: Yes. Yes.

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

MR. AKE: Because they actually do --

MEMBER BANERJEE: What are the physics there?

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

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

(Laughter.)

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

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

MEMBER BANERJEE: That is right.

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

MR. AKE: Yes.

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

MEMBER BANERJEE: The solution to the wave equation.

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

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

MEMBER BANERJEE: Okay. So, qualitatively.

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

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

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

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

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

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

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

MR. AKE: Well, right. Right.

MEMBER BANERJEE: Right?

MR. AKE: That is correct.

MEMBER BANERJEE: Yes.

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

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

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

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

(Laughter.)

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

(Laughter.)

MR. AKE: Yes.

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

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

(Laughter.)

The existing option models that are 2004 and 2006, I would mention that the original 2004 model, what I referred to a moment ago when we were looking at those attenuation functions, which were the aleatory variability part of that, that was updated in 20006. So, when you see the nomenclature EPRI 2004-2006, the median models were developed in the 2004 model. Those are still used. The aleatory variability part was updated in 2006.

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

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

(Laughter.)

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

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

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

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

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

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

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

And then, the last is that -- and this

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

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

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

MEMBER BANERJEE: Right.

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

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

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

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

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

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

Is there anything else on that you want to

say?

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

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

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

MR. AKE: Yes.

MEMBER BANERJEE: -- and do uncertainty calculations?

MR. AKE: Yes.

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

MR. AKE: Yes.

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

MR. AKE: Right.

MEMBER BANERJEE: Okay.

MR. AKE: And ultimately, where these are

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

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

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

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

MR. AKE: Yes. Yes.

MEMBER BANERJEE: To look at uncertainties?

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

(Laughter.)

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

MEMBER BANERJEE: Okay.

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

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

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

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

MR. AKE: Yes.

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

MEMBER BANERJEE: It gets rather --

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

technology.

MR. AKE: Right.

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

MR. AKE: Yes.

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

(Laughter.)

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

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

with it.

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

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

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

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

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

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

MEMBER SKILLMAN: Will that give you a number?

(Laughter.)

MEMBER POWERS: But the problem is --

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

MEMBER POWERS: Yes, the curves all go flat.

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

MEMBER POWERS: Yes, yes.

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

MEMBER POWERS: Yes.

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

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

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

MR. AKE: Right.

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

MR. AKE: Right.

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

MR. AKE: Right, exactly.

MEMBER POWERS: Really, really interested in them.

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

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

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

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

MEMBER BANERJEE: Right.

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

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

MR. AKE: Right.

MEMBER BANERJEE: Yes.

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

(Laughter.)

MEMBER BANERJEE: Right, right.

MR. AKE: Ever.

(Laughter.)

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

MR. AKE: Right.

MEMBER BANERJEE: It could be a --

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

(Laughter.)

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

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

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

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

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

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

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

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

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

MR. AKE: Actually, only one.

MEMBER SCHULTZ: One?

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

MEMBER SCHULTZ: "They" being?

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

MEMBER SCHULTZ: They have an internal one?

MR. AKE: Yes.

MEMBER SCHULTZ: And who is that?

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

MEMBER RAY: EPRI is now able to speak.

MR. AKE: Okay.

MEMBER RAY: We opened the line for them.

EPRI, do you want to answer that question?

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

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

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

MEMBER RAY: Thank you.

MEMBER CORRADINI: Where are these people from?

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

Bob Horton is from southern --

MR. HORTON: South Carolina.

MR. AKE: Yes, okay.

MR. HORTON: Hi. Good morning.

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

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

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

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

MEMBER RAY: Go ahead.

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

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

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

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

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

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

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

MEMBER RAY: Okay. Thank you.

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

presentation.

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

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

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

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

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

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

MEMBER POWERS: But he worries about meteorite impacts --

MEMBER BANERJEE: I know.

MEMBER POWERS: -- and we have excluded those.

(Laughter.)

CHAIR ARMIJO: So far, we have.

(Laughter.)

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

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

MEMBER RAY: Let me finish up. Can I?

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

MEMBER RAY: Okay.

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

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

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

And that is our presentation.

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

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

MEMBER RAY: -- in the final report?

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

MEMBER RAY: Okay. We have got, by the

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

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

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

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

MEMBER RAY: Okay.

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

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

MEMBER RAY: Thank you.

Any other questions from members?

MEMBER SCHULTZ: I have one more general

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

MEMBER RAY: You are speaking to EPRI, Steve?

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

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

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

MR. AKE: No. No.

MEMBER SCHULTZ: Okay.

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

MEMBER SCHULTZ: Understood. Thank you for the clarification.

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

available.

Other questions?

(No response.)

All right. I believe we are done, Mr. Chairman. I will pass back to you.

CHAIR ARMIJO: Okay. Thank you very much. Thanks for the presentation.

MEMBER RAY: I appreciate it very much. The staff did an excellent job, I think.

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

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

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

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

1:14 p.m.

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

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

And John Stetkar will lead us through this briefing.

John?

VICE CHAIR STETKAR: Thank you, Mr. Chairman.

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

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

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

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

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

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

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

And with that introduction, I will turn it

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

MR. CIOCCO: Yes. Thank you.

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

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

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

And I will turn it over to MHI.

Ryan, are you up here?

MR. SPRENGEL: It is me.

VICE CHAIR STETKAR: It is you.

(Laughter.)

MR. SPRENGEL: Good afternoon, everyone.

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

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

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

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

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

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

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

MR. NAGAI: Good afternoon.

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

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

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

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

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

MR. NAGAI: Thank you very much.

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

MR. NAGAI: Okay. Thank you very much.

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

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

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

CHAIR ARMIJO: I guess I have to take

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

So, please continue.

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

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

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

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

additional question?

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

MS. STEINMAN: Uh-hum.

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

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

MEMBER REMPE: Okay.

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

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

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

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

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

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

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

MR. SCHMIDT: Right.

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

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

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

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

MEMBER REMPE: Okay.

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

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

MS. STEINMAN: No problem.

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

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

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

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

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

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

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

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

VICE CHAIR STETKAR: I didn't --

MR. SCHMIDT: This is Jeff Schmidt.

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

beginning of the conversation.

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

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

MR. SCHMIDT: Which?

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

MS. STEINMAN: We can, okay, yes.

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

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

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

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

MS. STEINMAN: It is an administrative open item.

VICE CHAIR STETKAR: Oh, okay.

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

MS. STEINMAN: It says don't forget to

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

MR. SCHMIDT: Yes. Right, right.

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

MR. SCHMIDT: Right.

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

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

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

I was just surprised to hear that --

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

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

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

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

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

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

(No response.)

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

And one of the outstanding items with

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

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

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

MS. STEINMAN: That is correct.

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

Thank you.

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

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

That concludes my --

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

(No response.)

If not --

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

MR. LYNN: Thanks, Ryan.

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

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

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

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

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

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

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

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

MR. LYNN: Yes.

VICE CHAIR STETKAR: Yes.

MEMBER SKILLMAN: What is the organizational change, please?

MR. LYNN: What exactly is the organizational change?

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

MEMBER SKILLMAN: Thank you.

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

which we had in February of this year.

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

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

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

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

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

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

VICE CHAIR STETKAR: Yes, yes, yes.

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

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

MEMBER CORRADINI: So, like what?

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

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

VICE CHAIR STETKAR: I suspect, Jeff, we

will hear about those.

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

VICE CHAIR STETKAR: Maybe not all of them.

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

MEMBER CORRADINI: Okay.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

MEMBER REMPE: Okay. Thank you.

VICE CHAIR STETKAR: Thank you.

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

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

who have not slogged through the Subcommittee meetings.

(No response.)

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

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

Jeff, are you ready?

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

(Laughter.)

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

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

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

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

(Laughter.)

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

Thank you for having us.

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

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

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

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

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

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

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

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

MR. CIOCCO: Okay.

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

MR. CIOCCO: Okay. Very good.

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

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

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

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

MR. CIOCCO: Okay. Certainly.

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

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

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

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

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

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

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

VICE CHAIR STETKAR: Just be careful with your paper.

MR. CIOCCO: Okay.

VICE CHAIR STETKAR: When it hits that microphone --

MR. CIOCCO: Okay. Thank you.

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

MR. CIOCCO: Sure.

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

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

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

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

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

And the numbers that you see here are tied

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

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

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

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

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

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

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

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

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

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

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

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

MR. CIOCCO: Yes, they are.

VICE CHAIR STETKAR: Okay.

MR. CIOCCO: I think it is Rev 4.

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

MR. CIOCCO: Yes.

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

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

VICE CHAIR STETKAR: Okay.

MR. CIOCCO: I mean, MHI is --

VICE CHAIR STETKAR: They are still working on that?

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

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

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

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

MR. SPRENGEL: This is Ryan Sprengel.

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

VICE CHAIR STETKAR: Okay.

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

VICE CHAIR STETKAR: '14?

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

VICE CHAIR STETKAR: Okay.

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

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

MR. SPRENGEL: Yes.

VICE CHAIR STETKAR: Okay. Thanks.

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

VICE CHAIR STETKAR: Yes.

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

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

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

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

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

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

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

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

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

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

In that area --

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

MR. CIOCCO: I have one more slide.

MEMBER REMPE: Go ahead and finish.

MR. CIOCCO: Yes.

MEMBER REMPE: And then, I have a question.

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

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

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

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

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

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

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

VICE CHAIR STETKAR: Yes. Well, that is

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

MEMBER BLEY: Okay.

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

MR. SPRENGEL: This is Ryan Sprengel again.

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

VICE CHAIR STETKAR: Yes, we may want to.

MR. SPRENGEL: -- these specific items.

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

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

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

VICE CHAIR STETKAR: That is right.

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

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

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

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

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

VICE CHAIR STETKAR: Good. Thank you.

MR. CIOCCO: Yes. You're welcome.

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

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

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

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

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

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

MEMBER REMPE: All right. Thank you.

MR. CIOCCO: -- on that topic.

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

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

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

MR. CIOCCO: Yes, sir.

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

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

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

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

MR. CIOCCO: Yes.

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

MR. CIOCCO: Oh, okay. Okay.

CHAIR ARMIJO: Yes.

MR. CIOCCO: Yes, and we did get your

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

CHAIR ARMIJO: Yes, that was just background.

MR. CIOCCO: Yes.

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

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

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

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

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

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

(Laughter.)

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

MR. CIOCCO: Okay.

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

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

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

CHAIR ARMIJO: Okay.

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

CHAIR ARMIJO: Okay.

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

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

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

MR. SCHMIDT: This is Jeff Schmidt again.

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

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

CHAIR ARMIJO: Yes, close that out.

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

CHAIR ARMIJO: Okay.

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

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

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

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

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

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

MR. SCHMIDT: Understandable.

CHAIR ARMIJO: Yes.

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

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

MR. CIOCCO: Yes.

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

need to discuss it --

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

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

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

VICE CHAIR STETKAR: We appreciate that.

CHAIR ARMIJO: It is a good suggestion.

All right. Let's move on.

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

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

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

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

CHAIR ARMIJO: That is why I raised my point.

VICE CHAIR STETKAR: Anything else?

(No response.)

If not, thank you, sir.

MR. CIOCCO: Okay. Thank you.

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

Don, it is yours.

MR. WOODLAN: All right. Thank you.

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

Good afternoon.

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

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

Next slide, please.

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

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

Next slide.

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

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

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

MEMBER SKILLMAN: When you do add site-

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

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

MEMBER SKILLMAN: Okay. Thank you. Got it.

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

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

MR. WOODLAN: Yes.

VICE CHAIR STETKAR: The condenser circulating water cooling towers.

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

MEMBER SKILLMAN: Okay. Thank you. Okay.

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

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

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

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

Next slide.

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

did the Subcommittee briefings on some of these Chapters.

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

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

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

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

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

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

(Laughter.)

Okay. Thanks.

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

The next bullet, we talked about -- and I

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

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

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

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

of control of access at one of the vulnerable locations.

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

MR. WOODLAN: Okay.

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

Is that crisp enough?

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

MEMBER BROWN: Oh, yes. Oh, no.

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

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

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

(Laughter.)

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

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

MR. WOODLAN: Okay.

MEMBER BROWN: So, thank you.

MR. WOODLAN: Okay.

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

(Laughter.)

MEMBER SKILLMAN: Don, let me ask this.

MR. WOODLAN: Yes.

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

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

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

the record?

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

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

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

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

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

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

(Laughter.)

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

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

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

MEMBER BLEY: And the PRA.

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

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

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

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

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

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

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

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

MR. WOODLAN: Enhancing.

VICE CHAIR STETKAR: -- is where a lot of

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

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

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

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

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

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

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

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

And then, in the last one, we talked somewhat about what kind of quality is applied to some of the non-safety-related SSCs. The discussions stem from the DRAP program, where it is recognized that there are some SSCs in the DRAP that are not safety-

related. When it is safety-related, we all know Appendix B will be applied to those components. When they are not safety-related, it wasn't clear. So, we had a discussion, and we did point out that we will have specific quality controls, as appropriate, for those non-safety-related components.

VICE CHAIR STETKAR: And some of the discussion was back to, let's say, the level of refinement of the PRA itself; that if the PRA is used to inform that process -- for example, the main feedwater system is simply a line item right now, which is not something going forward from the DRAP to an implemented operational program that you can necessarily manage in the real world. Because, you know, by implication, any vent and drainline off of any piece of pipe anywhere in the main feedwater system, as it is currently listed, would be subject to those additional controls because it is listed in the DRAP just as main feedwater system. So, we had some discussion about that, which I think is the genesis of that --

MR. WOODLAN: Yes.

VICE CHAIR STETKAR: -- part of the genesis of that third sub-bullet there.

MR. WOODLAN: And we threw around multiple

terms like special treatment, automated QA --

VICE CHAIR STETKAR: Special treatment, there is a lot, ORAP, DRAP, RAP, whatever.

MR. WOODLAN: Yes.

VICE CHAIR STETKAR: Yes.

MR. WOODLAN: Okay. Next I have Chapter 19. We had a lot of discussions on Chapter 19, some of which we have already talked about today. But one, in particular, was the use of industry standards. There was a question about, you know, exactly how are we going to do this PRA, how are we going to do the enhancements. And we did point out that our methodology does reference specific industry standards. We intend on employing those as we do these enhancements.

And then, we also had a discussion on the LOLA, Loss of Large Area, a very high-level discussion, but we did discuss Luminant's strategies and how Luminant has incorporated this already in our application. We are addressing the issues, and we have provided a complete product to the NRC, which will, of course, be enhanced by the Fukushima followup activities.

VICE CHAIR STETKAR: We will have another Subcommittee meeting scheduled specifically on the

post-Fukushima issues once we get that scheduled, and from the Design Certification, their assessment of the aircraft impact analysis, which is a security-related issue.

MR. WOODLAN: And that concludes my presentation, unless the staff wants to talk about EOPs or wait until their presentation.

MR. MONARQUE: We are not ready to address EOPs.

VICE CHAIR STETKAR: Well, you are going to come up.

MR. MONARQUE: Yes.

VICE CHAIR STETKAR: We will let the musical chairs happen.

MR. WOODLAN: Okay.

VICE CHAIR STETKAR: Any members have any questions for Luminant, in particular, on any of those items?

(No response.)

If not, Don, thank you very much.

MR. WOODLAN: Thank you, John.

VICE CHAIR STETKAR: More efficient than normal even, and you are normally very efficient. So, we appreciate that.

We will have the staff come up.

And, Steve, you can address the EOPs first, and then get into your presentation.

I do note, while he is doing this, that the staff is, indeed, multi-talented.

(Laughter.)

MR. MONARQUE: Good afternoon.

My name is Steve Monarque.

I want to thank the ACRS full Committee for giving me the opportunity to present our seven Chapters today for the Committee. This is our second presentation before a full Committee with regards to Comanche Peak.

The Chapters I will be presenting today will be Safety Evaluation Reports with Open Items, Chapters 4, 13, 15, 16, 17, and 19, including LOLA.

And to get back on the question regarding emergency operating procedures, I need to take it back as an action item. We will get back to you on that, because we are still researching that.

VICE CHAIR STETKAR: Okay. Thanks.

MR. MONARQUE: Thanks.

Okay. As I said before, today I am presenting seven Chapters before the full Committee, and I have identified significant issues for Chapters 16 and 19 that I want to discuss in detail.

Okay. Chapter 4. Chapter 4 addresses the fuel system, nuclear and thermal hydraulic designs, reactor materials, reactivity control system, functional design. We presented this, our Safety Evaluation, to the full Committee last October. This was 100-percent IBR, no issues to be discussed.

Okay. Chapter 13, Conduct of Operations, 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. And I should note that Luminant has submitted their proposed implementation for the new emergency planning rule, and the staff will be evaluating that.

And also, the staff is waiting for Luminant to provide their response for Fukushima as it relates to emergency planning.

Okay. And we presented Chapter 13, Safety Evaluation, to the --

VICE CHAIR STETKAR: Steve, in terms of Fukushima, you mentioned emergency planning. Is there also Fukushima-related action items, or I don't know how they are cast for the Applicants, related to thinks like Near-Term Task Force Recommendation 8 regarding integration of emergency operating

procedures, SAMGs, organizational requirements for multi-unit accidents? Is that covered under Chapter 13, Fukushima issues? I mean, you specifically highlighted emergency planning.

MR. MONARQUE: Correct. I know the Applicant is going to provide a response.

Dan, can you --

VICE CHAIR STETKAR: But I was curious how that NTTF Recommendation 8 topic affected the COL Applicants, because we do have a COLA for a multi-unit site here now, 3 and 4.

MR. TAKACS: Right. This is Mike Takacs, Project Manager for 13.

I can't answer 8, but for 9.3 --

VICE CHAIR STETKAR: 9.3, I get it.

MR. TAKACS: You get that, but --

VICE CHAIR STETKAR: Yes.

MR. TAKACS: -- 8 I can't answer right now. I will follow up.

VICE CHAIR STETKAR: Because, in principle, that comes under 13, well, I mean functionally.

MR. TAKACS: For the SAMGs?

VICE CHAIR STETKAR: Well, EOPs, SAMGs, and in terms of staffing for multi-unit, because that

is also part of 8, right? Well, I mean, it is 8 and 10 and --

MR. TAKACS: It is the Near-Term Task Force, 8, yes, correct.

VICE CHAIR STETKAR: Yes, and then 9. Yes.

MR. TAKACS: And I will have to follow up on that for you.

VICE CHAIR STETKAR: Okay. As I said, we will have a separate Subcommittee meeting to find out how they are addressing all of the --

MR. TAKACS: The 9.3 will be a license condition, as you know.

VICE CHAIR STETKAR: Yes. Yes, that is clear.

MR. TAKACS: Okay.

MR. CIOCCO: John, Steve has issued the RAIs related to the Fukushima Near-Term Task Force. MHI hasn't submitted its Fukushima evaluation yet.

Is that correct, Don?

MR. MONARQUE: Well, they haven't submitted their complete -- go ahead, Don.

MR. WOODLAN: I assume you mean Luminant hasn't submitted it yet.

VICE CHAIR STETKAR: Luminant hasn't,

correct.

(Laughter.)

MR. WOODLAN: No, we have not. We submitted a very high-level, brief response, recognizing that there were three issues that were picked up as being issues required to be addressed for licensing, and we are working on those. We are supposed to have responses to those as well as kind of an overall Fukushima evaluation thus far in the August timeframe of this year.

VICE CHAIR STETKAR: Okay. And I hope Recommendation No. 8 is part of whatever you are working on.

MR. WOODLAN: Well, you probably know that the Commission and the staff have developed kind of a sequencing of which ones are to be addressed for new plants as part of licensing --

VICE CHAIR STETKAR: Yes, yes.

MR. WOODLAN: -- which ones prior to fuel load, and things like that. I don't remember where 8 falls.

VICE CHAIR STETKAR: Yes, and I honestly don't remember exactly where that one is in this. So, thanks.

MR. MONARQUE: Okay. With that, I will go

to Chapter 15. Chapter 15 addresses the analysis of the plant's responses to postulated disturbances and postulated equipment failures or malfunctions. We presented this to the Subcommittee in July of last year. This was IBR with the exception of design basis accident radiological consequences analysis. We do not have any open items, and I didn't identify any issues to be discussed today.

Okay. I am going out of order now because I am going to present 16 and 19 at the end, where I have issues.

Chapter 17 addresses the Quality Assurance and Reliability Assurance programs and the Applicant's program for implementing 10 CFR Maintenance Rule, 50.65. We presented the Safety Evaluation to the Subcommittee in February of this year. There are no issues to be discussed.

And LOLA, also large areas of the plant due to explosions or fires, I gave a synopsis of the rule in 10 CFR 50.54(hh)(2), where the Applicant has to develop and implement guidance and strategies intended to maintain or restore core cooling, containment, and spent-fuel capabilities associated with LOLA, Loss of Large Areas of the plant due to explosions or fire. We presented the Safety

Evaluation to the Subcommittee in February 2013. No issues were identified.

Chapter 16, we identify an issue regarding implementation of risk-managed tech specs, Surveillance Frequency Control Program. Comanche Peak Units 3 and 4 are adopting the risk-managed tech specs, technical specifications, and Surveillance Frequency Control Program, using risk information with specific PRA requirements.

Since the Comanche Peak PRA reflecting the as-built, as-to-be-operated plant will not be available at the time of the COL issuance, when tech specs is complete, a tech spec methodology is needed in accordance with Option 3 of the Interim Staff Guidance 08, for completing a PRA that is adequate for risk-managed tech specs and Surveillance Frequency Control Program applications.

Risk-managed tech specs and Surveillance Frequency Control Programs require programs in the Comanche Peak tech spec admin control section referencing the approved NEI Topical Reports 04-10 and 06-09 methodology documents. The Comanche Peak tech spec methodology is referenced in the tech spec admin control section along with the two NEI Topical Reports.

Any questions before I go to 19?

(No response.)

Chapter 19, I have identified two areas for discussion. The first one is external events. Reg Guide 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 low-risk profiles, the quantitative screening value should be adjusted according to the relative baseline risk value, consistent with a list of external hazards identified in ASME/ANS RA-Sa-2009, Appendix 6-1, List of External Hazards Requiring Consideration.

The staff's acceptance of Chapter 19, External Hazards, will be contingent in part on the completion of the review of SER COL Chapter 2 and Chapter 3.

VICE CHAIR STETKAR: For those of you who don't speak all of this stuff, it means you ought not to screen out something because it is less than 10 to the minus 6, if your total core damage frequency is 0.5 times 10 to the minus 7.

MR. MONARQUE: The last one, the last issue we brought up, we want to bring up before the full Committee is application of the risk-informed

technical specifications. In response to the staff's RAI, Luminant has made the following commitments regarding the use of PRA to support risk-informed tech specs:

Site-specific models will be included in the first 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 upgrade.

And peer review will be performed and findings will be resolved prior to initial fuel load.

Okay. The last slide, regarding the risk-informed tech specs, in its response to the RAI 32-87, Question 19.3, the Applicant provided the following statements:

"The PRA for risk-managed tech specs 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 plus an early large release frequency.

"Contributions from external events, internal flooding events, and internal fire events

must also be considered.

"The PRA for risk-managed tech specs will be updated to satisfy the PRA technical adequacy described in the NEI guideline, and will be available one year prior to fuel load."

VICE CHAIR STETKAR: Stephen, because we haven't faced this type of application before, because the PRA will be used for risk-informed application, does the staff review the PRA for its adequacy to perform, to support that application? In other words, do you perform a formal review of the PRA? Because in other Design Centers there are words that say the PRA must be consistent with as-built, as-operated plants, consistent with, you know, the procedures, and that has to be accomplished one year prior to fuel load --

MR. MONARQUE: Right.

VICE CHAIR STETKAR: -- according to whatever standards are in place, and all of that.

But, at that point, the PRA is only, from the staff's perspective, as I understand it, the staff can go audit that PRA, but there is no requirement for the staff to review the PRA.

MR. MONARQUE: Yes.

VICE CHAIR STETKAR: Because it is not actually being used for anything at that point.

MR. MONARQUE: We have Lynn Mrowca here, the Branch Chief.

VICE CHAIR STETKAR: Hi, Lynn.

MS. MROWCA: Hi.

MR. MONARQUE: Go ahead, Lynn.

MS. MROWCA: I am Lynn.

John, you're right --

VICE CHAIR STETKAR: Actually, for the record, your last name also.

MS. MROWCA: For the record, I am Lynn Mrowca --

VICE CHAIR STETKAR: Thank you.

MS. MROWCA: -- from the NRC.

And that is true, John, that we don't have any requirements to audit that PRA, but there has been precedent to perform an implementation inspection after they do implement the risk-informed tech specs. So, I think that is one way that we have precedent to do that, to look at the PRA as it has been implemented. It doesn't mean that we won't do something else, but that is a precedent that has already been set.

MEMBER BLEY: Once that PRA is finished, though, Reg Guide 1.200 requires the same thing, that they have to do a peer review of the complete base PRA

as completed at that point, not rely on the peer reviews, or whatever, of the DCD PRA which wasn't complete.

MS. MROWCA: That is correct. So, they will have a peer review.

VICE CHAIR STETKAR: But there is no requirement that the staff, then --

MS. MROWCA: No.

VICE CHAIR STETKAR: -- independently --

MS. MROWCA: That is correct.

MEMBER BLEY: But you can audit both --

VICE CHAIR STETKAR: Can audit.

MEMBER BLEY: -- the peer review and the PRA itself.

MS. MROWCA: Yes, we can audit it when it is ready.

VICE CHAIR STETKAR: Good. Thank you.

MEMBER SKILLMAN: Let me ask this, please: with, if you will, the risk-informed or risk management tech specs, there is an even heightened requirement for configuration control in that plant, such that if there is a physical change or an operating procedure change or an emergency procedure change that tilts the risk, what has been assumed to be acceptable in the tech specs may no longer be as

acceptable as it once was.

What consideration has been given to, if you will, the tightness of the configuration control programs at the site to ensure that there isn't a fading of crispness for the accuracy of the risk-managed tech specs?

MS. MROWCA: If Bob Tjader wants to add to this, fine. But, basically, in their tech specs, they commit to the NEI documents to provide guidance, and there are requirements in there for controlling your configuration, make sure your PRA is updated, those types of things.

MEMBER SKILLMAN: Thank you.

MR. MONARQUE: The other thing is I should add to supplement your answer, we do have a mechanism in place where they would have to do 50.59 screening and come in for a license amendment if there was a configuration change.

VICE CHAIR STETKAR: That has a significant affect on risk --

MR. MONARQUE: Right, risk.

VICE CHAIR STETKAR: -- under Reg Guide 1.174. Otherwise --

MR. MONARQUE: Or they would have to come in for staff approval.

VICE CHAIR STETKAR: Yes, staff approval only if they have a significant effect on risk, right. Otherwise, the process is they can make the changes under a 50.59-like approach, and the staff -- you know, it is available for audit --

MR. MONARQUE: Yes.

VICE CHAIR STETKAR: -- but the staff doesn't review it.

MEMBER BLEY: Something I am not clear about, because I don't know if it is under regulations or agreements, or where it came up, but over the years staff has developed, through its contractor labs, their own PRA models for operating plants that have been, at least to some extent, validated against the licensee's own PRAs.

For new plants coming along, is there a requirement or how does this happen for the new plants? Does it happen for the new plants?

MS. MROWCA: Yes. Yes, we have already been working on development of them. In fact, for this design, we do have an internal events SPAR model for the APWR. And as we get closer to fuel load, we plan to have a full scope here, internal fires, internal floods, all those SPAR-model modules available, so that we can use them for the

significance determination process in the ROP.

MEMBER BLEY: Can you tell us a little bit about how those get validated against the owner's PRAs?

MS. MROWCA: Well, currently, we haven't been able to do that. I think for the internal -- well, actually, at fuel load, when we have the site-specific PRA available, that is when we will do that.

MEMBER BLEY: That is a year, at least a year before fuel load.

MS. MROWCA: Yes, we can do it at any time when they are ready. I mean, our plan is to have those available prior to fuel load. And so, we could do that comparison at any time, the benchmarking to ensure that our SPAR models will give pretty much the same results as the licensee's --

MEMBER BLEY: So, you gain confidence in their own --

MS. MROWCA: Uh-hum.

MEMBER BLEY: Okay. Thanks.

MR. MONARQUE: Okay. And this concludes my presentation.

VICE CHAIR STETKAR: Anything else for the staff on Comanche Peak?

(No response.)

If not, Stephen --

MR. MONARQUE: Okay. Thank you.

VICE CHAIR STETKAR: -- you covered a lot of ground very well. And again, I appreciate it.

And to everybody this afternoon, you managed to squeeze an awful lot of information into more than efficient time management. So, we appreciate that.

Mr. Chairman, it is back to you.

CHAIR ARMIJO: Well, congratulations, John. I think we are well ahead of schedule.

We will take a 15-minute break and reconvene at three o'clock, and we will start on letter-writing.

(Whereupon, at 2:45 p.m., the Open Session was concluded.)

ABWR Fuel LTR – WCAP-17116-P

Westinghouse BWR ECCS Evaluation Model: Supplement 5 – Application to the ABWR

Presentation to ACRS

04/11/2013

Westinghouse

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

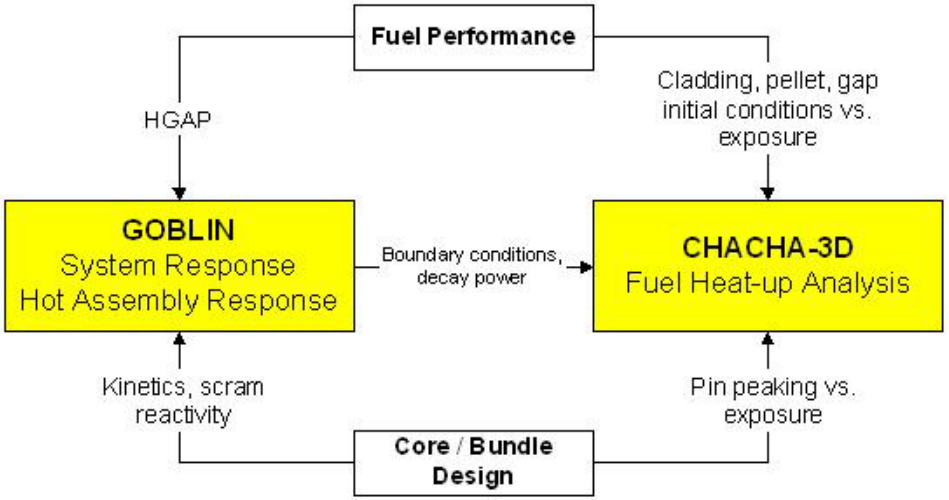
Westinghouse

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**

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Westinghouse Methodology

- 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

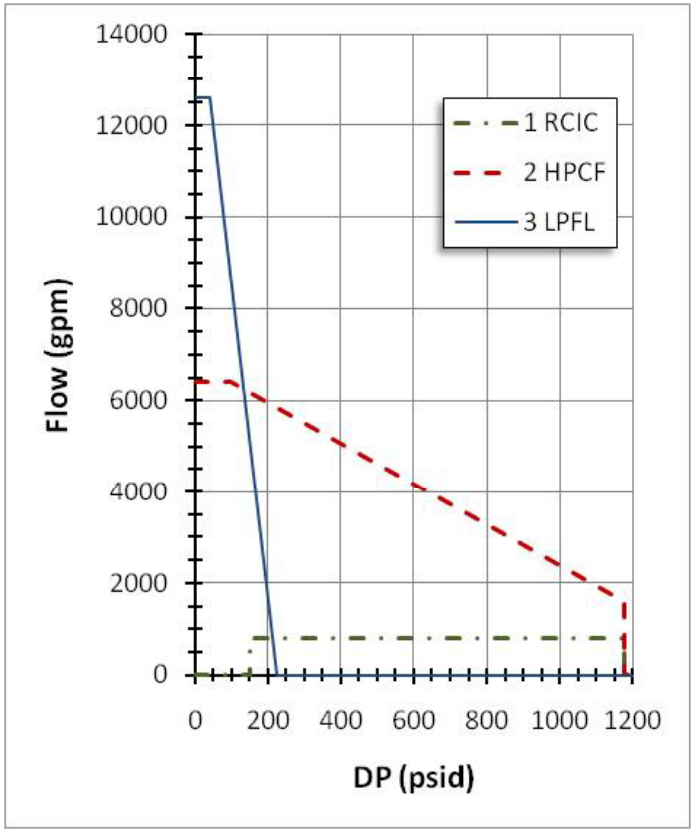
- Recirculation System
  - 10 Reactor Internal Pumps (RIPs) vs. 2 external loops / jet pumps
  - Lower inertia leads to faster coastdown time constant (< 1s vs. ~ 5s)
- No Large Breaks Below Top of Active Fuel (TAF)

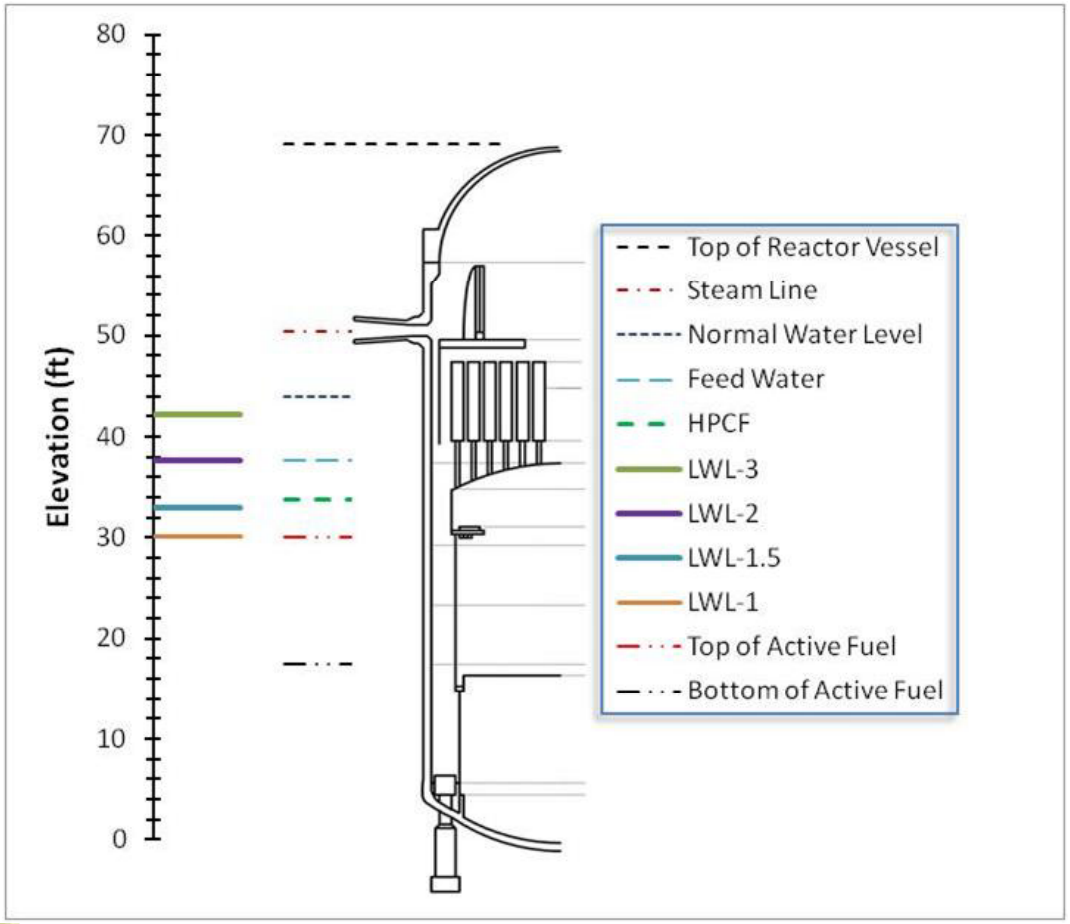
Break	Area	Elev. Above TAF
BWR Recirculation Line Break (double-ended)	7.23 ft^2	-16.7 ft
ABWR Steam Line Break (after MSIV isolation)	1.06 ft^2	20.4 ft
ABWR FW Line Break (vessel side)	0.90 ft^2	7.6 ft
ABWR RHR Suction Line Break	0.85 ft^2	5.8 ft
ABWR HPCF Line Break	0.10 ft^2	3.2 ft
ABWR Bottom Drain Line Break	0.02 ft^2	-30.0 ft

Important Features of the ABWR

- 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





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ABWR Evaluation Model

- **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 < 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

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ABWR Evaluation Model

- Modeling Considerations
  - Fast Coastdown of RIPs Expected to Result in Early Dryout
    - Core noding 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

	Available ECCS				
Break Location	RCIC	HPCF	LPFL	ADS	**Failure**
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

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Break Spectrum Results

Break Location	PCT °F	Minimum Inventory (Mlb)
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

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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 uncovery limited to some low power assemblies for HPCF break only but does not lead to PCT
- The model is applicable to the ABWR

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Response Question from ACRS Subcommittee Meeting

- HPCF Line Break
  - Results in partial uncovery 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 uncovery?*

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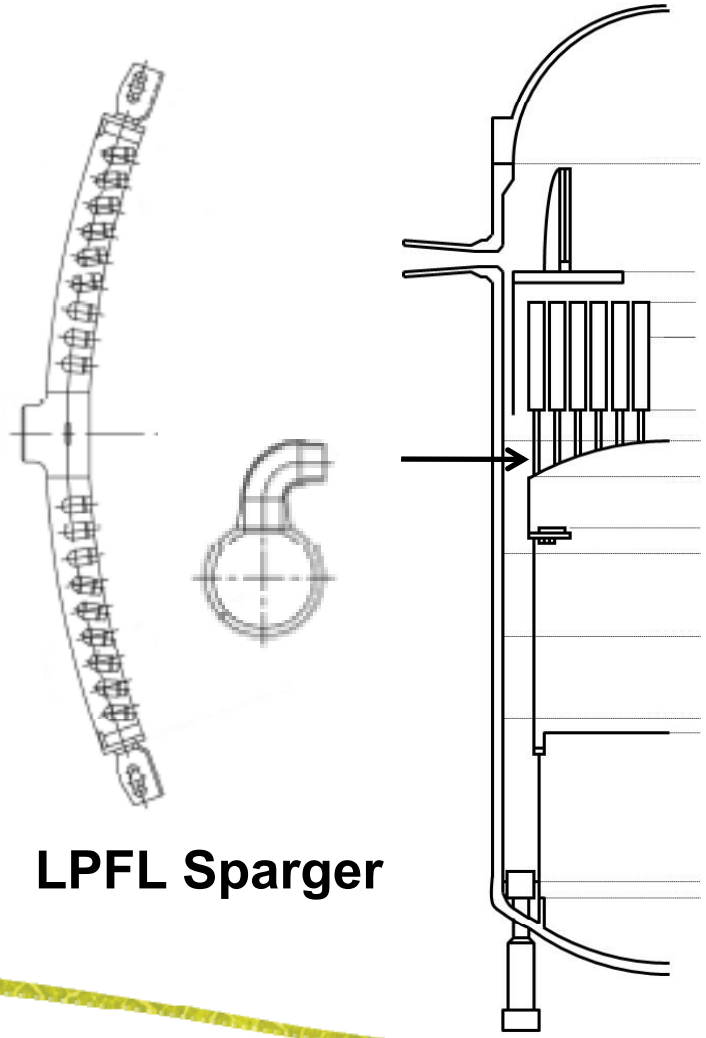
Response Question from ACRS Subcommittee Meeting

- 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 ~ 5 – 25 ft/s, depending on the sparger
  - Injection made along a minimum of 180° of circumference



LPFL Sparger

Response Question from ACRS Subcommittee Meeting

- 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

- 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

- Results of the study:
  - The hot assembly is unaffected – PCT (1306°F) occurs during pump coastdown and there is no subsequent uncovery
  - Some low power assemblies might see ~ 1 ft additional uncovery 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

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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

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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

United States Nuclear Regulatory Commission
Protecting People and the Environment

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)

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- LOCA Behavior
  - Rapid coastdown of RIPs results in early boiling transition
  - Typical extended core uncovery 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)

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- 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

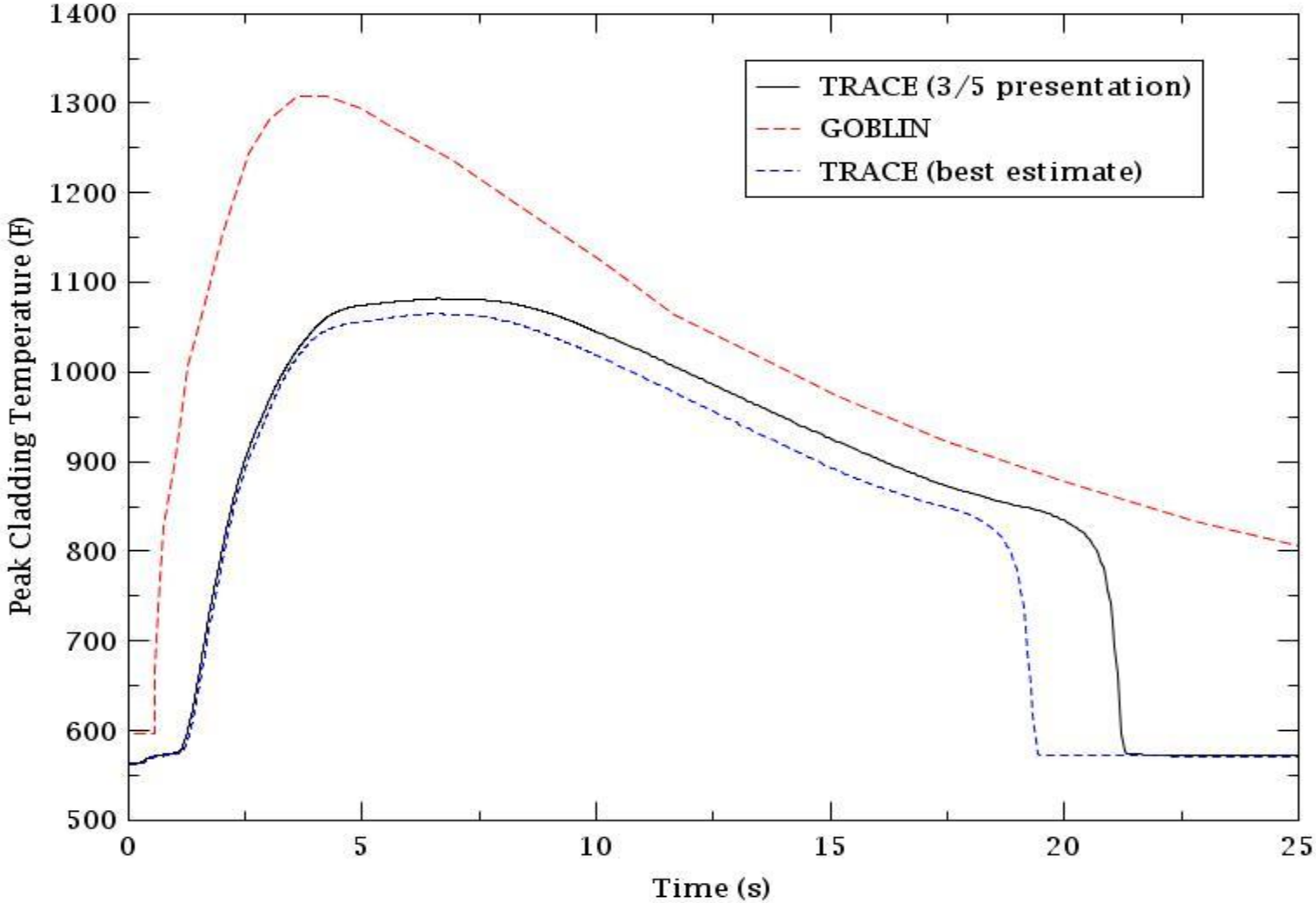
RES Staff LOCA Analysis Results

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 flooder 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-scram 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 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

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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
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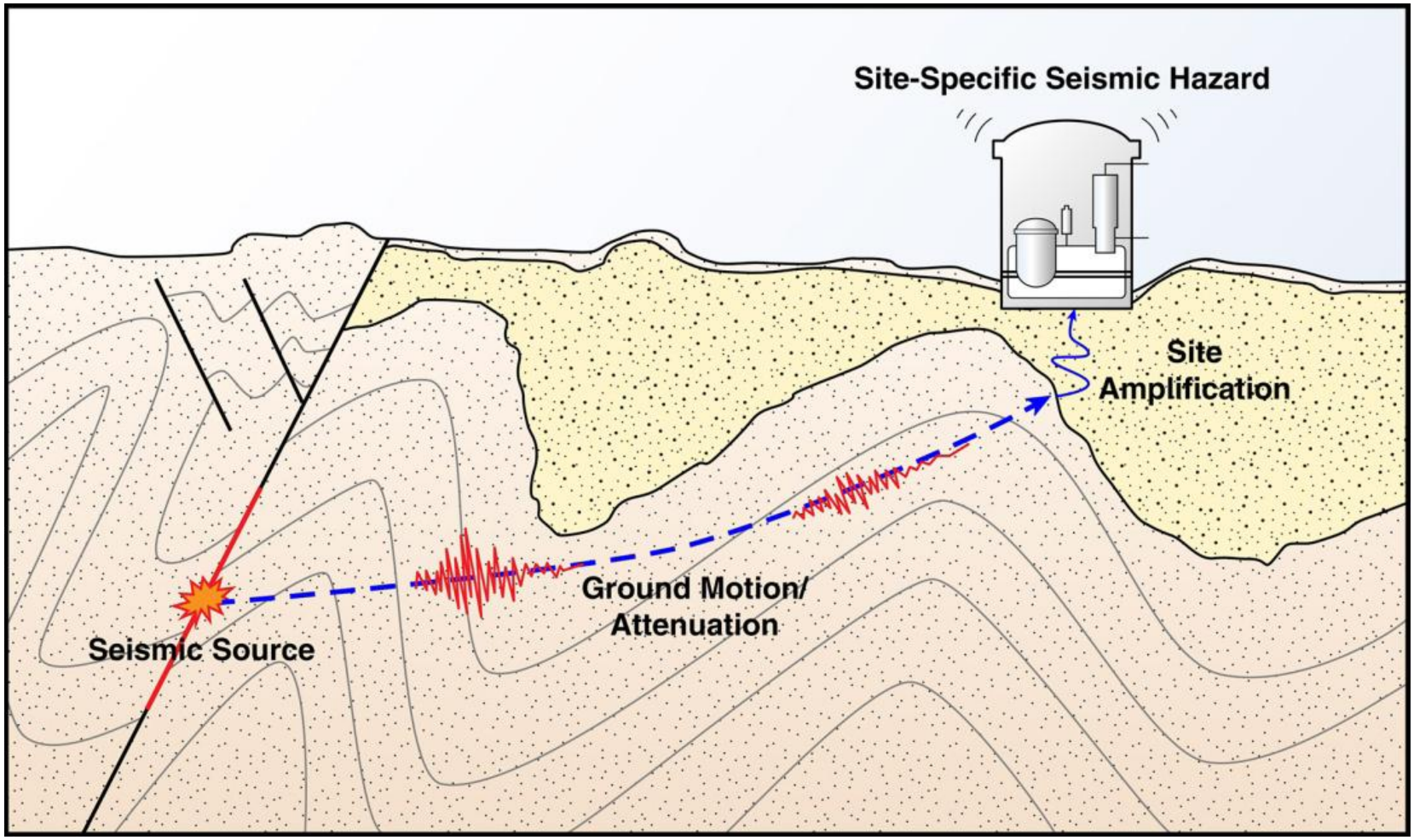
Outline of Presentation

- Background
- EPRI (2004, 2006) Ground Motion Model
- Update of Model
- Path Forward

Site-Specific Seismic Hazard Development



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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

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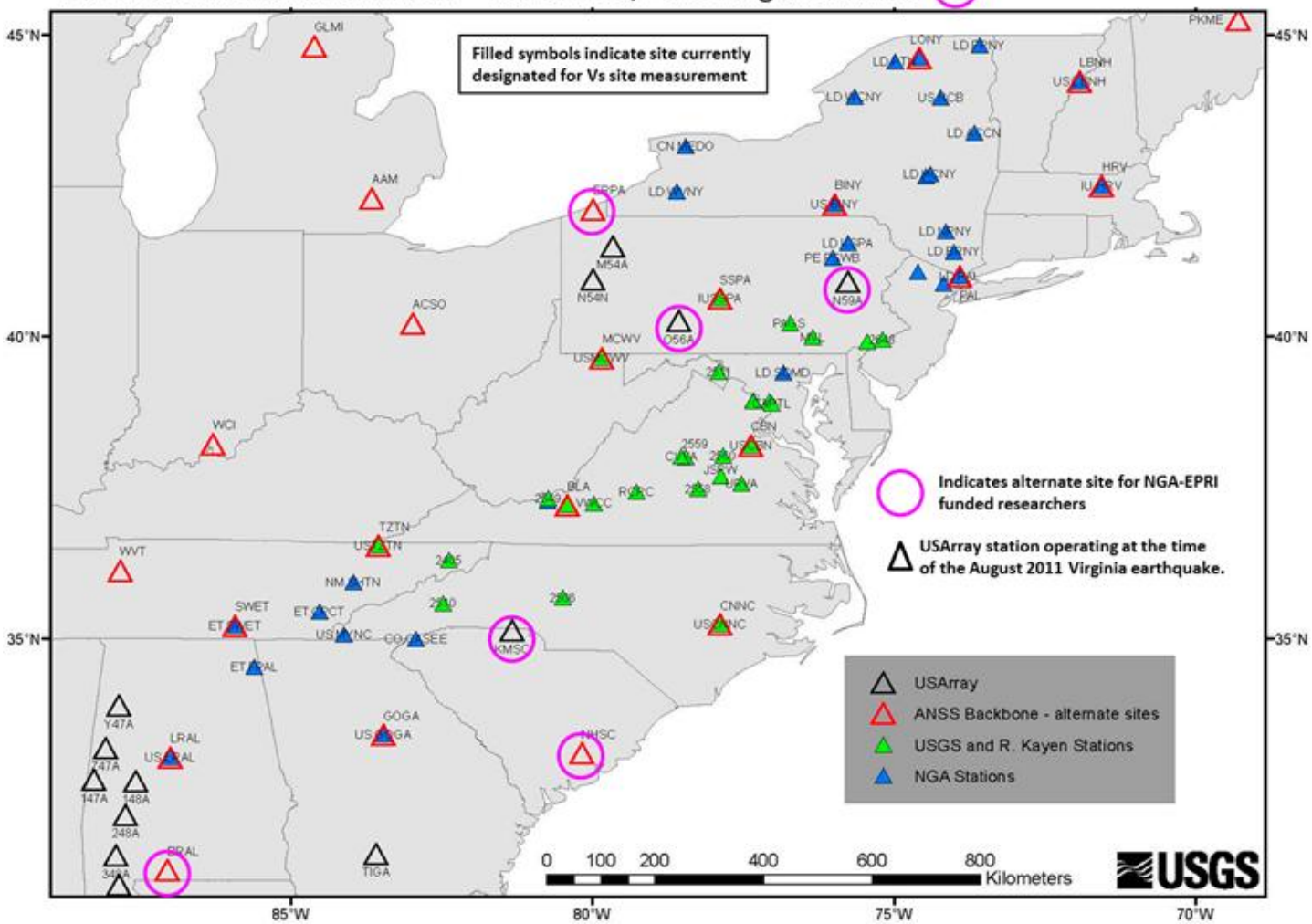
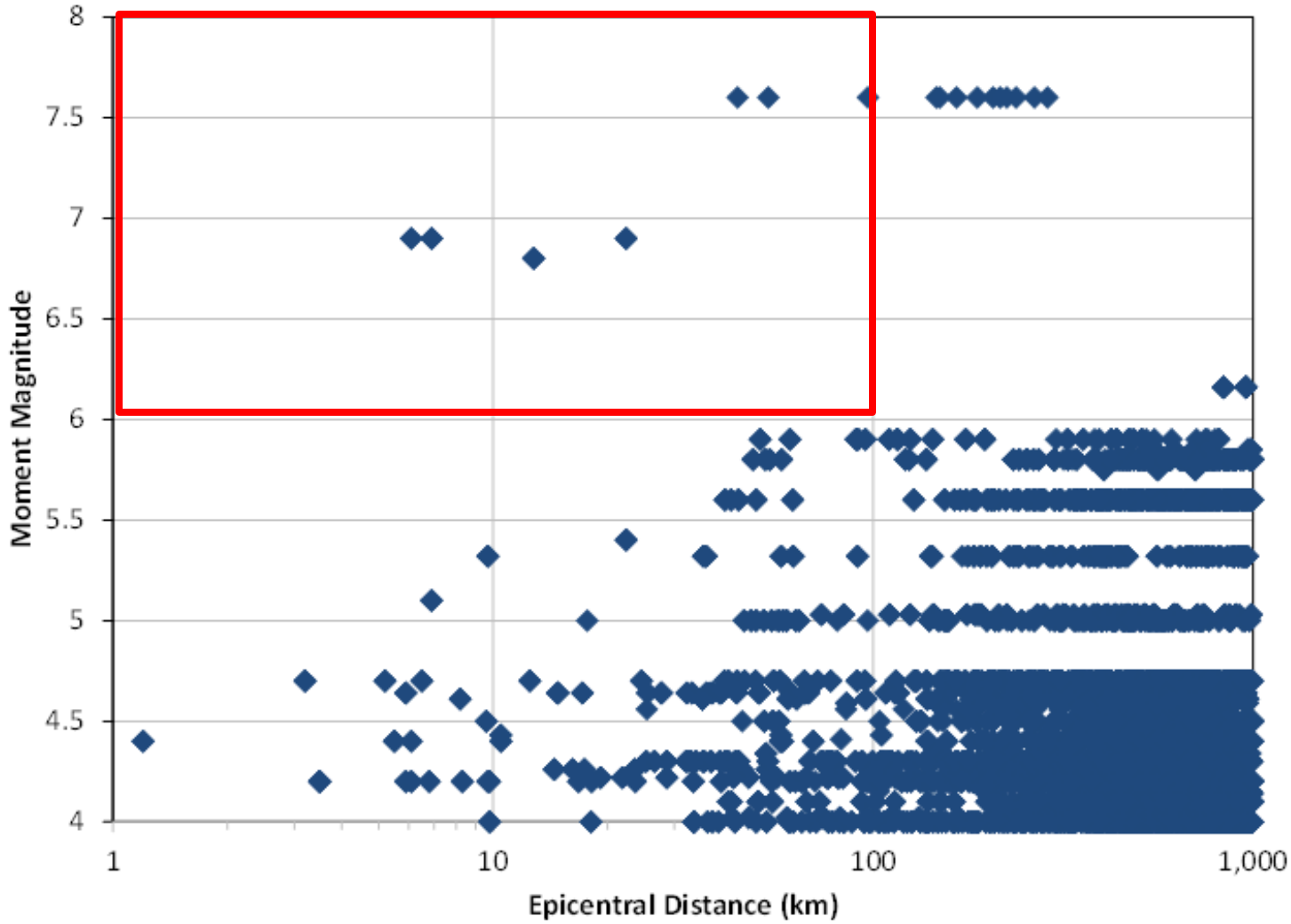
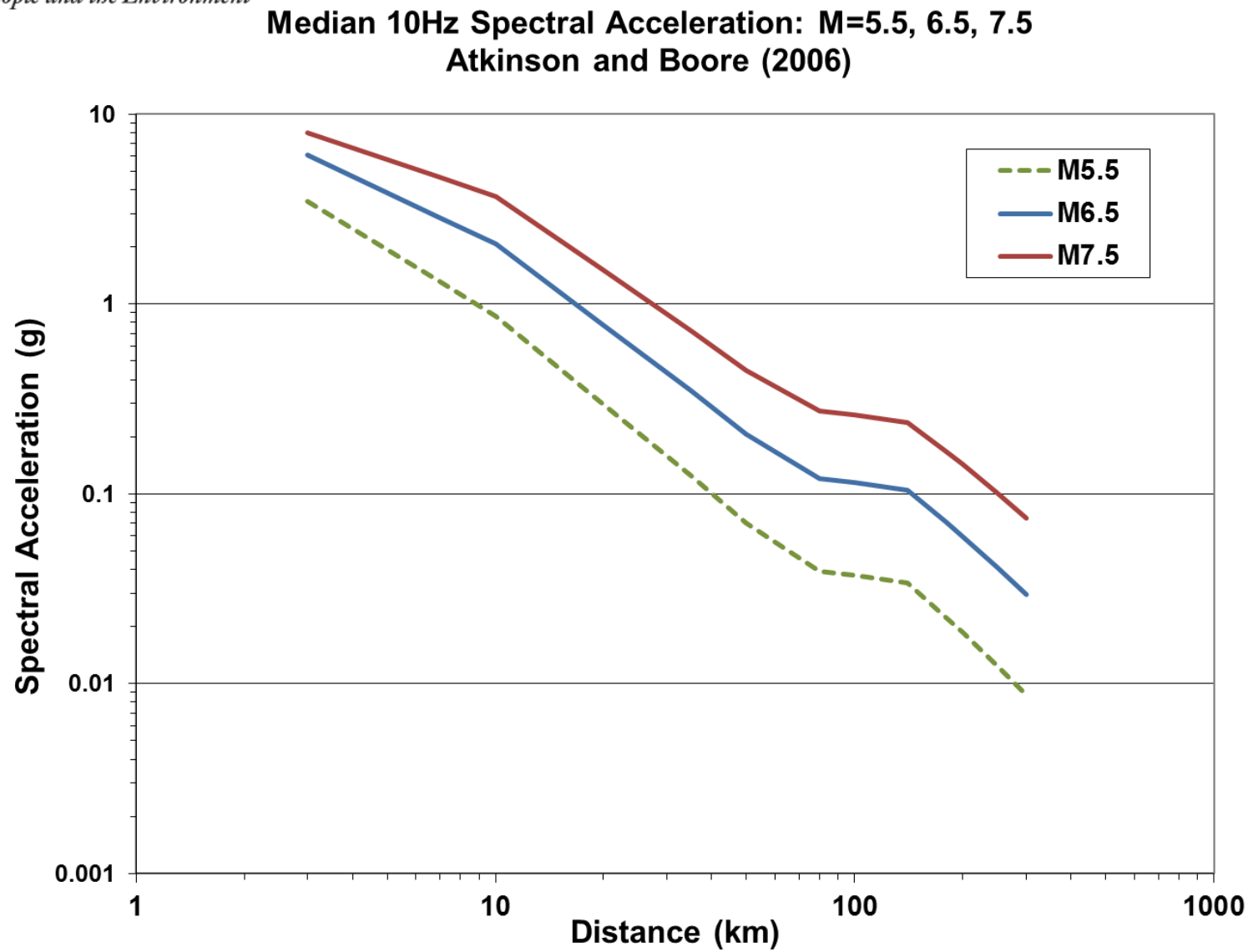
2012 Vs Site Characterization – Eastern US; showing alternates



MAGNITUDE-DISTANCE PLOT



Example Ground Motion Model



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)

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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

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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 ~R^{-1} Geometrical spreading	Silva et al (2002) DC – Sat Atkinson (2008')
3	Complex/Empirical ~$R^{-1.3}$ Geometrical spreading	Atkinson & Boore (2006') Pezeshk et al (2011)
4	Finite Source /Green's Function	Somerville et al. (2001)

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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

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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.

Presenters

- **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

Introduction

- **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

Chapter 4 – Reactor

- **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

Chapter 4 – Topical Reports

- **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

Chapter 15 – Transient and Accident Analyses

- **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**

Chapter 15 – Topical Reports

- **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

Chapter 17 – QA and Reliability Assurance

- **ACRS Subcommittee meeting held February 2013**
- **No SE Open Items**
- **SE Confirmatory Items to be closed following DCD Rev 4 submittal**
- **No current RAIs**
- **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**

Chapter 19 – PRA and SA Evaluation

- **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

Chapter 19 – PRA and SA Evaluation (cont.)

- **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 GENERATION COMPANY

Comanche Peak Nuclear Power Plant, Units 3 and 4

603rd ACRS Meeting

FSAR Chapters
4, 13, 15, 16, 17, 19

April 11, 2013

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 <u>any</u> 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**

Acronyms

- ASLB — Atomic Safety and Licensing Board
- COL — Combined License
- DCD — Design Control Document
- DRAP — Design Reliability Assurance Program
- EOP — Emergency Operating Procedure
- FSAR — Final Safety Analysis Report
- ITS — Important to Safety
- LOLA — Loss of Large Areas
- ORAP — Operations Reliability Assurance Program
- PRA — Probabilistic Risk Assessment
- R-COLA — Reference Combined License Application
- RITS — Risk-Informed Technical Specifications
- SER — Safety Evaluation Report
- US-APWR — United States Advanced Pressurized Water Reactor

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Presentation to the ACRS Full Committee – 603rd 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

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- 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

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- 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 29th, 2013, MHI provided responses to ACRS questions from the October 18, 2012, meeting.

US-APWR Chapter 15 Transient and Accident Analyses

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- 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

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- 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

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- 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)

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- **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)

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- **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, Question19-494.

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 29th, 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 4th and March 26th, 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 28th, 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 28th, 2013, MHI provided responses to ACRS questions from the July 2012 meeting.

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Presentation to the ACRS Full Committee – 603rd 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

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- 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

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- 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

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- 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

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- 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/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)

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- 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

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- 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."