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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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AP1000 SUBCOMMITTEE

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WEDNESDAY

OCTOBER 21, 2015

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Harold B. Ray, Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD B. RAY, Chairman

DENNIS C. BLEY, Member

SANJOY BANERJEE, Member

JOY L. REMPE, Member

PETER RICCARDELLA, Member

STEPHEN P. SCHULTZ, Member

GORDON R. SKILLMAN, Member

ACRS CONSULTANT:

BILL HINZE

DESIGNATED FEDERAL OFFICIAL:

PETER WEN

C O N T E N T S

P R O C E E D I N G S

8:31 a.m.

CHAIRMAN RAY: This is a meeting of the AP1000 Subcommittee. I am Harold Ray, Chairman of the Subcommittee.

The meeting is scheduled for two days. And will continue tomorrow for as long as necessary up to the full day.

ACRS members in attendance are Peter Riccardella, Steve Schultz, Dick Skillman, Joy Rempe and Dennis Bley. We may be joined later by Sanjoy Banerjee.

In addition, ACRS Consultant, Dr. Bill Hinze is participating in this meeting via a dedicated telephone line. Peter Wen of the ACRS staff is the designated Federal Official for this meeting.

The purpose of this meeting is to review the William States Lee Nuclear Station, Units One and Two, combined license application. We will hear presentations from Duke Energy and NRC Staff.

The entire meeting will be open to the public. This Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions appropriate for deliberation by the full Committee.

This license application is being processed in accordance with what is known as a design-centered review approach. The reference plant using this approach for AP1000 is the Vogtle Electric Generating Plant.

The Williams States Lee Nuclear Station is known as a subsequent plant application. In this regard, this meeting of the Subcommittee will limit its review scope to the Lee site specific matters.

There are other non-site specific matters which are involved in the Lee COLA, but which will not be discussed at this Subcommittee meeting.

These matters are expected to first be addressed at meeting of another subsequent plant application subcommittee. This is the Levy Subcommittee and the meeting has not yet been scheduled.

Following completion of Subcommittee review of Lee site specific matters and completion of the Committee review of the non-site specific matters which are common to Lee and other AP1000 COLA holders and applicants, Lee is expected to be scheduled to meet with the full Committee.

The rules for participation at today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register. The detail procedures for the conduct of and participation in ACRS meetings were published in the Federal Register on November 8, 2013.

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

A transcript of the meeting is being kept. And will be made available as stated in the Federal Register notice.

Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. Participants should first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We may have people on the public phone bridge line, which is separate from the one that Dr. Hinze is on. To preclude interruption of the meeting, this phone line will be placed on a listen in mode.

We will open the line for any public comment at the end of today's meeting, prior to our recess. And then again at the conclusion of the meeting tomorrow, whenever that occurs.

We'll now proceed with the meeting. And I'll call upon Mr. Brian Hughes at NRO staff to begin.

MR. HUGHES: Chairman Ray --

CHAIRMAN RAY: Yes, you'll have to use your microphone as I did mine too. It's near you. The push button. Okay.

MR. HUGHES: Chairman Ray, members, I want to thank you for scheduling this AP1000 Subcommittee meeting for the William States Lee III Nuclear Station, Units One and Two, combined operating licenses.

My name is Brian Hughes. I am the Senior Project Manager for the Lee application for the combined license application.

Next to me is Lawrence Burkhart. Larry is the Branch Chief for the NRO AP1000 projects, both license and applications.

I'll turn this to Larry.

MR. BURKHART: Yes, thank you, Mr. Chairman for setting out the details of the design-centered review approach. This is the fourth combined license application referencing the AP1000 that has come to this stage to discuss the application with the ACRS.

So we look forward to that interchange and the presentations by Duke, the applicant and the NRC staff. Of course the design-centered review approach is one issue, one review, one position. I think the ACRS as well is familiar with that today.

As Mr. Ray said, we are focusing on the site specific issues of the Lee plant. There are about five or six what we call generic issues, design changes, that are applicable to all the AP1000s, which will come to the ACRS with -- separately under the Levy Docket.

And we'll talk about the logistics of that. So, we can eventually achieve a letter from the full Committee for Lee. And I want to that Turkey Point also is the next combined license applicant that is kind of in the same situation.

So, we look forward to working with the ACRS and the logistics of how we work the site specific issues and the generic issues. And we're looking for feedback on how productive this meeting and light -- that it has to be paired up with another meeting on these generic issues.

So again, I just want to say again,

thank you for all your efforts at the ACRS, the ACRS staff and the applicant, Westinghouse and the NRC staff. And thank you very much for the opportunity to be here today.

MR. HUGHES: Thank you. And I want to say further, is Duke Energy proposes to construct and operate two Westinghouse AP1000 reactors at their owned and controlled William States Lee Nuclear Station, Units One and Two. A 1,900-acre site, which is located in a rural Cherokee County, South Carolina.

The two AP1000 reactors are referred to the -- as the Lee Nuclear Station. With the abbreviation WLS, Units 1 and 2.

On the site there are no industrial, military, commercial, recreation or residential structures within the site area.

There is a railroad spur from the main railroad and a box running for at a quarter mile away that does come into the site, which is controlled by Duke. And that will be used for delivery of heavy equipment and material when the time comes.

At the site, there used to be the three unit PWR Cherokee. Cherokee was started and then subsequently cancelled.

And in fact Lee Unit 1 is planned to be built right on top of the former Cherokee Unit 1 concrete. The Unit 1 concrete was inspected by Region II prior to the -- well, they sub-surfaced the rock and job prior to the original pour.

Those documents are located in a public document room. We did -- they were part of the review.

The original Cherokee borings, the site documents and photos, were used for the Unit 1 geology mapping. In addition, some recent borings and borings of the concrete, and that will be discussed when we get into the geology portion.

The Cherokee buildings that were there were demolished. And either recycled or used as what they call riprap on make up on B.

Again, as Chairman Ray stated, this meeting will provide you with site specific information related to the review using the Central Eastern U.S. Lee hard rock, geological, seismic, and hydrological properties that interface with the AP1000 requirements.

And again, this will be the first post-Fukushima AP1000 hard rock site to be presented.

And there will also be a presentation of a new approach using a combination of habit and ALORA codes where we have a chlorine tanker truck release accident was analyzed.

And due to the extended travel times and the limitations on the code run time, they used both codes. And they'll explain that in detail when we get there.

At this time, if there is no further questions, or any questions, I will turn it over to Duke Energy.

MEMBER SKILLMAN: Let me ask a question Brian. Well, you said there are no structures. This 1,900 acre site is bounded on the east by the Broad River. But it's really the 99 Mile Islands Reservoir.

MR. HUGHES: That is correct.

MEMBER SKILLMAN: And I know something about this portion of South Carolina and North Carolina. I would think that there are fishing camps and recreational structures dotting the land along that beautiful piece of waterway.

So, when you say structures, do you mean 100 percent all? Or only industrial?

MR. HUGHES: I would say there are no

camps. There are no homes. No residential areas. There are -- this is an old warehouse. There are several recent buildings.

And there is a place where they have a security individual to keep the fishing and hunting off the site. It doesn't go well with the locals because that was their fishing.

But unfortunately, it's not open for public use.

MEMBER SKILLMAN: Yes, sir. Thank you.

MR. HUGHES: And I'll turn it over to Duke. Any further questions also?

CHAIRMAN RAY: Thank you, Brian.

MR. HUGHES: Thank you, Mr. Chairman.

MR. KITCHEN: Good morning Mr. Ray. Good morning members of the ACRS. Before I get started on the presentation, Chris Fallon, who's our Vice President on Nuclear Development, has just a few opening comments. And then we'll start.

CHAIRMAN RAY: Please.

MR. FALLON: Good morning Chairman Ray and members of the Committee. Thank you very much for having us here today.

As Bob said, my name is Chris Fallon. I'm Vice President of Nuclear Development.

And today, we plan to present the Lee COL application with a focus on the site specific aspects of our application. In selecting a site for new nuclear generation, Duke Energy considered sites in South Carolina and North Carolina.

A rigorous evaluation based on the EPRI site selection guidelines resulted in the selection of the Lee site near Gaffney, South Carolina. A site that was previously selected for a three unit PWR in the 1970s.

Our focus today will be to discuss the site specific challenges that we've identified. And how each of these challenges have been addressed.

Duke Energy submitted the Lee COLA in December 2007. Our application is based upon the AP1000 DCD, revision 19 with minimal departures.

We will discuss the departures that are unique to the Lee COLA in our ACRS presentations today. We have closely monitored the development of the AP1000 detailed design through our active involvement in the AP1000 Design-Centered Working Group.

And have identified five exemptions resulting from detailed design that will be included in the Lee COLA. These standard design exemptions are being addressed on the Levy COLA Docket and are not included in our ACRS presentations.

Nuclear power remains an important element of Duke Energy's balanced portfolio strategy to provide reliable low-cost power to our customers. The plant in service dates in the time frame of 2024/2025, support our generation needs.

And the time line enables Duke to benefit from the experience of other AP1000 products under construction. However, Duke Energy has determined that the final decisions regarding Lee construction will be made after issuance of the COL.

There are many reasons that the Lee project is important to Duke Energy. And this meeting is a significant milestone to us.

Our team is ready to present the Lee COLA information. So you will be able to find reasonable assurance that Lee can be built and operated without undue risk to the health and safety of the public.

We appreciate the significant effort that the NRC staff and the ACRS have put into reviewing the Lee COLA. The staff's review has been extensive and thorough, and accomplished with the highest degree of professionalism.

We are ready to discuss the Lee COLA. And at this point I'll turn it over to Bob for an introduction.

MR. KITCHEN: All right, thank you. I want to take a few minutes to just kind of review, you know the layout for Lee.

Some of the issues that are specific to Lee so you kind of have an understanding, you know, big picture of the things that affect our COLA application. We'll talk about more of these, many of these, if not all in more detail as we go through the presentations today.

So, as Chris mentioned, this is the service area for the Lee project. And you can see the Duke Energy Carolinas stations, Catawba, Oconee, McGuire, that are currently there for nuclear plant service in that area.

The Lee plant location is about 35 miles southwest of Charlotte. And is a site which we believe is a very good site.

And we'll talk more about it. It's a hard rock. It was previously selected as a station for Cherokee, which I will talk about. And so it's been selected before. And also we think is a good selection for Lee.

Looking at the background of the site, so we talked about it a bit. It was selected for Cherokee, which was a three unit, pressurized water reactor system AD design.

And in fact, we got pretty far along. We actually started construction on one of the units. And in fact did the Corps of Engineers permit, the NPDES permits, et cetera, that supported it.

And you can see some of the structures that were actually in place before the decision was made in the early '80s to discontinue the Cherokee station.

CHAIRMAN RAY: Bob?

MR. KITCHEN: Yes, sir?

CHAIRMAN RAY: Somehow I got hung up on USACE. What is that?

MR. KITCHEN: United States Army Corps of Engineers.

CHAIRMAN RAY: Okay. Got it. When I first looked at it, I thought it was reversing.

MR. KITCHEN: Yes.

CHAIRMAN RAY: But I didn't understand the permit reference either. So now I understand it. Thank you.

MR. KITCHEN: No, of course you're familiar with it. It's required for any major construction activities.

This is just to give you some visuals of what the site looked like. And a little bit of what it looks like today.

There were, as you can see, structures in place for Cherokee. This is not Lee. These structures were in place. And so we had, you know, certainly a bit of a cleanup effort to do to prep the site to support a new plant construction, to clear up what was there.

And you can see some of the excavation clean up that was done to support COLA investigations. And just basically get the site to where we could really be able to move forward from the way it existed previously.

Demolition, and you can see the before and after here, pictures of the site where -- from what demolishing the Cherokee structures and then restoring to site prep for Lee.

So, quite a bit of progress just in terms of you might say, restoring to what we consider a true green field site. There hasn't been a plant there, but it's certainly started.

We've also been trying to take advantage of the time that we've had to prepare other things in the COL. We've done a lot of work on systems, structures and components design for site specific activities.

Or that were a plant specific interface to the AP1000 like circ water systems. So we've gotten about three quarters of the way through our design for that.

And we've also done quite a bit of look at infrastructure support, you know, commercial buildings, things that you would need to support the nuclear plant. We've gotten a long ways in that regard, about 90 percent.

And then in working with the consortium in particular, Chicago Bridge & Iron mostly, to prep construction plans and get things in place. So we've done a lot of work outside of COLA to try to be ready to move forward when the time is right for Duke to build the lead plant.

This just gives you a visual of the site layout. It's standard AP1000. You can see the sites are side by side. We do have the cooling towers are two mechanical draft cooling tower for each plant.

And you can see the locations of hold up ponds which are -- we'll talk a little bit more, but one of the things that we've been challenged on is make up water.

You can see the make-up pond Alpha here down in the right side of the screen. That is the primary make up source for the cooling towers.

The original plant -- of course the source for the water is the Broad River. So the Broad River is used to provide water in the make-up pond.

And then make up pond Bravo provides back up to fill make up pond Alpha. And as we talk through this, you'll see that we've discovered we needed even more water to be able to basically ride through droughts.

Which we've had a couple of pretty significant ones in the last few years. So that's the general site layout for Lee.

MEMBER BLEY: You're going to get into that more in a few -- later today, right?

MR. KITCHEN: On the water?

MEMBER BLEY: Yes.

MR. KITCHEN: Yes, sir.

MEMBER BLEY: Okay. I'll wait.

MEMBER SKILLMAN: Please back up two slides. Lower right-hand corner. Incorporates lessons learned from Vogtle and Summer.

Could you just explain one or two of the significant ones for us please?

MR. KITCHEN: Well, probably a big one is staging of equipment. I mean, just frankly the lay down area. You look at the Vogtle and VC Summers, they're really challenged with lay down.

For a couple of reasons. Maybe delay and construction sequence. Or, you know, equipment delivery.

So ability to have lay down space. And how you manage lay down is a big one in terms of construction effort.

You know, just the whole -- that whole -- not just lay down, but also staging. How we're doing that equipment. We would -- would be the biggest one I think I could point to, in terms of Vogtle and VC Summer.

MEMBER SKILLMAN: Thank you.

MR. KITCHEN: Um-hum.

MEMBER REMPE: So with those percentage complete, there's some issues about seismic that you're going to be talking about later today. Are those -- your assessments based on that you've done the consideration that you may have some differences because of the seismic peak challenges at this site?

MR. KITCHEN: I would like to think we're not going to have differences. And that's what we're going to talk through.

It's how we have evaluated and demonstrated that.

MEMBER REMPE: Okay.

MR. KITCHEN: But even though we have a site specific evaluation, the impacts on designs and requirements doesn't change with it.

MEMBER REMPE: Okay.

MR. KITCHEN: So, we'll go through that a lot.

MEMBER REMPE: Okay. Thank you.

MR. KITCHEN: Yes, ma'am. Other questions on that? So, let's talk about a little -- on what's different for Lee that's kind of happened since the reference Sea Willis.

As Brian mentioned earlier and Larry, Vogtle is the referenced sea well for the AP1000. And where they're standard material at Lee it mimics. Replicates what's in the referenced sea well.

Of course the big one was Fukushima. That largely translated for new plants into a seismic update. Which was a significant effort.

I will tell you for Levy, which is -- folks looked at the Levy review, very benign. And that took us about ten months to get through that.

So that's an easy one. And so this is not an insignificant effort here. For Lee, we'll talk about the challenges we had because of some small accidences that we had in the high frequency area.

That was the biggest impact, of course the flooding. The evaluation staff did on flooding. The requirements for flooding evaluations for new plant were what they would expect for operating plants to comply with Fukushima lessons learned.

So the big one, this seismic. The other, tied in, I mentioned here emergency plan rule. There were some emergency plan implementation.

Largely licensed conditions for us. But basically mitigating strategies after the implement. Along with that, there was a change to the emergency plan rule, which was required to be implemented by December 2013.

So we had to -- because of where we're at, we had to go back and made that change in the emergency plan. And that's implemented.

Another issue that came up was a bulletin that NRC issued in 2012 related to an offsite power loss of phase event that occurred at the Byron station. Then revealed some weaknesses in protection.

The AP1000 is very robust in terms of design and protection from a similar type of event. But we were still required to address that.

MEMBER BLEY: You're going to get into the electric power tomorrow?

MR. KITCHENS: Yes, sir.

MEMBER BLEY: You'll talk more about the open phase and your solution to it?

MR. KITCHENS: We will.

MEMBER BLEY: Okay.

MR. KITCHEN: So basically what that boiled down for AP1000 was to address providing an alarm and then switch yard in the control room. So that you're aware that it occurred.

Although, if we have an offsite power loss of phase, probably going to have the unit trips because it's pretty obvious. But, we do have requirements to implement an alarm. And we'll talk more tomorrow about the electrical.

Things that we have on our plate that we have to resolve that have not been resolved. We have a number of issues.

We've use Staff Guidance Interim -- Staff Guidance 11 criteria for special activities that are significant enough that are -- need to be addressed in the license. And at this point there are five.

Condensate return and passive RHR cooling has certainly been the most challenging. We've had a lot of challenges in getting through that. That's not resolved yet.

And as Larry mentioned these issues will all be discussed on the Levy docket at a latter ACRS meeting. We also have issues with the main control room in terms of operator dose, and also heat load for the control room given the current design.

We also have an ITAAC that we can't meet because of changes in design that are there to verify containment structural impacts form a beyond design basis accident with hydrogen release and burn. That we're trying to resolve.

And most recently, we had an issue, and

the last one here I'll tell you, is really a compliance issue. That are designed for the filtration monitoring system for flux doubling.

That doesn't comply with IEEE 603. The reason that it exceeds the criteria, is that the regulation specifically required compliance with 603. So we felt we had to address that.

So those are the items we have in front of us. And again, those will be covered on the Levy docket.

MEMBER BLEY: Is that one still an open issue?

MR. KITCHEN: Yes, sir. These are -- unfortunately, these are all open issues.

MEMBER BLEY: All open issues, okay.

MR. KITCHEN: Although I want to tell you, it's very close. Well, --

MEMBER BLEY: You think you're close.

MR. KITCHEN: I think we're pretty close too. I mean, we've made submittal and at this point we don't have any RAIs. And I think that one is very straightforward resolution.

But it's not -- well, we'll hear from them.

MEMBER BLEY: Understand. Thanks.

MEMBER SKILLMAN: Bob, when you say you've made a submittal and you don't have many RAIs, does that also include your passive RHR and condensate return?

Or have you deferred that completely to the Levy application?

MR. KITCHEN: All of these will be addressed on Levy --

MEMBER SKILLMAN: I understand that. But --

MR. KITCHEN: Docket -- I'm sorry --

MEMBER SKILLMAN: Dr. Bley's question was, where are these? And you said you're pretty close to all of them. But were you referring only to the flux coupling? Or to all five?

MR. KITCHEN: Only the flux stuff.

MEMBER SKILLMAN: Yes, sir.

MR. KITCHEN: I sort of don't feel like that on passive RHR anyway.

MEMBER SKILLMAN: Thank you.

MR. KITCHEN: So, and the RAIs are issued on the Levy docket, just so I don't mislead. They're issued to Levy. The response and how those are addressed in the license ultimately will be reflected in Lee and will be the same.

Challenges that we have on Lee. We'll talk a little bit more about water management. We also had an interesting issue on plant relocation.

It's not as dramatic if we move the site. We barely moved the plant about 50 feet. But we'll talk about why and what that impacted.

And then the seismic in the impacts, which we'll talk at length with you today and maybe even tomorrow depending on how that goes.

CHAIRMAN RAY: Bob, let me interrupt. And I'll just tell my colleagues.

At my request, Duke has provided, and I would suggest when we get to it, which is not now, we begin with sort of a tutorial on what the provisions are in the design certification for addressing a high frequency response accidence.

So, we've got that -- I have it here. And we'll start there so we're all on the same page in terms of what the ground rules are.

MR. KITCHEN: Okay.

CHAIRMAN RAY: Thank you.

MR. KITCHEN: Looking at water management, this is just another version of the slide you saw earlier. With the varies we're going to talk about over here to the right is make up pond

Alpha. And we also had make up pond Bravo.

The change that we have in this larger scale it shows that there is another make up pond that we determined needed to be added, make up pond Charlie, to provide enough reservoir to be able to continue plant operation through severe drought periods without having to withdraw on the Broad River. We would have restrictions on water withdrawal.

So that's the challenge we have. Of course, looking at it, this is a little more clear, showing the cycle that we're dealing with.

Of course the cooling tower and make up for the cooling towers again, you can see the pond Alpha make up. Which is a source during normal flow periods here from the -- down by -- as we mentioned earlier, Ninety-nine Islands Reservoir, the Broad River source for the make up pond Alpha.

If we have a situation, a drought, Broad River restrictions from withdrawal, then we would limit that or stop and depend on make up pond Al -- excuse me, Bravo or Charlie, to provide make up during low flow periods.

The rea --

MEMBER BLEY: Just to give us a sense,

at least in the photographs the River looks kind of small. How long is it going to take to fill up these reservoirs, you know, before you start up?

MR. KITCHEN: Boy, I don't know. I don't know the answer to that.

MEMBER BLEY: A fairly long time though, we'd bet. But I don't know.

MR. KITCHEN: I would only be guessing.

MEMBER BLEY: Okay.

MR. KITCHEN: But -- so, getting these in place, fully, you know, early on so that they're ready to support operations. And Mr. Bley's point is valid.

But the reason we went back and decided to add make up pond Charlie, looking at make up pond Alpha and Bravo, and if you look at the droughts over I think about the last 80 years, there were about five occasions where we would have had the -- in that situation, had to shut the plant down.

So by adding another make up pond, we provide additional reservoir capability.

MEMBER BLEY: You just looked over the last eight years?

MR. KITCHEN: No, 80.

MEMBER BLEY: Eighty. Got you. Thank

you.

MR. KITCHEN: About 80 years.

MEMBER BLEY: I misunderstood.

MR. KITCHEN: No, eight that would be -- although it would be pretty -- it would be a pretty good picture. I think if I remember right, two or three of those five are in the last ten.

So, that's the make up pond challenge. And that was the issue that we had to deal within terms of water management.

MEMBER SCHULTZ: Bob, with regard to the make up ponds and then also the use of the Broad River, what are the current restrictions that Duke may have associated with the use of the river?

And what have you worked out with regard to long term use of the river?

MR. KITCHEN: We have withdrawal limits that -- and I don't remember the number right off the top of my head. But, withdrawal limits on the Broad River that we would have to align with.

And that's allowed. So we've got that approval for operation.

MEMBER BLEY: Is that the Corps that controls this River? Or somebody else?

MR. KITCHEN: Well, it's waters of the

U.S. So it would be, you know, anything you do on that that impacts the river would have to go through the Corps.

But it also involves State environmental agencies as well. We get into a dual regulation there --

MEMBER BLEY: Okay.

MR. KITCHEN: In terms of withdrawal. And EPA in terms of -- we get to hit all the agencies. EPA in terms of withdrawal limits.

But, I can get the specific one. I think I have it in notes somewhere. But I -- we have a withdrawal limit on the Broad River that we have to comply with.

So, if you have a drought period, then we're going to have to stop our limit.

MEMBER BLEY: Um-hum. Thank you.

MEMBER SKILLMAN: Bob, let me ask this question please. Is there competition between the nuclear arm of Duke and the hydro arm of Duke for Broad River and downstream generation that would affect the flow rate? And Dr. Schultz' question, withdrawal from -- or Mike's question, withdrawal from Broad River?

A couple of these downstream dams are

hydro stations. And I'm just wondering if there's an economic consideration that is underlying some of the discussion here that we might not hear about unless we ask?

MR. KITCHEN: I don't think I could answer that directly in terms of internal competition. But, whatever the issue that limits Broad River availability, that's the reason why we have these make up ponds to be able to ride through that.

So, we should -- I mean, it's not something that you expect to be in a continuous interface issue with.

MEMBER BLEY: Let me ask it another way. How long can you go without tapping into the Broad River?

MR. KITCHEN: I believe that's -- one without the River, it's about a year, isn't it?

MEMBER BLEY: And it should work.

MR. THRASHER: Yes, if we're restricted on withdrawals from the Broad River, make up pond Bravo will provide make up needs for the two unit operation for approximately 30 days. And make up pond Charlie will be approximately 150 days.

MR. KITCHEN: Six months.

MEMBER BLEY: All right, half the year. You need to say who you are and where you're from for our record. This is going on the transcript.

MR. THRASHER: Oh, excuse me. Yes, okay. John Thrasher, Duke Energy.

MEMBER BLEY: Thank you, sir.

MR. KITCHEN: So about six months.

MEMBER SKILLMAN: So, I heard the length of the duration that the ponds will support the plant in time of drought. I think your answer to me about competition for hydro is not likely. And other guidances on the river prevail.

Is that what you're saying?

CHAIRMAN RAY: I think we're off topic here. If I could suggest we -- the question that you're posing Dick, I think isn't part of our review scope here.

MEMBER SKILLMAN: I was just wondering whether or not there is -- there can be competition for the river based on hydro.

CHAIRMAN RAY: But again, I don't think that's our concern.

MEMBER SKILLMAN: Well.

MR. THRASHER: This is John Thrasher with Duke Energy. On the front end of the project, Duke did an extensive Broad River study looking at Broad River upper basin above the plant and also downstream of the plant.

And also projected future water needs from municipalities and industry and everything out 60 years. So it was an extensive study.

And we had cooperation from local and State agencies, industries and others. So, we're, you know, looking at making sure that we're managing water needs.

Duke has facilities upstream. And you know, Summer nuclear station, SCE&G is downstream of the plant. They're pretty small hydro plants along the Broad River.

So, that was all evaluated looking at our water flows. And the IMDS permit limits our withdrawals to five percent of the mean annual flow on the Broad River.

MEMBER SKILLMAN: Thank you, John. That was helpful. Thank you.

MR. KITCHEN: Another interesting area we ran into was plant relocation. This was not a safety issue. We had an issue on the northwest corner of Unit One where the depth to get to hard rock to support a foundation was fairly significant.

It required a significant excavation. So we were concerned -- this was truly commercial. We were concerned about construction impacts, delays. You couldn't do anything with it until you got out there.

But we would need to excavate and backfill. So, when we had the waste confidence issue that came up and we knew there was going to be a significant delay in our license, we elected to go ahead and change our license to move the plant.

Literally the location change, Unit One was moved 50 feet east. So the plants were 50 feet closer. We moved both Units 66 feet south.

So, it's not a huge change. The reason we were doing that, twofold. It avoids this impact during construction of having to excavate and backfill and delay, and schedule impacts, costs, which could be fairly significant.

It also puts, you know, one as Brian mentioned in the introduction, entirely over the Cherokee foundation so that it's -- the plant completely aligns with the DCD configuration, it's assumed in terms of hard rock.

It just made it a little bit easier.

So, it's really an advantage that we took advantage of the delay to improve our situation.

As always, any change like that we had to go back and look at a lot of things. We were only moving it like 60 feet. We still have to go back and say does that change anything and effect -- and we had to review or update calculations and evaluations.

And submittals, the NRC had to go back and review. So it was not insignificant even though the move is small. We can see the type of things that we had to consider.

And all those, as you would expect, with this kind of relocation, were not significant impact to COLA.

MEMBER BANERJEE: Just for clarification, would building this plant in the --

CHAIRMAN RAY: Is your microphone on Sanjoy?

MEMBER BANERJEE: The plant you're proposing will be built right on top of an existing foundation?

MR. KITCHEN: Yes, sir.

MEMBER BANERJEE: Okay.

MR. KITCHEN: You can see that on this

drawing. Or the Figure -- I just went back to Figure 13. The gray area is the Cherokee plant footprint.

And you can see that by -- for the original location of Unit One, you can see up here in this white area, is the northwest corner. So by moving the plant down just a small amount as we discussed, it puts the plant entirely over the Cherokee foundation footprint.

MEMBER BANERJEE: So, I don't know enough civil engineering. Explain to me please, what this means? What the implications of this could be for things like seismic and so on?

MR. KITCHEN: We're going to talk about that a little bit later if it's okay.

MEMBER BANERJEE: Oh, you're going to do that?

MR. KITCHEN: If it's okay, we'll just --

MEMBER BANERJEE: Yes, okay. You can defer that.

MR. KITCHEN: Address it then. Yes, because I'm not a civil engineer.

MEMBER BANERJEE: But, you're using an existing pad or something, right? Which is there.

MR. KITCHEN: Especially extension of hard rock.

MEMBER BANERJEE: And when was that done?

MR. KITCHEN: For the Cherokee I believe it started in the mid '70s. Anyway the Cherokee plant was abandoned in the early '80s. And that was just basically, literally, it was abandoned.

And so now we're going to take advantage of what foundation work that's there. And we'll talk that more when we --

MEMBER BANERJEE: But -- okay.

MR. KITCHEN: Get into the seismic review. So anyway, basically that's the change when you hear plant relocation. Significant in terms of COLA review. Insignificant in terms of, you know, impact.

Just a little bit about Chapter One. Of course we threw out, as Chris mentioned, we maximized our DCD. Minimized departures. However, you want to look at it. Only taking those where we had to.

We've incorporated standard material. And as you would expect, those site specific information regarding layout, vendors and contractors that we're using for construction and COLA and interface with standard design.

This shows the vendors that we're using. Intercon primarily in support of preparing the COLA application. And then some of the site specific evaluations and calculations supporting information now.

AP1000 design, of course Westinghouse, and significant interaction with Westinghouse on some of the site specific issues. Most notably the structural evaluation from the seismic update that we'll talk about.

And then tech services, a variety here of -- Chicago Bridge & Iron of course is part of the consortium for the AP1000. The others supported us in either environmental, seismic, or site specific activities.

That's the end of the introduction overview. If there are questions.

CHAIRMAN RAY: Okay. Any other questions on the scope so far? We will pursue most of the items Bob's touched on in more detail as we go forward.

All right. Thank you, then.

MR. KITCHEN: We'll move onto site

characteristics, Chapter 2. John Thrasher will present this. John?

CHAIRMAN RAY: I want to make a comment while we're changing here. We're aware that there's a -- I think a staff meteorology is it? Here?

We've got some folks who have a deadline. We need to get them in this morning. Staff meteorology is it?

Yes, no, but I mean the point is, if we -- if there are things we need to pursue in addition, we can do that. But we want to be able to get to the staff after the break and before the noon lunch break because of availability considerations.

So, with that note, please proceed.

MR. THRASHER: Good morning. John Thrasher, Director of Engineering of Nuclear Development with Duke Energy.

I also have John McConaghy who is one of our civil engineers on the Lee project. He supported me in the presentation this morning.

I want to end up covering for the highlights or overview of FSAR Chapter 2. We'll focus on the subsections 2.0 through 2.4. There will be discussions on subsections 2.5, most or a lot of the seismic information that will be in a discussion later today.

So one of the first things looking at site characteristics, got to look at the Lee site characteristics and determine if those site parameters are bounded by the AP1000 parameters. So, in Section 2.0, there's a table. 2.0-201 that provides a comparison of these site related design parameters.

And in all situations we show that the site characteristics for the Lee site are bounded by the standard plant design parameters except in the area of seismic hazards. And again, we'll have a lot more discussion on that later today.

Those seismic inputs for the Lee site have been identified as a DCD departure. And site specific analysis have been performed to demonstrate the acceptability of the AP1000 standard plant design for those site specific seismic demands.

Looking again briefly at the site layout to orient you little bit more to the site. We've already mentioned the site was located on the former Cherokee nuclear station site along the Broad River in Cherokee County, South Carolina.

The Broad River is just north of the site as shown on this overview. Ninety-Nine Islands hydro station, which went into operation in 1910, is located just downstream of the site.

Raw water intake for the station makeup water will be built in the Ninety-Nine Islands Reservoir. And Duke Energy recently received the Corps -- Army Corps of Engineer 404 permit, which will support and allow that impacts.

Lee nuclear stations One and Two will be located between existing make up ponds Alpha and Bravo. So the former Cherokee site is shaded in the tan color on this slide.

And pond Alphas is a sedimentation basin basically. So we pull make up water in off the Broad River. Sediment can settle out into pond Alpha before make up water is pulled into the plant systems.

Make up pond Bravo existed, was built during the Cherokee construction time frame. And was basically for the system AD.

PWR design was the safety related external water source. The AP1000 not requiring an external water source, make up pond Bravo will be used as a drop contingency pond.

Our evaluations looking at droughts in the area and analyzing 80 years of flow down on the

Broad River, we determined that additional make up capacity to have the plant operating through severe droughts would be required.

So proposed make up pond Charlie will be built to provide those needs. And those ponds -- again, ponds Alpha and Bravo exist. And as you saw in some of the overviews earlier, those ponds actually exist and are currently, you now, full of water.

Pond Charlie will be built to support the station's needs. And since I mentioned earlier, it would provide make up water needs for the plant for 150 days.

And it will take obviously a little bit longer than that to fill the pond. Because the main way of filling that pond will be pulling water out of the Broad River and used to fill that pond initially. And to refill it after it's used for drought conditions.

MEMBER BANERJEE: How long are the droughts typically? Historically?

MR. THRASHER: Some of the worst case droughts have typically been on a three to four month duration. Typically during the summertime. I'd say roughly June through September time frame.

And the rainfall normally picks up in the fall and winter months.

MEMBER BANERJEE: And if it doesn't for a year, what happens?

MR. THRASHER: Our evaluation showed that there were some droughts and the flow didn't pick back up. And our evaluations show that we can ride through those. But the pond C is sized so that we can get through the worst case droughts of record and have some margin on that.

Our NPDES operating permit will allow us to during high flow conditions to meet plant needs and go above the five percent mean annual flow withdrawals to refill the ponds during high flow conditions on the river.

There is a ridge between make up pond Charlie and make up pond Bravo. So, from a flooding evaluation standpoint, the waters, you know, full pond elevation at pond Charlie is higher than the site grade elevation.

But the only way that from a flooding evaluation standpoint, waters from pond Charlie could get to the site would have to be through discharge or flooding or dam failure through the -- down into the Broad River and along the site. And our flooding evaluations have evaluated that.

Section 2.2, in the FSAR evaluates industrial hazards within five miles of the site. Sources of potential hazards that are close to the site are road and rail transportation.

There's potential -- not being able to control what's transported along those rails of explosives or toxic materials. The closest major roads or rail are 3.2 miles, South Carolina Route 329.

There's also major natural gas pipelines that are right over three miles from the site. Analysis were performed looking at explosions and flammable vapor clouds to show that there's no threat to safety related structure systems or components at the site.

So basically those evaluations were done in accordance with Regulatory Guide 1.91. And evaluated a safe distance, which there would not be a peak pressure of greater then one psi at the site.

And all those potential transportation pass, rail pass, and potential incidents were evaluated. Again, none were found to be close enough to the site to exceed one psi, pressure wave at the site.

We also performed analysis of toxicant vapor clouds. And there will be additional information presented later today on that when we talk about FSAR Chapter 6 and discussing chlorine tanker failure.

And looking at an evaluation to show that the toxicity limits in the control rooms do not pose a threat to control room operators. And again, we'll cover that in Chapter 6 later today or tomorrow.

MEMBER BANERJEE: Which way does the wind blow between that Route 329 and -- does it blow towards the plant? Or what way?

MR. THRASHER: I would have to -- I've got some of that information. Let me --

MEMBER BANERJEE: Were you going to talk about it?

MR. THRASHER: Yes, we can talk about that and describe that when we talk about Chapter 6. Which handled that theory.

MEMBER BANERJEE: It would be also interesting to know what sort of weather you typically have. Do you get into pascal F weather with the wind blowing towards the plant?

MR. THRASHER: Okay. So in our

discussion in Chapter 6, we'll make sure we talk about wind direction. I know that's considered in that evaluation that was done there. We'll also look at the weather.

Okay, Section 2.3 covers meteorology. And as I think I mentioned, at a high level that all of the site specific meteorology characteristics are bounded by what's used as site design parameters for the AP1000 standard plant.

So we looked at air temperature, wind speed, precipitation, and also atmospheric dispersion factors. So again, all the characteristics that are seen at the Lee site as far as meteorology are bounded by AP1000 standard-design design parameters.

Section 2.4 covers hydrological engineering.

CHAIRMAN RAY: Well, let me -- how long do you expect this to take? If you're going to be done shortly, we'll wait for the staff to come up on 2.3.

MR. THRASHER: Oh, I was going to go ahead and cover 2.4. But, if you need, I'll stop.

CHAIRMAN RAY: Well, it's just a matter of timing. We can --

MR. THRASHER: Probably about ten minutes left. That are on 2.4.

CHAIRMAN RAY: Okay. Is that all right? Yes. Okay. All right, let's go ahead and complete this as the -- the agenda shows.

But then we'll come up with the staff before we break and let them speak to their review of meteorology. And then we'll take a break.

MR. THRASHER: Okay. Section 2.4 in the FSAR covers hydrological engineering. So we can just discuss briefly the AP1000 DCD site parameter for flood elevation.

We'll look at a hydrological description and then explain the flooding evaluation's maximum flood level out of those evaluations. We'll also touch for a moment on ground water and the accidental release of radioactive liquid effluents.

So site design parameter for the AP1000 standard plant is the maximum flood elevation should be less then plant elevation 100. And so DCD standard plant elevation 100 corresponds at the Lee site to yard elevation 593.

And so at the Lee site we'll end up having the nuclear island building floors that you walk into off of the ground will be at elevation for the standard plant. That's an elevation again of 100.

And again for the Lee site that will be on site specific drawings, elevation 593. When you step off of that floor onto the plant yard, you'll step down to an elevation 592.

So basically we'll have the one foot step down to the yard elevation closest to the standard plant structures. And then that yard will be graded sloping away so that precipitation will drain off of the site to the adjacent water bodies.

Quickly looking at a hydrological description of the area, the plant is located adjacent to Ninety-Nine Islands Reservoir. And if you look at the pink area on this slide, is the upper Broad River basin.

And the watershed that feeds into that water basin is 1,550 square miles. Most of the upper Broad River water basin is in North Carolina. And obviously the lower portions of it are in South Carolina as the plant is located in Cherokee County, South Carolina.

From a topography standpoint, elevations range from the upper edges of the upper Broad River basin at an elevation of 1,200 feet. And down to an elevation of 511 feet, which is full pond elevation at Ninety-Nine Islands.

MEMBER BANERJEE: Does the region flood?

MR. THRASHER: Excuse me?

MEMBER BANERJEE: Does the region in the vicinity of the plant ever flood?

MR. THRASHER: The region in the area of the plant, we do have some information that we'll cover in just a moment of the historical flood levels. But typically not.

And particularly at the plant site, there's a pretty good difference in the elevation of plant grade and full pond. Again, full pond elevation at Ninety-Nine Islands Reservoir is 511.

And we mentioned that the yard grade for the Lee site will be 593 feet. So, there's a difference of 82 feet in elevation between the site and the Broad River.

So our site flooding evaluations --

MEMBER BANERJEE: Well, okay. Right, there you are.

MR. THRASHER: So we're getting into that. And if I don't hit your questions, let me know.

So Lee was, we wanted to design the site as what's called a dry site. So basically you want to make sure that all your worst case flooding scenarios, that the water is below that 593 elevation so you don't have concerns with water flooding and getting into the safety related structures.

So, our evaluation showed that the maximum flood level, the worst case out of all the evaluations we did was from local, intense precipitation. So you look at maximum precipitation right there on the site.

And again, with the building elevation being 593 and you stepping out onto yard at 592, that local intense precipitation, you have a little bit of ponding of water.

So, our worst case flood level is 592.56 feet, which gives us about five inches of margin there. I know that doesn't sound like a lot, but it's basically that precipitation would pond up a little bit and the yard sloped away so that it will drain away from the site.

MEMBER SCHULTZ: John, has there been any investigations recently given the local intense precipitation in Columbia, South Carolina?

MR. THRASHER: Yes.

MEMBER SCHULTZ: Have you looked at that? And what have you found?

MR. THRASHER: We looked at that. And if I could, let me go a couple more slides. And I'll kind of relate the numbers to some other information that I'll share.

MEMBER SCHULTZ: That will help. Thank you.

MR. THRASHER: Okay.

DR. HINZE: If I might. Excuse me, but John, does the dam failure include the make up pond C dam?

MR. THRASHER: Yes. Our dam failure evaluations also include looking at make up pond C. Potential failure.

CHAIRMAN RAY: So, speaking on the phone line, go ahead and start.

MR. THRASHER: Okay. So again, our worst flooding situation was looking at local intense precipitation right there at the yard grade. Right around the nuclear island structures.

But we also had to evaluate worst case flooding situations on the adjacent water bodies. And we've seen there's a lot of water around the site. And water management is one of our issues.

But we have Broad River again to the north of the site. We had to look at worst case flood elevations on the Broad River. And also adjacent make up ponds Alpha and Bravo.

Flooding phenomena evaluator of those that are shown here on the slide, looking at maximum probable precipitation, probably maximum flood, also considered dam failure. Looked at wind wave activity and then other situations that we needed to evaluate.

These flooding evaluations were done in conformance with Regulatory Guide 1.59. ANSI Standard 2.8, the 1992 version. And also we're in compliance with the recent NUREG Contractor Report 70.46.

MEMBER BANERJEE: Is there a trend that these types of severe precipitation and so on are increasing with time? Or with the years? And is there a growth in intensity of these events?

MR. THRASHER: Let me share a little bit of information and another slide here. And we can show some perspective to the historic maximum flows that we've seen on the Broad River.

MEMBER BANERJEE: And also the trends. Is it increasing or not, I mean?

MR. THRASHER: Okay.

MEMBER BANERJEE: You know, how do we extrapolate into the future? That's really what --

MR. THRASHER: Well, I guess the evaluations we did to support the Lee site, obviously for the water needs, we looked at 80 years of flow data on the river.

MEMBER BANERJEE: In the past then?

MR. THRASHER: And we're really concerned -- right, looking at the past 80 years of flow data. So, one of the issues we had there was with the trout situations and everything.

But we also obviously looked at the other end of that spectrum as the high flows. And we didn't see any significant increase in those looking over that 80-year period.

So our flooding evaluation results, and I'll try to also share a little bit of information based on recent significant rainfall events in the State of South Carolina.

So, again, we wanted the site designed as a dry site. Maximum flood elevation as we mentioned was from the local intense precipitation.

The evaluations we did of adjacent surface water bodies, we show for the Blount River probable maximum flood, we found the Blount River increased to an elevation of 551.49 feet. So again, that's an increase from a probable maximum flood evaluation of about 40 feet in elevation.

We also evaluated dam failure and showed an elevation of 576.5 feet. And that flow relates with PM -- looking at PMF with dam failure. And that elevation along the Broad River, you can still see we're significantly less then the site elevation.

But the flows that we're seeing, they were translated to 1,858,000 cubic feet per second. Now the mean annual flow on the river is 2,500 cubic feet per second.

The 500-year flow on the river is projected to be 127,000 feet per second. So this PMF with dam failure is quite a bit larger than the 500-year flow.

Looking at the recent rainfall events in the State of South Carolina, most of the highest intense precipitation was really further down towards the coast. But we also looked at those events.

And 1,000 year flow in this area would we'd anticipate 140,000 cubic feet per second. And a river elevation of 523.5 feet.

So again, the elevation going from 511 feet to 523 feet upon a 1,000 year rainfall event. Again, that's much less than these evaluations that we're showing that we did to support the Lee application.

The actual data that was measured at the Lee site, because the rainfall over those six day period with a lot of rain in South Carolina, there wasn't nearly as much rainfall in the upper part or the Cherokee County part. And also in the upper reaches of the Broad River up into North Carolina.

We only saw a flow of 10,000 cubic per second. Or about four times mean annual flow. And the elevation there at the site on the Broad River increased to 513.5 feet. So about two and a half feet increase above normal full pond.

MEMBER SCHULTZ: Thank you, John. I appreciate that.

MR. THRASHER: So, back to the slide again, looking at the adjacent water bodies, you can see from PMF dam failure, and also considering wind wave action, looking again at the Broad River, make up pond Alpha and make up pond Bravo, we have even worst case situations with the wind wave elevations on top of these other evaluations. We still have four to eight feet of margin from the site elevation.

Other phenomena, we're bounded by these evaluations. And therefore, Lee site will be a dry site since all the flooding evaluations, maximum levels, are less then 593. And no additional flood protection is required for this site.

CHAIRMAN RAY: And we have a very secure ultimate heat sink. So, we don't have to worry about dam failures or flooding for that purpose.

MR. THRASHER: That's correct. All right, two more areas to cover. We'll talk briefly about Section 2.4.12 on ground water.

The AP1000 DCD requires maximum ground water elevation of two feet below the plant grade. Again, our plant grade will be in 593 mean sea level.

Duke Energy performed MODFLOW evaluations to evaluate maximum post construction ground water level. That analysis considered a maximum historic regional precipitation event.

And looking back into the Lee site and in the local area, Tropical Storm Jerry, with the 24 hour maximum precipitation of 12.3 inches, which exceed the maximum one day precipitation in this most recent rainfall events in South Carolina.

And so our MODFLOW analysis considered that Tropical Storm Jerry event. And also looked at post construction grading and ground cover.

And determined that our maximum post construction ground water elevation is estimated to be approximately 584 feet. So we have several feet of margin there from the required two feet below plant grade elevation.

And the last part of Section 2.4 looks at accidental releases of radioactive liquid effluence. Duke Energy used RESRAD offsite version 2.0 to evaluate transport pathways to the nearest potable water.

Failure of a Unit Two effluent hold up tank to hold up pond Alpha was used to determine -- was determined to be the limiting pathway. And if we can go the next slide.

So again, in looking at accidental release, we had to evaluate and determine the limiting pathways. And so we looked at pathways if we had accidental release of tanks with radioactive liquid.

And so pathways were looked towards the

north. And the limiting pathway was found from Unit Two towards hold up pond Alpha, which basically is adjacent to the Broad River. So, if those releases got into hold up pond Alpha, it was assumed to be in the Broad River.

We also looked at pathways if we were to have a release travel towards make up pond Alpha to the right, east. And also to make up pond Bravo to the west.

The limiting pathway again was from failure of a hold up tank in Unit Two because that was the shortest and shortest travel path time from Unit Two nuclear island to hold up pond Alpha or basically the Broad River.

Our evaluations were done consistent with guidance and Branch Technical Position 11.6. And the results of those evaluations show that the radiological consequences do not exceed 10 CFR 20 concentration limits at hold up pond Alpha.

So before those would even be released into the Broad River. Also note that the nearest potable water supply from the Broad River is located approximately 21 miles downstream from the plant site.

That was all the information that I had

to present on Sections 2.0 through 2.4.

CHAIRMAN RAY: Any questions before we ask the staff to come up and discuss meteorology? And then we'll be having a break.

But, I think we've got a couple of minutes here if we want to proceed with any questions to John.

MEMBER BANERJEE: Yes. On the site map, where are the -- where is that red line with the chlorine transports and the pipeline?

MR. THRASHER: So it may have been the slide --

MEMBER BANERJEE: So you can just indicate it on the slides. The rough direction? Where it is?

MR. THRASHER: Let me see if it's in our backup.

MEMBER BANERJEE: Any one of your slides which shows --

MEMBER SCHULTZ: 101.

MR. THRASHER: 101? I think so. If you can get to 101. Okay, so here's the site in green. And if we go towards the west, Highway 329.

And so that line that is kind of drawn across there. That black line is really the evaluation shortest pathway that's used in the chlorine release evaluation that we'll talk about in Chapter 6.

MEMBER BANERJEE: Is that uphill or downhill?

MR. THRASHER: The topography varies along there. I mean, make up pond Charlie will end up -- proposed make up pond Charlie will be built in that area.

And there's a ridge between where the pond will be and where you get to make up pond Bravo. So, it's --

MEMBER BANERJEE: But what's the elevation of that road along which the chlorine transports?

MR. THRASHER: The elevation of the road --

MEMBER BANERJEE: On that area, yes.

MR. THRASHER: Is probably -- the full pond elevation on make up pond Charlie is going to be 650. So the road's above that. So it's probably close to 670. 660 to 670.

MEMBER BANERJEE: And your plant is 590?

MR. THRASHER: 593. Right.

MEMBER BANERJEE: And where is the

pipeline?

MR. THRASHER: The pipelines are up towards the Broad Energy River Center. Down a little bit, along 329. Down a little further. Pipelines cross right near where that Broad River Energy Center wording is on there.

So, natural gas pipelines that are buried that run along there.

MEMBER BANERJEE: And that's how far away?

MR. THRASHER: About three to three and a half miles from the plant site. A five mile radius is that line that's shown there. So the pipelines are down kind of across 329 down a little bit.

MEMBER BANERJEE: Is the river going along on sort of a valley with rising topography on each side? Or what is it, is it flat land there?

MR. THRASHER: Oh, it's pretty much down some. There's a -- you know, with the plant being 593 and full pond elevation is 511, so the river's running around and just kind of over the years has cut down.

So, there is kind of a bank on each side that goes up before the land levels out.

MEMBER BANERJEE: And that goes up to what? 600 or 700, something?

MR. THRASHER: The highest elevation on the plant site is I think about 670, 680 feet. There's a ridge up over on the other side of pond Bravo is actually where we're looking at building a visitor center.

And then there's -- that ridge continues in between Bravo and Charlie.

MEMBER BANERJEE: I would be nice to be able to see the contours of the elevation so that, you know, your pipeline is a little higher I take it then the plant. And what I'm looking for is trying to understand where the, there's a sort of valley along which the river runs, where it goes to the plant.

So anyway --

CHAIRMAN RAY: Sanjoy, which pipeline -- you're referring to pipeline.

MEMBER BANERJEE: The gas pipeline.

CHAIRMAN RAY: Okay. When you said your pipeline, I didn't know what you meant by that.

MEMBER BANERJEE: Sorry. I meant --

CHAIRMAN RAY: The --

MEMBER BANERJEE: The pipeline.

CHAIRMAN RAY: The gas pipeline.

MR. THRASHER: Yes. There's multiple gas pipelines that run through there.

MEMBER BANERJEE: But there is a --

MR. THRASHER: But we can get that information for you.

MEMBER BANERJEE: The pipelines are up there. Up the river quite a distance away.

MR. THRASHER: Right.

MEMBER BANERJEE: Okay.

MR. THRASHER: And the Chlorine release was assumed to be in that closest point on Highway 329. And that analysis will get into those details.

But I believe that analysis just assumed that it was level. You know, very conservatively assumed it was level drain and it's not. But a conservative down.

MEMBER BANERJEE: Well, if the terrain is sloping towards the plant because chlorine is a heavy gas --

MR. THRASHER: Well it slopes and then it's like I said, it's a ridge.

MEMBER BANERJEE: Yes. So, but there are tools to do that calculation.

MR. THRASHER: Right.

MEMBER BANERJEE: There are heavy gas dispersion tools.

MR. THRASHER: Right. And you will discuss that more in Chapter 6. One of our guys is prepared to discuss that.

MEMBER BANERJEE: I wrote a book on it.

MR. THRASHER: All right. This will be an interesting discussion then on Chapter 6.

CHAIRMAN RAY: Anything else at this point?

MEMBER SCHULTZ: Yes, there was something I missed.

CHAIRMAN RAY: Yes, go ahead Steve.

MEMBER SCHULTZ: You mentioned that 1,000 year event, 140,000 cubic feet per second flow. And you mentioned the elevation but I missed that.

What was the elevation of that?

MR. THRASHER: That elevation was estimate to be 523.5 feet.

MEMBER SCHULTZ: Okay.

MR. THRASHER: On that 1,000 year event.

MEMBER SCHULTZ: Thank you.

CHAIRMAN RAY: Anything else?

MEMBER BANERJEE: But it's quite a

distance? Several miles, right? The gas, the chlorine line transport?

MR. THRASHER: Yes.

MEMBER BANERJEE: It's not that close?

MR. THRASHER: Yes. The gas lines and the nearest that the chlorine tanker, the nearest that road is like 3.2 miles. It's pretty far away.

MEMBER BANERJEE: It's a long way.

CHAIRMAN RAY: Anything else? Okay. We're going to invite our -- thank you, --

MR. THRASHER: Thank you.

CHAIRMAN RAY: John and John. We'll have our staff come up. It should be a brief statement on their part concerning meteorology. So we can close the issue.

Brian, did you want to say something?

MR. HUGHES: I'm going to go ahead. I want to say Chairman Ray and members, I appreciate this variation in the schedule.

Kevin, Mr. Quinlin has a professional meeting. And he has a flight scheduled around 1:00 today. So, thank you for the courtesy of time.

CHAIRMAN RAY: We deal with that all the time. So, we're glad to cooperate. Go ahead.

MR. QUINLIN: As Brian said, thank you

for accommodating my travel schedule. Ironically enough I'm traveling to a meeting of nuclear metrologists. So, it's right on topic. Next slide, please.

FSAR Chapter 2.3, as you know is meteorology. It incorporates 2.3 of the AP1000 DCD. And as Duke Energy just said, all of the site characteristics for meteorology are bounded by the AP1000 site parameters and the DCD.

The Section 2.3 is broken up into five sections consisting of five different COL information items. The first one is regional climatology. The second one is local meteorology.

And the onsite meteorological measurements program, short term diffusion estimates, and long term diffusion estimates. All the site characteristics and site parameters are in Table 2.0, which is a comparison of the site parameters and the site characteristics.

Going into a little bit more detail for each of the five sections. The first one is Section 2.3.1, regional climatology.

This compares the AP1000 mainly to a climatic set of parameters. The 50 and 100 year wind speeds for three second gusts. The tornado wind speeds, the maximum wind speeds. As well as all the other considerations for tornados such as pressure drop, or the maximum wind speed, and so on.

The maximum reflow for winter precipitation as well as the accedence in winter air term period in temperatures. There are other ones in there.

These are the most important ones. We also considered things like hurricanes.

For Section 2.3.2 --

MEMBER BANERJEE: Is this region prone to be hit by hurricanes?

MR. QUINLIN: The coastal area can be. Lee is far enough inland that the maximum hurricane wind speeds are not really a concern for the site.

And they are well bounded by the tornado wind speeds as far as design.

MEMBER BANERJEE: How far from the coast are they?

MR. QUINLIN: I'm not entirely sure of the mileage from the coast. Perhaps he is better to answer that. But, as far as hurricane wind speeds go, the 10 to the minus 7 for your wind speeds I believe around 130 or so miles per hour, which is well below the design basis.

MEMBER BANERJEE: Which is what? The design basis?

MR. QUINLIN: For tornados, I believe 300 miles per hour.

MEMBER BANERJEE: Okay.

MR. QUINLIN: Yes, oh, I'm sorry, it was 160 miles per hour.

MEMBER BANERJEE: Okay.

MR. QUINLIN: So.

CHAIRMAN RAY: If someone from Duke has it in hand, approximate distance from the coast line, you can step to the microphone now or later and give us that.

MR. THRASHER: John Thrasher, Duke Energy. The site's approximately 150 miles from the site -- from the coast.

MR. QUINLIN: Section 2.3.2 addresses local meteorology. This section address cooling tower induced effects on local temperature, moisture and salt deposition.

There are no major changes to the local environment due to the cooling towers. One thing that we did look at was salt deposition especially in areas such as the switch yard.

And the staff found that there was no

real concerns there. It's a very low amount of salt that's deposited in the switch yard.

And any salt that is deposited would be washed away by rain well before any build up would lead to corrosiveness. It would take a number of months for that to happen.

And we compared it against IEEE criteria and standards to make sure that it was well below that criteria. The application also provided detailed information for the site meteorological data recorded on their met tower.

And we compared it against the site -- or regional meteorological information to make sure that it was representative for the area. And it was for most of the parameters.

DR. HINZE: This is Bill Hinze. How did you evaluate that?

MR. QUINLIN: For which part? As far as how it was representative?

DR. HINZE: Yes.

MR. QUINLIN: Well, we compare temperatures to the local National Weather Service meteorological stations. We look at wind direction.

Frequency, that is probably one area that was not as representative as some of the other sites that we evaluated. But mainly less because the National Weather Service stations aren't very close.

And this is a little bit of a river valley as was described in the last presentation. So, this side wind roses are a little different then the National Weather Service stations that are about 40 miles away or so.

But temperature was a little bit more uniform throughout the area. So that one was certainly representative.

MEMBER SCHULTZ: Kevin, is there any surprises there in terms of comparisons of the general data to the site data that you would have seen at other sites? As compared to what you've seen at other sites?

MR. QUINLIN: No. Well, some of the other sites had National Weather Service stations that were significantly closer. So then you would expect the data to match up a little bit better.

MEMBER SCHULTZ: So there's a correlation there. But in terms of --

MR. QUINLIN: Sure, but there was no surprises as far as the location of the site near the river. It was as you would expect it to be.

And the wind roses were fairly uniform as well.

So, there's not a strong river valley component.

MEMBER SCHULTZ: Thank you.

CHAIRMAN RAY: Bill, did you have further questions you wanted to follow up?

DR. HINZE: This is Bill Hinze. I was just wondering what the vegetation situation is with regard to the control tower? And also the elevation of the tower compared to the surrounding elevations?

MR. QUINLIN: The -- as far as the vegetation goes, I'm not completely sure. I was not on the review that early when they did a site visit.

However, I was told that they did meet all the criteria in Reg Guide 1.23, which does speak to trees and other vegetation needing to be certain distance from the med tower.

MR. HUGHES: This is Brian Hughes. I was at the site. The med tower vegetation is basically, it's up on a hill. It is close-cut grass I would say for about -- from the top of the hill all the way to the bottom.

All the trees were removed. All the significant vegetation was removed. So, it was in accordance. And it was kind of -- it's a model really for the applicant and the rest of the people.

It meets Reg Guide 1.23. We do have a staff member who was on a -- at one time was on that committee. He also attended -- his name was Tom Escalata. He attended the -- when we went to the site.

And he was actually impressed with the removal of the vegetation. The removal of the trees. The way the whole site was set up. So, it -- as far as the staff, not so much the -- for the med data, but the actual location and the prep for the site, for the tower, was very -- they did a -- Duke did a very good job on that site.

DR. HINZE: Thank you, very much.

MR. HUGHES: You're welcome.

MR. QUINLIN: Thank you, Brian. Next slide. 2.3.3. I actually think we just covered as part of that question.

It addresses the onsite meteorological measurements program. Duke submitted their onsite meteorological measurement data to the staff or us to review.

The staff reviewed it in detail for quality assurance. And to make sure that it was data of significant quality to use in the atmospheric dispersion estimates. It was deemed acceptable.

And the applicant met Reg Guide 1.23 for additional criteria as Brian just spoke to you for siting the meteorological tower.

MEMBER SCHULTZ: Kevin, how many years of data do we have?

MR. QUINLIN: It was two years of data.

MEMBER SCHULTZ: Thank you.

MR. QUINLIN: 2005 through almost the end of 2007.

MEMBER SCHULTZ: Thank you.

MR. QUINLIN: Next slide please. Sections 2.3.4. and 2.3.5 address the atmospheric dispersion estimates. 2.3.4 is the short term or the actionate -- or sorry, the accident diffusion estimates.

The applicant used the NRC models PVN and ARCON96. For the PVN for the off sites, the EAB and the LPZ x/Q values. And they used ARCON96 for the onsite control room x/Q values.

All their x/Q's were bounded by the AP1000 design parameters. And the staff confirmed that.

The Section 2.3.5, long term or routine

diffusion estimates, they used the XOQ view model, which is also a staff model. And the staff verified that all of the x/Q values for all the off site diffusion estimates also were within the bounds of the AP1000 design.

MEMBER SCHULTZ: How are they making those calculations with two years of data?

MR. QUINLIN: The -- DCD actually recommends two years of data.

MEMBER SCHULTZ: Just two?

MR. QUINLIN: At least two.

MEMBER SCHULTZ: Okay.

MR. QUINLIN: Sometimes -- almost all the applications we -- all of the applications that we received for NRO have used at least two years of data. And I believe at most five or six.

So, it's fairly typical. Which is why we go through a little bit of the exercise to make sure that the -- it's representative of the area. But the site data is what it says it is.

MEMBER SCHULTZ: But the basis here is two years for the x/Q, not five years.

MR. QUINLIN: For the x/Q, yes.

MEMBER SCHULTZ: Okay. Thank you.

MR. QUINLIN: As I stated earlier, all

regulatory requirements for Section 2.3 have been satisfied. They are within the bounds of the AP1000 DCD for all their site characteristics.

For Section 2.3 we had no open items. No more confirmatory items. And there are no exemptions or departures from the DCD. Any questions?

CHAIRMAN RAY: Any questions for Kevin?

(No audible response.)

CHAIRMAN RAY: Thank you. And I wish you a good trip.

MR. QUINLIN: Thank you very much.

CHAIRMAN RAY: We're going to take a break now. And we'll have it around until -- I should be looking at a clock that is somewhat close too on time. But it runs to 10:20.

We're going to go off the record at this point.

(Whereupon, the above-entitled matter went off the record at 9:54 a.m. and resumed at 10:21 a.m.)

CHAIRMAN RAY: Back on the record and we'll continue with staff presentations.

MR. HUGHES: Thank you for coming back. My name is Brian Hughes. I'm going to introduce Rao

Tamara and he is going to make the presentation for hazards at the site.

CHAIRMAN RAY: Okay. Thank you.

MR. TAMARA: My name is Rao Tamara. I'm with DSEA RPAC. I evaluate the FSAR Sections 2.1, 2.2, and 3.5. We are presenting sections 2.1 and 2.2. 2.1 contains the conformance to the requirements pertaining to geography and demography. The main sections that were covered are site description and site location, exclusion of any area boundary, and also authority and control in the EAV and population distribution. These are the main subsections which are covered under site geography and demography.

Staff reviewed the Applicant's addressed information pertaining to these three areas and also independently looked at the information available in the public domain. Based on the review and confirmatory evaluation, Staff found the Applicant's information to be acceptable and it also meets the requirements of 10 CFR 100.20 and also the guidance described or provided in the NUREG-0800. Next slide.

The Section 2.2 covers the descriptions of the industrial facilities like the industrial productions or storage, transportation, and military facilities within the five miles of the site which may have the potential to adversely impact the plant. So Section 2.2.1 to 2.2.2 first identifies all the facilities like routes nearby, roadways, airways, or waterways, and also the pipelines and also any manufacturing facilities and if there are any big facilities for storage and any military facilities or ammunition storage facilities. All of these are being first identified within the five miles of the site, for the particularly airports. And also if there is any major industry which is beyond the five miles within ten miles also being considered and evaluated.

So the information is presented in the forms of maps and description of the facilities, how many people are there, how much distance they are, and is there any potential growth in the future for the life of the plant. If so, it will be identified and considered. In this case, particularly we made a site visit. There was only a board saying DSE and there is a facility, but it was not addressed. So we would look at it and then we pursued. There was an ammunition storage, which is going to come into future, so we identified to the Applicant to consider that when they evaluate, included that one to get the information from the requisite whatever, I don't whether Army or -- but they have got the information and evaluated that one. So it is one of those things which we identified and included in the evaluation.

The second part of the evaluation is to, once it is identified, the potential impacts will be evaluated based on the information available, considering the products or the volume of the traffic or the transportation of the materials. So these are the -- next slide, please. These are the potential impacts which are being evaluated. The measured impacts we will evaluate are the explosions, explosions due to the direct source and also if there are any chemicals which are being released and further carried out in the form of vapor cloud. So we also evaluated the vapor cloud explosions and also we calculated the concentration of any hazardous or toxic chemicals which may have the potential for the control room habitability.

And also we also look at the transportation accidents, considering what are the major products being transported and if there are any major storage locations, we considered those chemicals or products or hazardous materials for the potential accident. In addition to that one, we also look at any onsite chemicals which are being stored for the daily operation of the plant.

In this case, we designed -- the AP1000 identified the standard chemicals which they have addressed, and that is -- the impact of those chemicals are included by reference. In addition to that one, if any Applicant uses any other chemicals that are necessary for the operation, those will be identified and also being evaluated for potential impact from the explosion, also from the control room habitability.

In this case, Lee's case, they have identified two chemicals -- they have site specific chemicals, out of which our confirmatory analysis identified two chemicals which are exceeding the IDLH concentration, immediate danger to life and health. So that is called IDLH concentration which are described by the OSHA. So we looked at -- in Chapter 2, we look at the chemicals, we model that one and see what is the concentration at the inlet to the control room. If that concentration exceeds the IDLH, we identify those chemicals and pass on to our control room habitability Section 6.4, which they will evaluate further, taking into account the dilution and HVAC and their requirements to see whether inside the control room, if that is being exceeded or if there is any potential for the incapacitating the operators.

So that is the two branches are set up, we identify the chemical because there are hundreds of chemicals, instead of repeating the whole effort, only those chemicals which has a potential, we identify in Chapter 2 and then are evaluated more rigorously in Chapter 6.4. So, therefore, these two chemicals in addition to the chemical -- they have evaluated the bounding case of chlorine, which exceeded also the concentration at the inlet. Therefore, these three chemicals are being identified further to be evaluated in 6.4. The other two chemicals in addition to these two chemicals, chlorine also being evaluated and concluded in Chapter 6.4 which will be presented, I think later.

MEMBER SKILLMAN: Rao, let me ask this question, please. I was doing some research in preparation for this meeting and I noticed basically due north of the plant or perhaps due north and slightly to the west is a company called Herbie's

Famous Fireworks.

MR. TAMARA: Right.

MEMBER SKILLMAN: Can you speak to that in the context of this slide, please?

MR. TAMARA: Okay. We looked at that facility. We went and looked at it and also we have taken the inventory -- I mean, they have provided the inventory of the potential amounts. And we have calculated what would be the minimum distance to the safe structures, SSCs, to exceed one PSI. So the minimum distance is satisfied, it is not exceeding one PSI.

MEMBER SKILLMAN: Thank you, Rao.

MR. TAMARA: Yes. And not only that one, we also looked at the chemicals from the Broad River Energy Center and also, as I mentioned, the new facility which was storing the ammunition in future. I don't think it has come into being yet, but there was a proposed storage of that one which we got the inventory and looked at that facility also as a part of future growth.

MEMBER SKILLMAN: Thank you.

MR. TAMARA: Therefore, Staff reviewed the Applicant addressed site specific evaluations of potential accidents and also we performed the independent confirmatory calculations. And based on the review of the Applicant provided information, we had a lot of, I mean, not a lot, we had RAIs back and forth with respect to some of the information. The response to the RAIs, Staff calculations, independent calculations, Staff found the Applicant's conclusions to be acceptable in accordance with the guidance provided in NUREG-0800 Section 2.23. Therefore, there are no open items or any other outstanding items to be addressed.

MEMBER SCHULTZ: So just to rehash what you said in regard to the hazardous chemicals, you have reviewed and agreed with the conclusions of the Applicant associated with those that they've identified need further evaluation in Chapter 6?

MR. TAMARA: Right. Those are --

MEMBER SCHULTZ: We'll talk about those tomorrow?

MR. TAMARA: -- the three chemicals which we -- Applicant has already identified chlorine being exceeding, therefore, they evaluated in more detail. So they identified site specific chemicals, these two chemicals methoxypropylamine and dimethylamine, MPA and DMA. So those, when we did the analysis, we had concentration exceeding at the inlet. Therefore, we identified and asked them, our confirmatory analysis shows it is exceeding. And then they have evaluated and they have further answered our RAI and then I passed on to the control room habitable team, they ran through their habit model at whatever and they concluded in Section 6.4, in the SER, that there is no problem.

MEMBER SCHULTZ: And given that here as we heard this morning, the construction and operation of the facility is out in the future, what's the obligation of the Applicant to review the industrial hazards that might be --

MR. TAMARA: It is a --

MEMBER SCHULTZ: -- in place in the late 20s, let's say.

MR. TAMARA: I think when they are making the application, if they are aware of any potential big storage or any other big industry which may, they think has a potential, they will generally consider. So this is one of those things which they don't -- I mean, I'm not saying they are not aware of, there is no prescribed date they have announced or anything. But they have put a board saying that this will be future or whatever it is, which caught the eye.

MEMBER SCHULTZ: But there's an obligation for them to be aware of any hazardous industrial facilities that might be constructed in the future?

MR. TAMARA: As a part of -- that's why we put as a part of potential growth, they can check with the counties or whatever information that is available from the counties or whatever it is.

MEMBER SCHULTZ: And you're satisfied that --

MR. TAMARA: Right. That's what --

MEMBER SCHULTZ: -- they have set up the required communications?

MR. TAMARA: When we identified, they immediately they said, okay, we will get the information. And then as a part of the RAI, they got the inventory and they evaluated, we reviewed, we evaluated, and then said, okay, even if it comes then it is okay.

MEMBER SCHULTZ: Thank you.

MR. TAMARA: But at that time, there isn't a lot of options supposed if the inventory or anything is greater than what they have anticipated or what we have evaluated. There are some other vehicles, like allegation or reputation or whatever.

At that time, there is a chance to reevaluate if that is being considered or it comes into being. So there is also a vehicle available for the public to get into the evaluations. To answer precisely, because it is a hypothetical question that at least we have addressed to the extent possible.

MEMBER SCHULTZ: Thank you.

CHAIRMAN RAY: Does that conclude?

MR. TAMARA: That concludes.

CHAIRMAN RAY: Any other questions for Rao? If not, we can move to 2.4.

MR. HUGHES: Peter is that -- who goes first? Is it Duke?

MR. TAMARA: Thank you very much.

MR. HUGHES: Okay. Joe? Thank you.

MR. GIACINTO: Thank you.

MR. HUGHES: We'll go right into 2.4.

MR. GIACINTO: Thank you. Good morning. I'm Joe Giacinto, the lead for hydrology review. And to my right is Dr. Rajiv Prasad and Dr. Mike Fayer of Pacific Northwest National Laboratories, who assisted in the review. And they'll be going into details of the topics that we're going to talk about today. Today we're going to be discussing key areas of the Staff safety evaluation review, which included obviously flooding, potential dam failures, groundwater, and then we'll wrap up with a summary of the Staff's conclusions.

As far as background, to get to this point, the Staff issued a total of 79 RAIs or Requests for Additional Information. Eight of these are related to the hydrologic description of the site. An additional 21 were identified for surface water sections. And the Staff identified 50 RAIs for groundwater sections. All the RAIs are resolved and no further information from the Applicant is needed. And we'll start with an overview of the site location, which is in the Piedmont physiographic province of Cherokee County near Gaffney, South Carolina. And I'll hand it off to Rajiv at this point to go into the details.

DR. PRASAD: Thank you, Joe. So, we have seen this map before. This comes from the FSAR. It shows the WLS site, the surface water features. Shown here are the Make-Up Pond A and B are located over there, they're shown. Some of the water stuff, the elevation of important locations on the site are shown here, the Ninety Nine Island Dam.

CHAIRMAN RAY: It would help if you could just speak up a little bit.

DR. PRASAD: Sorry. I'll try to speak up a little bit more. So Make-Up Pond B is located on the west of the site. Make-Up Pond A is located on the east of the site. Make-Up Pond C is not shown on this figure, but we have seen it before during the Applicant's presentation. It's located about two miles northwest of the site. The impoundments as they described before are going to be used for the Circulating Water System Cooling. There are no current or proposed safety related cooling water canals or reservoirs required for the Lee Nuclear Station because of it being AP1000, where the atmosphere really is the ultimate heat sink.

There was an issue that we identified during the hydrology review that remnant drainage lines that were associated with Hold-Up Pond A, which was installed during the Cherokee Nuclear Station construction, still exist on the site and the Applicant has a commitment to remove them and backfill them with some material. And we'll get to that description as part of the groundwater in a little bit.

CHAIRMAN RAY: As part of what?

DR. PRASAD: As part of the groundwater review. So next slide, please. For local intense precipitation, the Applicant's analysis included the following components. First of all, they identified the precipitation itself from the guidance documents, primary among them being the National Weather Service hydrometeorological reports. And then they assumed that all drainage features including the vehicle barrier system trenches that go through them are blocked. Surface elevations immediately adjacent to the power block range from about 592 feet to 590 feet main sea level. You'll recall that the plan for it is at 593, so the one foot drop that they were talking about before.

And they have used two models, the Army Corps of Engineers Hydrological Engineering Center Hydrological Modeling System, HEC-HMS, and a river analysis system also out of the same group to estimate the water surface elevations adjacent to the buildings. The Staff reviewed these analyses and found them to be conservative and reasonable and we agree with their calculated water surface elevation, I think we reported 592.56 in feet main sea level. In the SER, the Staff is reporting only to one decimal place, so we are reporting it to be 592.6.

Next slide deals with the probably

maximum flood. And during Staff's review of the probable maximum floods related with riverine flooding, we found that the estimated water surface elevation near the site would be significantly affected by the degree of blockage that they might have on the Make-Up Pond B spillway. And in response to one of our RAIs, the Applicant has provided details of a Shoreline Management Program that is designed to limit debris being accumulated on the spillway. And the Management Program would consist of annually inspecting the Pond shoreline for fallen or about to fall trees.

The Applicant will also inspect the spillway for any debris that is being collected there after any rainfall event that exceeds three inches an hour. And there is a debris barrier system that they will install in the Make-Up Pond B to keep the spillway free of obstructions. The Staff considers the implementation of this plan to be a commitment on the part of the Applicant.

MEMBER SCHULTZ: Is there a need for such a program plan for the other Make-Up Ponds, A and C?

DR. PRASAD: No. Because Make-Up Pond B, that elevation gets close to the site grade if you have the degree of blockage on that Pond spillway.

The others don't have that.

MEMBER SCHULTZ: Including Pond C?

DR. PRASAD: Including Pond C, yes.

MEMBER SCHULTZ: Thank you.

CHAIRMAN RAY: So this plan will be part of the COLA or the license?

DR. PRASAD: It is in the FSAR right now, so we consider that to be a commitment.

CHAIRMAN RAY: It's enforceable requirement that it be implemented?

DR. PRASAD: Yes, it's a commitment.

MEMBER SKILLMAN: May I ask this, please. What prevents the debris barrier from becoming an alternate dam?

DR. PRASAD: It is a floating barrier system, so what it does basically is as the Pond rises above and below it based on events, then that floating barrier is just going to rise and fall along with the water level. So any debris, the only thing it does is catches it and prevents it from going out through the spillway.

MEMBER SKILLMAN: Thank you. I understand.

DR. PRASAD: So possibly they can collect that debris and move it away.

MEMBER SKILLMAN: Okay. Thank you.

DR. PRASAD: So next slide is about the potential dam failures. Like Duke described earlier, they considered dam failures during the PMF event in the river basin. And during our review, the Staff found that there is a proposed dam that is proposed to be constructed on the First Broad River one mile north of Lawndale. This proposed dam and its potential failure was not addressed by the Applicant in the FSAR. So we performed an independent analysis to look at what that dam, if it were to be constructed and then fail, would do to the flood level at the site.

So the Staff estimated the discharge for a potential dam failure and then also included wind wave effects on top of that and estimated that the margin above that water level to the site grade is still seven and a half feet. So our conclusion was that the dam failure analysis, even if we were to include the proposed dam, would be acceptable. At this point, I'll turn it over to Dr. Fayer for his groundwater review.

DR. FAYER: Okay. The general hydrologic position was described earlier --

CHAIRMAN RAY: I'm not sure your

microphone is on. Is it? I can't see. Towards you.

DR. FAYER: There we go. Is that okay? Thanks. As the description occurred this morning, the site is an unconfined Piedmont surficial aquifer. We've got soil, saprolite, and partially weathered rock on top of bedrock. Groundwater generally flows to the north towards the site and then from the site both to the west, north, and to the east. The focus of the review was on the maximum groundwater elevation at the plant and also the transport pathways in event of an accident. So the Applicant collected samples, monitored groundwater levels, conducted a groundwater model study to evaluate conditions. Next slide.

We reviewed the modeling, the data analysis, thought that the conceptual model was appropriate. They identified several alternative pathways. Assumptions were conservative. In all the analyses, the maximum groundwater level was below the DCD requirement of 591 foot elevation. And the pathways were conservative. The one thing that did occur is in the review identified one drainage pipe going to the north that was potentially in the zone of the maximum groundwater level elevation and could become a potential pathway. And so the Applicant in the FSAR mentions removing that pipe and backfilling basically with compacting material. Next slide.

This I believe was shown earlier. It shows the four alternate pathways that were considered. The one going directly north from Unit 2 to Hold-Up Pond A was deemed to be the most conservative, it has the shortest distance, it's one of the larger hydraulic gradients basically, change in water level. So it yields the shortest travel distance to the public. And we concurred with that. Next slide.

And just to sum up some of the elevations that occurred in the analyses, this actually includes both groundwater and surface water, but for the groundwater perspective, the maximum groundwater level would be 584, which if you can read that slide shows it's well below the 591 DCD level that we're targeting. I don't know if you want to speak to the levels for the Ponds at all, but --

DR. PRASAD: Yes. Everything on that slide for surface water sections, which are the first four bars, well, the first and the second and the fourth, fifth, sixth bars, they are all below the 593 peak elevation. Which is the DCD requirement for surface water elevation.

DR. FAYER: Next slide. So our conclusions are that the Applicant demonstrated that the site is suitable by satisfying the regulatory requirements, addressed the COL-specific information items identified in the respective sections of the DCD. The Applicant performed necessary hydrologic analysis and determined the design basis flood as required with an acceptable level of conservatism. And there are no post-combined Staff reviewed license activities. And that concludes our presentation.

CHAIRMAN RAY: I'm pondering what's meant by no post-combined license activities. What does that mean?

MR. GIACINTO: We have no -- there are no commitments to be made by the Applicant.

CHAIRMAN RAY: Well, there's a license condition for the removal of that pipe, for example.

MR. GIACINTO: That's correct. What it's intended -- that bullet's a little confusing. It's intended for the Staff activities, not for the Applicant.

MR. BURKHART: So if I can just -- this is Larry Burkhart from the licensing branch for AP1000. Sometimes the Applicants will make commitments to do something. We don't necessarily rely on that to make our finding, so I think that's what that bullet is referring to is there's no specific commitments that Duke has made. But even when sometimes they do make these commitments in other areas, we don't necessarily rely on that for our safety finding. I know it seems kind of odd, but that's actually what we have seen.

CHAIRMAN RAY: I'll just observe, Larry, that it's a very confusing statement, to me anyway. I have no idea what it's intent was. I guess I understand that you're saying the Staff doesn't have anything it needs to follow up on once the license is issued.

MR. HUGHES: This is Brian Hughes. We do have a license condition in place. There is a legacy storm drain that would bypass the flow path. So there is a license condition that would require that to be removed, not only the piping, but also any surrounding soils, and then it would be backfilled with compacted native soils. And that will be inspected at a later date by the Staff.

CHAIRMAN RAY: Yes. I mentioned that. I still wasn't sure what that statement meant. Bill, do you have anything you want to -- questions you have in this Section 2.4?

DR. HINZE: If you're asking me, Harold, going back to the dam failure, we heard in newspaper accounts that there were over 60 dams in South Carolina that were ruptured as a result of intense precipitation associated with the recent hurricane. Is this a result of the enhanced precipitation along the coastline or is this the construction of dams, the method of construction of the dams, and how does that affect the dams that we see and anticipate on Make-Up Pond C?

CHAIRMAN RAY: Okay. You're saying that -- the way I understand Bill's question, is there anything in the recent developments associated with the record hurricane rainfall that would affect the review that's conducted if it had occurred earlier?

DR. PRASAD: I can address that a little bit. We did look at the dams that failed during this recent flooding event. And just because of where the maximum precipitation amounts were located, these dams are all lower in the basin, in the Broad River Basin, lower than the Lee site. We are not entirely sure because we haven't really had the chance to look thoroughly into the reasons for the failure, but the South Carolina Department of Health and Environmental Protection has a study that is ongoing currently that is geared towards determining what these dam failure events looked like, why that happened. And they are still working through some of the reasons behind these dam failures.

Going back to the design basis calculation that the Applicant did in the FSAR, the dams were treated to fail in a very conservative manner. And then the flood wave that is produced from the breach is also rather very conservatively down the river section to the site. Also realize that these dam failure analysis that were done for the FSAR was done in combination with the probable maximum flood event, which is produced by a PMP falling on the basin. And initial indications based on data that we have seen does not -- the recent precipitation event in South Carolina does not quite get up to the PMP event. So I think based on the data that I have right now, that the dam failure analysis is still conservative.

CHAIRMAN RAY: Were you able to hear

that, Bill?

DR. HINZE: Yes, I was. And that's a good explanation. What I'm concerned about is that we are -- if there are any lessons to be learned from these recent dam failures, it would be well to bring those into this discussion.

CHAIRMAN RAY: Well, one lesson might be, don't rely on dams located close to the coast. But I think part of what we're hearing is that this site being 150 miles from the coast is not within the zone that these lessons we're referring to are expected to be applied, assuming there are lessons that are drawn from the recent experience. But do I understand, the Staff anyway, views what has occurred as being, you referred to it as downstream or closer to the coastline, that's the main takeaway from that experience that we should have as we look here at the Lee site? This is an inland site, not expected to be exposed to that kind of event?

DR. PRASAD: Yes.

DR. HINZE: Is it related in any way to the manner of construction of the dams?

CHAIRMAN RAY: Well, no doubt that it is related to the manner of construction of the dams. The question is, though, is it applicable in this area here? But, go ahead, comment.

DR. PRASAD: I would just point out that the dam failures were definitely related to the construction quality, also the amount of precipitation and the floods that came in, maybe there is a little overtopping and eroding of the dams. The NRC Staff has recently, post-Fukushima, also has put together an interim staff guidance for dam failure analysis. And some of the ways in which dam failures are analyzed now, particularly for the Fukushima reevaluation reviews, make very conservative assumptions in terms of how many dams can fail and how do you analyze particularly the flood resulting from that where you are concerned about safety related structures. So I still think, in my opinion, that the Staff guidance is still appropriate.

CHAIRMAN RAY: Well, you said that the coastal precipitation associated with the hurricane was a little less than what is assumed in the probable maximum precipitation even in this area. And I guess Bill's observation would be that the standards used for construction of these many, many, I guess mostly earth filled dams, I don't know, are in question and, therefore, that question would be applicable in this region as well, assuming we are looking at the probable maximum precipitation that's equivalent to what they experienced. So, all of that having been said, is the Staff of the view that there's going to be some change in our approach to these analyses drawn out of this experience or anything else? In other words, are we looking backward when we should be looking forward with respect to dam failures?

DR. PRASAD: I don't believe that there's anything on the cards to change any of the Staff guidance in light of this event. And definitely we need to wait until the Department of Health and Environmental Protection in the state goes through the analysis and finds out exactly why these dams failed and what the flood event was from that point on.

CHAIRMAN RAY: Well, Duke presented information about the flow rates assumed for flooding events that are an order of magnitude greater than the normal flow rate, or maybe two orders of magnitude, so I guess from the standpoint of this site in particular, there are more vulnerable sites that we've looked at than this one, relative to the waterway that it's adjacent to.

DR. PRASAD: Yes. I think the way this event happened, that the coastal areas got a lot of rain and up in the inland portion of the basin, they got less amount of rain. It wasn't -- it been challenge the Ninety Nine Islands Dam, I think, closer to the Duke site, the WLS site. But as far as guidance is concerned, I don't think there is any gap at the moment that we need to address.

CHAIRMAN RAY: Okay. Anything else, Bill?

DR. HINZE: No, that's it. Thank you.

CHAIRMAN RAY: All right. Any other questions from Members? Thank you. And let me ask you to turn off your microphones as you leave. We'll ask the next people up to turn them on again when the time comes. Larry, now that finishes where we were to be at noon, according to this. Is that correct from your standpoint looking at the agenda?

MR. BURKHART: We are ahead.

CHAIRMAN RAY: All right. So I think it's pertinent to ask Duke if they want to use the next hour for 2.5 or you want to wait until after the lunch break?

MR. KITCHEN: Mr. Ray, it's Bob Kitchen with Duke Energy. Is this not on?

CHAIRMAN RAY: It should be on, just pull it a little closer to you, Bob.

MR. KITCHEN: Okay. This is Bob Kitchen with Duke Energy. We can proceed on with 2.5 if that fits with the committee.

CHAIRMAN RAY: Yes. Well, I don't think there's any reason for us to wait around for 1:00. I mean, we have to do that at full committee, but we don't have to do that here. So if you'd like to come forward with 2.5, we'll begin there, or we'll continue there. Now, let me remind my colleagues that 2.5 -- I mean, excuse me, the discussion we're about to have on 2.5 is not a discussion on 3.7. That will definitely be for this afternoon. So we'll get close to maybe some things that would prompt questioning that really belongs in 3.7 and I just ask that we hold those questions until that session comes up. Now we're looking at the sources of seismic events and other matters associated with geology and geotechnical engineering. So now I'll ask those of you who are there when you speak to turn your microphones. And with that, you may proceed.

MR. THRASHER: Thank you, Mr. Ray. John Thrasher again with Duke Energy. I'd like to provide a high level introduction to Section 2.5 in the FSAR on Geology, Seismology, and Geotechnical Engineering and then I'll turn over the details presentation to Michael Gray, who is the lead geologist on the Lee project. And Michael's with Lettis Consultants International.

First off, a brief overview of the foundation conditions at the Lee site. We have a slight relocation of the two units that we mentioned earlier has resulted in a uniform hard rock support conditions for the nuclear island and the Seismic Category II adjacent structures, just as described in AP1000 DCD. If you look at information on the site, there's been no tectonic deformation experienced since early Mesozoic periods and possibly in the last 300 million years.

DR. HINZE: That really covers the entire Mesozoic, doesn't it, 52 to 66?

MR. THRASHER: Right.

DR. HINZE: Are you talking about the Triassic period?

MR. THRASHER: Mike, you want to --

MR. GRAY: Well, we have dates for undeformed minerals that cross-cut or infill ductile and brittle shear zones that date at 296 to 298 million years ago. And that's the basis for the statement that's provided on that bullet item. So it would be the Mesozoic and then, I guess that would be the early Paleozoic, I guess it would be the Permian as well.

DR. HINZE: Thank you.

MR. THRASHER: Okay. Again, we've determined that the site characteristic ground motion response spectra and the Unit 1 foundation input response spectra exceed the DCD certified seismic design response spectra. And so we'll be taking a departure for that. The site spectra is also slightly higher than the hard rock high frequency spectra that's in the AP1000 DCD. Therefore, site specific analyses were performed for the Seismic Category I nuclear island and also a separate analysis for the Seismic Category II adjacent buildings to demonstrate design adequacy for these high frequency seismic exceedances. So those analyses will be discussed in more detail in FSAR 3.7.

CHAIRMAN RAY: Yes. As well as the certified design context in which they were done.

MR. THRASHER: That's correct.

CHAIRMAN RAY: That's where we want to

begin.

MR. THRASHER: So in our introduction to 3.7, we'll provide kind of the context of what the DCD suggests the path forward if you see those exceedances, so we'll cover an overview of that in the introduction to 3.7.

CHAIRMAN RAY: All right. So we just acknowledge that, that's the case now and move forward. Okay.

MR. THRASHER: Thank you. All right. Again, with looking at critical site parameters for the AP1000 DCD, we see the Seismic Category I nuclear island, we have uniform hard rock support conditions. Also for the Lee static bearing capacities, the safe shutdown earthquake bearing capacities, and the shear wave velocity values for the Lee site all exceed the DCD capacity requirements. Also, there's no liquefaction potential since the nuclear island is on a hard rock foundation.

For the Seismic Category II adjacent buildings, they'll have uniform filled concrete to the level of the base mat for the nuclear island, providing DCD-like uniform support conditions. The granular fill that will be used has a shear wave velocity greater than 500 feet per second and adequate bearing capacity, again, in conformance with the DCD design considerations. And there will be negligible liquefaction potential for the engineer granular fill material that will be used.

MEMBER BANERJEE: How large is this hard rock formation on which the nuclear island is built? Is it very extensive?

MR. GRAY: This is Mike Gray with Lettis Consultants. The entire area underlying the nuclear island, including the Seismic Category II structures and surrounding area, is underlain by hard rock. It's essentially a pluton that has come up through the metavolcanic sediments that will serve as the foundation material.

MEMBER BANERJEE: Pluton is what? A protrusion which is sort of --

MR. GRAY: It's an igneous rock, yes.

MEMBER BANERJEE: I see. So it came up and formed this sort of -- and how large is that structure?

MR. GRAY: Well, the dimensions of what the east to west dimensions of the Unit 1 and Unit 2 reactors are, I believe, over a thousand feet laterally, horizontally.

MEMBER BANERJEE: So it's at least a thousand feet?

MR. GRAY: It's beyond that. And I have a figure that will show that.

MEMBER BANERJEE: Okay. You have a figure showing what the rock formation is like?

MR. GRAY: Yes.

CHAIRMAN RAY: And when we get to that, I guess we can then ask about the integrity of this formation from a standpoint of depth as well.

MR. GRAY: Sure.

CHAIRMAN RAY: Okay.

MEMBER RICCARDELLA: Excuse me. I'm trying to understand the difference between the solid concrete and the granular fill. You're saying the nuclear island is supported on the old solid concrete, but you use granular fill for the adjacent, in the vicinity of the adjacent buildings. Is that the --

MR. GRAY: The granular fill will be provided to use as a foundation support material for the Seismic Category II structures that are immediately adjacent to the Category I structures. I have two or three slides that will show the cross-section profile of what that configuration would look like.

MEMBER RICCARDELLA: Okay. Thank you. I'll wait for those.

MR. THRASHER: Okay. On the next slide, we've got a high level discussion of site explorations. This site is probably one of the most explored or examined sites in the country, considering that it was previously approved for a three unit nuclear site with Cherokee Nuclear Station. Additional explorations were required for the Lee COLA. Site explorations and laboratory testing were performed in accordance with Reg Guides 1.132 and 1.138.

The information was assembled really in three phases. We went back and were able to use site exploration information from Cherokee Nuclear Station construction permit, site exploration supporting the Lee COLA submittal in 2007, and as mentioned as far as the slight plant relocation, there were supplemental site explorations performed in 2012 -- or to support that 2012 submittal of a site relocation. Next slide.

DR. HINZE: If I may ask a question there. What was your criteria for terminating the bedrock drill holes?

MR. GRAY: Once --

DR. HINZE: You have to terminate those at some point and I'm just wondering what decision was used, what evidence was used to make that decision?

MR. GRAY: Well, there's multiple considerations that come into play. Specifically, the intended use or what's the purpose of the exploration point. So in some areas where we have deep foundations, our borings would go very deep in those instances. We have borings that go up to about, I believe it is 225 feet below the site grade. We would perform bore hole tests inside those locations for measuring the dynamic properties, specifically the shear wave and compression wave velocities. We also performed televiewer view explorations in those. We examined rock discontinuities, not only in the core itself, but in the bore hole.

In areas where borings are maybe less than that depth, we would be looking at more shallow location foundation features. For example, in the area at Unit 1 where we have the existing turbine building structure or foundation for Cherokee Unit 1. We relied on the deep borings from the Cherokee site. We also performed detailed borings for the Lee Station development. In the instances that I'm citing for, like, the turbine building, we were looking at not only the underlying rock condition, but the bonding of the concrete-rock interface. And we were also looking at criteria where we believed that the foundation rock had suitable properties that met the requirements for the AP1000.

The criteria that we used was based on rock quality designation. The basis for the rock quality designation was 65 percent, and I can explain how that's derived if necessary. That 65 percent represents rock that is fresh -- pardon me, is of fair to good quality. The rock was also considered to be suitable if it had a low weathering profile. What I mean by that is that the rock mineral surfaces were devoid of substantial staining or degradation in their quality. Does that answer your question?

DR. HINZE: That's very helpful. I assume that the deep bore holes were terminated if you had consistent rock for some extent of the drilling. Is that correct?

MR. GRAY: Yes. All of the bore holes were terminated at a depth where we were viewing or looking at consistent rock quality. In the case of the deep borings, those borings were intended to assess, primarily to establish I should say, deep locations across the site to develop a dynamic profile that served as the basis for our evaluations for the dynamic profiles that are developed in 2.5.47.

DR. HINZE: Did you encounter any shear zones that you did not anticipate?

MR. GRAY: The rock in that area does contain shears. It's a little bit different than the surrounding rock, but the rock contains shears. Many of these were mapped and identified as part of the Cherokee construction activities and investigation prior to construction. We evaluated that information in detail in preparing for our exploration. We did not identify anything in particular that we felt was different or anomalous to the conditions that were documented in the Cherokee report and we did not identify any conditions that led us to believe that previous interpretations were incorrect or in any way maybe incomplete.

DR. HINZE: Did you see any shears along the margins of the dikes?

MR. GRAY: Yes.

DR. HINZE: Are they extensive or were they --

MR. GRAY: In some areas, they were very localized. In other areas, they are quite extensive. In all cases, the rock was not weathered or degraded. Like I mentioned in one of my opening comments, we had -- there's several phases of deformation that have occurred at the site, ductile and brittle. And in these cases, were -- or I should say, in the cases that were observed in the rock surface, which is quite extensive, the shears are representative of late Paleozoic deformation. And we have dates on rocks from thin section evaluations that support, like I mentioned previously, ages of about 290 million years. And these represent cooling temperatures for undeformed minerals that formed inside these brittle and ductile fabrics.

DR. HINZE: These are in the diorites?

MR. GRAY: They would be in the diorites, yes. Or in the parent rock as well. In the report, we have two different lithologies. One would be more dioritic or mafic and the other rock type would be what was characterized as felsic, which represents a more tonalite or granodiorite type rock.

DR. HINZE: That's very helpful. Let me ask you another question while we're talking about geological mapping. How extensive has been the geological mapping associated with the base and the surround of Make-Up Pond C?

MR. GRAY: I'm not able to answer that. I was not involved in the evaluations for the geologic design or engineering design for Make-Up Pond C. The focus of my work was related to the safety related structures in and around the power block and excavation and in the outbound areas for the cooling tower pads and such.

DR. HINZE: I assume that someone will be able to answer that. Thank you very much.

CHAIRMAN RAY: Let me turn to Bob and ask, since Pond C is of some interest, is there presentation later with corresponding information for Pond C?

MR. KITCHEN: Mr. Ray, it's Bob Kitchen. We don't have a presentation planned I think to address that specific question. But if we could have a little bit of time, we could pull something together and come back to the committee with that, if not today, than tomorrow.

CHAIRMAN RAY: Thank you. Staff, is there anything you guys wanted to say?

MR. HUGHES: We'll have a discussion on Pond C for the seismic induced reservoir situation.

CHAIRMAN RAY: Well, Bill's question went to more than just the seismic implication I think, it had more to do with what's known and so on.

MR. HUGHES: That I'll get back to you on.

CHAIRMAN RAY: Okay. All right. That's fine. You can't speak to anything that you weren't involved in. So it's just been identified as an area of interest by Bill and perhaps others here that we would like to know before the end of the meeting what we can about it.

MR. THRASHER: This is John Thrasher again. As Bob Kitchen mentioned, we can gather -- we didn't have any information prepared on that considering that Make-Up Pond C is basically a safety related -- I mean is non-safety related and everything. We did have a separate vendor that prepared and performed the geotechnical evaluations to support the design of the dam and everything, so we can pull together some information if we need to.

CHAIRMAN RAY: Well, yes. We're of course well aware that it's not a safety related feature. But the potential for its effect on safety related is, I think, really the issue. Does it have any potential to effect the plant? You've talked about the ridge that's between the plant --

MR. THRASHER: Right.

CHAIRMAN RAY: -- and Pond C from a flooding standpoint. And presumably any failure of the impoundment would lead to water going into the river and not into the plant site. But there's still a question of whether or not the failing of the Pond has any implication to the plant site from a foundation standpoint.

MR. THRASHER: Okay. I'm only aware of evaluations that we or review that we have performed looking at potential for reservoir induced seismicity.

CHAIRMAN RAY: That's an example, yes.

MR. THRASHER: But we can pull together some information on that as well.

CHAIRMAN RAY: Is that good for now, Bill?

DR. HINZE: Yes.

CHAIRMAN RAY: All right. So, please

proceed.

MR. THRASHER: Okay. So, the site explorations performed at the Lee site and the power block and adjacent areas on this figure, probably hard to tell, but the black dots represent borings that were performed for the Cherokee construction permit era, about 189 geotechnical borings were performed. The blue dots represent the borings that were performed, additional borings, to support the Lee combined license application, about 124 borings. And then with the site relocation of the plant, we performed seven additional geotech borings to support that 2012 submittal, and those are shown in red again on this figure.

DR. HINZE: Excuse me, if I could ask a question here. In my experience, it's very common to do as we see in Unit 1, where there is a drill hole, preferably there's a deep drill hole, in the center of the nuclear island. There's not in Unit 2. Is there a reason for that? Why wasn't there a drill hole put in the center of --

MR. GRAY: For Unit 2, the -- prior to relocation, there were borings near the center. Following relocation, we have those two red circles that locate the post-relocation exploration points.

There were several borings in the area of the nuclear island at Unit 2 define the -- that are very deep. I believe one of them is just to left of where the cursor is located.

CHAIRMAN RAY: He can't see the cursor.

MR. GRAY: Oh, I'm sorry. And that boring would have been on the range of about 175 to 200 feet. I have a cross-section that I can show that goes through Unit 1 and Unit 2 in that east-west direction. If you're looking at the figure, it would be Cross-Section BB, that we could show you the locations and the projection of the bore holes in a vertical section if you'd like.

DR. HINZE: That will take care of my question. Thank you.

MR. GRAY: Yes.

MR. THRASHER: Okay. A couple other comments to note on this slide. We have mentioned that Lee Unit 1 would be on top of Cherokee base mat and also Cherokee fill concrete. The AP1000 nuclear island base mat does not go into the ground quite as deep as the Cherokee design that was going to previously be used. So located on top of that base mat is pretty much the base mat, reinforced concrete base mat is becoming fill concrete rather than removing that material and replacing it with fill concrete. And we'll have to actually place additional fill concrete on top of the Cherokee base mat to get to the bottom of the Lee Unit 1 nuclear island base mat.

So we wanted to make sure that we had good quality base mat concrete there, good quality fill concrete, and also examined the interface between the base mat concrete, the fill concrete, and the interface between the fill concrete and the rock. So we did some site explorations all evaluating that old Cherokee base mat concrete prior to demolishing the above-grade structures and documented that in a report.

After the demolition work was finished, we went back and re-performed some of those same examinations to also enhance that report and to confirm that the demolition work had not resulted in any damage to either the base mat concrete or the fill concrete or the bonding between those items and the rock. And so that report -- pre-demolition and post-demolition reports were prepared and submitted to the NRC. We also, considering that we will be placing Lee Unit 1 on top of that existing foundation, had information from the Cherokee construction era where the top of rock was mapped and we pulled that information back up and pulled that together and provided a well-documented mapping report to the NRC in that area.

So, again, our foundation rock conditions in Unit 1 basically will be entirely underlain by legacy Cherokee foundation concrete over previously mapped hard rock. Legacy Cherokee concrete will remain in place and, again, we will have to place addition fill concrete on top of that Cherokee base mat to get to the bottom portions of the Lee Unit 1 nuclear island base map. And we will see some cross-sections of that in Mike Gray's presentation shortly.

In Unit 2, the foundation rock will be mapped as a construction activity after excavation because in Cherokee that portion of the foundation area was only partially excavated. So there will be additional excavation required and top of rock mapping will be performed as a construction activity for Lee Unit 2. The eastern edge of Unit 2 nuclear island will require localized area fill concrete and that's been evaluated and has no significant effect on the plant. And that will be discussed more in Mike Gray's --

MEMBER SKILLMAN: John, before you turn the slide, what is the significance of the concrete data for the legacy Cherokee concrete? Was that N1QA1 concrete? Do you know its characteristics? Do you know it meets or exceeds the requirements for what will be the underlying concrete for the new construction? How do we know that concrete's good enough?

MR. GRAY: As John described, we did an extensive testing program. And I was going to mention some of this information as part of my discussion, but let me --

MEMBER SKILLMAN: If it's going to be later, it's fine.

MR. GRAY: Yes.

MEMBER SKILLMAN: That would be fine.

MR. GRAY: I believe that the answer to your question on whether or not the quality is suitable for meeting the requirements of the AP1000 GS, we tested a number of locations, as John mentioned, prior to demolition. So during the exploration program, Duke went in and they cleaned out the lower levels of the superstructure so we could get to the foundation grade, the base mat level, so basically, the lowest level of the structure.

We did explorations inside there of coring for the concrete and rock. We tested the concrete, its compressive strength and shear wave velocity parameters for example. We did petrographic analysis of it as well to show that it had not degraded. We televiewer logged the concrete and rock interface to confirm that the rock and concrete is well bonded to each other. Some of the material property values, looking at the compressive strength of the concrete as a whole, whether it is fill concrete for Cherokee or the structural concrete that had -- essentially the same concrete materials, one had reinforcement with steel, the other one did not. We're looking at over 7,000 PSI for the compressive strength of the concrete. And then the shear wave velocity, the mean shear wave velocity of that material is about 8,100 feet per second. So we're looking at very rock-like type strengths for the concrete as well.

MEMBER SKILLMAN: Thank you.

MR. THRASHER: Okay. The summary of the foundation conditions, we see the properties of the Lee Nuclear Station foundation has been fully investigated, well known, and well understood. The

AP1000 DCD site foundation support parameters are satisfied. We have a uniform hard rock site with configuration just as described in the AP1000 DCD. We have determined our site characteristic ground motion response spectra and foundation input response spectra. And we'll explain the development of those in more detail. And the exceedances there resulted in a departure. And also the requirement for site specific analyses and those analyses were performed to demonstrate adequacy and those will be explained in full detail in FSAR 3.7. So I will now turn it over to Mike Gray to explain further.

MR. GRAY: As John mentioned, my name is Mike Gray. I'm with Lettis Consultants International. I was the principal geologist for the Lee project. Next slide please. So this is an outline of my presentation. Really what we're going to do is we're going to focus on -- the basis of the discussion will focus on the ground motion, the foundation interface, and then the seismic design characteristics. And then coming out of that discussion, we'll have a comparison of the site design response spectra, which we'll call the nuclear island FIRS or foundation input response spectra, which will then lead into the later discussion regarding the structural analysis. Next slide.

So for the CEUS model, the new CEUS model was issued as NUREG-2115 in 2012 and that was entitled CEUS Seismic Source Characterization for Nuclear Facilities. The study was co-sponsored by the DOE, NRC, and EPRI. This work was performed as a SSHAC Level III study using the guidance provided in the Regulatory Guide 2.117. This model is used as a replacement for the EPRI SOG model. And for the site evaluations at Lee, we implemented the Seismic Source Characterization model directly as modeled in the CEUS document.

DR. HINZE: Mike, will you speak to the updated attenuation?

MR. GRAY: Yes. The updated attenuation model that EPRI developed in 2013 was used and I was planning to mention that as part of the development of the PSHA discussion, maybe a couple of slides back. So, I can review that now or as part of that discussion.

DR. HINZE: Oh, that's fine.

MR. GRAY: Okay. So the NRC asked a question regarding what's the impact of the Eastern Tennessee Seismic Zone on the Lee site. Is there any new information that was published post issue of the CEUS SSC? There had been one particular paper issued by Hatcher in 2012 that looked at a number of features associated with Douglas Reservoir. The study that we did -- first let me describe the figure that is showing, I'm sorry.

The figure that is showing is from the FSAR. It represents the regional seismicity for the area surrounding Lee and the site region. The area with the star in the center of the circle is the location of the site itself. The red circle that surrounds the site is the site region, that's the area of interest as defined by Regulatory Guide 1.206, 200 mile radius. And then the Eastern Tennessee is characterized by the zone of or the linear band of seismicity up to the northwest of the site.

The Eastern Tennessee is characterized as a persistent low-level seismic area with magnitudes less than 5.0. The largest magnitude that historically has been measured is 4.6. And one of the key attributes of this structure is the earthquakes occurred about a depth of 15 kilometers. And that represents the -- I should say the 15 kilometer depth is clearly below what is referred to as the Appalachian Decollement. So we have a fold and thrust belt that overrides this lower rock, which appears where the earthquakes are occurring.

The sensitivity studies that we did in response to the NRC Letter 117 demonstrate that the Eastern Tennessee Zone is adequately represented in the current model. The information currently available for the Eastern Tennessee and whether or not it merits consideration as an RLME or a specific source within the CEUS model, is not well defined. And what I mean by that is the CEUS Seismic Source Characterization model defines an RLME or repeating large magnitude earthquake as a local earthquake source that has one or more magnitude 6.5 earthquakes associated with it. The information for the Eastern Tennessee to date in the publication does not support that interpretation. And that was the conclusion as well for the CEUS SSC TIT.

So, the Eastern Tennessee as currently modeled in the CEUS model is captured in the Mmax zone defined as the Mesozoic and younger extended crust, or in the Paleozoic extended crust seismotectonic zone. And so we use the Seismic Source Characterization model as defined by the CEUS in the Regulatory Guide 2.115 as is with respect to the Eastern Tennessee.

DR. HINZE: Mike, if I may, I have some questions about the evolving information on the seismicity of the Eastern Tennessee Seismic Zone, but I'll defer those until we have a discussion with the NRC Staff, who I think is monitoring those studies. And also until we get to 3.7.

MR. GRAY: Okay.

CHAIRMAN RAY: Okay. We understand, Bill. You guys have anything to add to what he said or comment further?

MR. GRAY: I have no comments.

CHAIRMAN RAY: Okay.

MR. GRAY: Another post CEUS study that we did was a result of the 2011 August Mineral Virginia Earthquake, which was a magnitude 5.8 event. This earthquake is located in the Central Virginia Seismic Zone, which is an area of persistent low-level seismic activity. The location is common to several of the CEUS seismic source background zones. Specifically what's referred to as the ECC AM or the Extended Continental Crust Atlantic Margin Seismotectonic Zone.

The event, using the CEUS guidance for magnitude conversion, would result in a 5.71

expected moment magnitude earthquake. This earthquake is well below the Mmax distribution for the ECC AM Seismotectonic Zone, for the Mmax distribution defined for that zone is 6.0 to 8.1. So based on that and other information, we opted to -- I should say based on that finding coupled with the fact that the Seismic Source Characterization model adequately represents seismicity in and around the Mineral Event, we opted to use the Seismic Source Characterization model as published by Regulatory Guide 2.115. Next slide.

So to reiterate some information that John presented earlier, Lee is a hard rock site. The underlying foundation rock has a shear wave velocity of 9,000 to 10,000 feet per second and greater at depth. We do not use -- pardon me, there's no site response views. To address Mr. Hinze's question, for the PSHA in using the CEUS Seismic Source Characterization model, we also used the updated EPRI ground motion model. As mentioned just in the previous two slides, we considered the guidance provided in the SSHAC Level III and IV evaluation, Reg Guide 2.117, to evaluate new date. We also considered distributed seismic sources out to about 500 --

CHAIRMAN RAY: Excuse me. I wondered what you meant by Reg Guide. You mean NUREG --

MR. GRAY: The NUREG, yes.

CHAIRMAN RAY: Okay.

MR. GRAY: I'm sorry, I misspoke.

CHAIRMAN RAY: That's all right. I thought maybe you were referring to something I wasn't --

MR. GRAY: No.

CHAIRMAN RAY: -- familiar with, but, okay.

MR. GRAY: To be clear, it was NUREG-2117 for the SSHAC guidance. For our PSHA or evaluating hazard at the site, we extended our search radius out to 520 kilometers. And we did that as a means to evaluate distant background sources that could contribute to hazard at Lee. As part of this evaluation, we also included the repeating large magnitude earthquake event models that are defined for Charleston and the New Madrid Fault System.

This figure here just demonstrates -- it's the same figure that I previously showed with respect to Eastern Tennessee, but it's larger, perhaps easier to read. It shows the Lee site in the center of the red circle. We've got our site region indicated with the red circle there. The Mineral Earthquake Event is located to the northeast of the site, approximately 480 miles, I believe it is, from the site. And then the Eastern Tennessee is shown there as well. And then for the New Madrid part of the Reelfoot Rift System is down near where those three red infilled circles are. Next slide.

So this slide represents the seismic deaggregation, basically it is a depiction of the low frequency and high frequency results that contribute to seismic hazard at the site. The deaggregation plot that are shown here represent the low frequency hazard, 1 and 2.5 hertz on the left-hand side. The right-hand side is the high frequency of 5 and 10 hertz. The deaggregation is performed following the guidance in Reg Guide 1.28.

What we see here, especially in the left diagram, is that the background source on the far left contributes to hazard. And then we have a good representation of the Charleston source in the center. And then the distant source on the far right of that diagram is the New Madrid Seismic Flood System. For the high frequency, the high frequency at the Lee site is dominated by the local background seismicity. Next slide.

So this information shown in this slide is similar to the one John showed. I just want to reiterate the foundation rock conditions at Unit 1 will be underlain entirely by legacy concrete from Cherokee. And then it overlies previously mapped foundation level rock, defined as hard rock, exceeding 9,000 feet or 9,200 feet per second. The legacy concrete will be removed and the approximate thickness of the fill concrete or the legacy and new concrete materials, the composite thickness will be about 23.5 feet beneath the nuclear island.

For Unit 2, the foundation rock will be mapped during excavation. The nuclear island will be placed on foundation level rock and then on the eastern side, we'll use fill concrete to backfill up to the base mat elevation for the nuclear island. That area was a little bit low with respect to the topographic elevation at the site, so it will have a configuration similar to -- the eastern edge of Unit 2 will have a configuration similar to Unit 1 center line.

MEMBER SKILLMAN: Michael, you said in reference to this slide that the legacy concrete would be removed. I think you meant the legacy concrete will remain.

MR. GRAY: Yes. If I said remove, that was not correct.

MEMBER SKILLMAN: Okay. Thank you --

MR. GRAY: Yes.

MEMBER SKILLMAN: -- for clarifying that.

MEMBER RICCARDELLA: Excuse me. This is a little far afield from my expertise, but are there standard ways that you tie these two concretes together so that you don't have a shear plane?

MR. GRAY: Yes. The concrete would be roughened. There's guidance in the FSAR Section, I believe it's 2.5.410 that describes the preparation of the existing concrete surface prior to pouring the new fill concrete.

MEMBER RICCARDELLA: But there's no rebar or any tie rods or anything like that?

MR. GRAY: No, there is not.

MEMBER RICCARDELLA: Okay.

MEMBER BLEY: Can you just give us a hint about what roughened means?

MR. GRAY: It would be a -- the surface would be mechanically ground or broken to create a roughened, irregular surface to avoid the condition that he was describing.

MEMBER BLEY: I was just -- are we

talking about roughened like this or roughened like this?

MR. GRAY: It's a small amount. I don't remember what the specification is in the ACI guidance.

MEMBER BLEY: So it's in the entrance range, so it doesn't take much.

MR. GRAY: Yes.

MEMBER BLEY: And that's really good enough to tack those together?

MR. GRAY: Yes. That's the standard we'll be following for that.

MEMBER REMPE: So there's a standard for it and there's a lot of experience with doing something like this? There's not nuclear experience, right? This is the first time we've done this with a nuclear plant, but other industry experience with doing this?

MR. GRAY: Yes. For the Lee Unit 1 site, not only will the concrete -- the horizontal surfaces be roughened, but in a cross-section that I have coming up, you'll see that there are irregular surfaces as well that will remain in place as part of the Cherokee legacy configuration. And so those will act as methods to prevent shear as well.

MEMBER REMPE: Thank you.

MEMBER BLEY: When you mentioned to standard, what standard is that?

MR. GRAY: It's an ACI standard and I don't have it offhand, but I can research that and have that for you.

MEMBER BLEY: We'd appreciate that.

MR. GRAY: Yes.

DR. HINZE: Mike, on a slightly different point for the record, are there any anomalous geological features in the mapping of the bedrock beneath the legacy Cherokee concrete?

MR. GRAY: I'm sorry, I'm not sure that I fully heard or understood your question.

DR. HINZE: Okay. Are there any anomalous geological features that have been mapped in the bedrock beneath the legacy Cherokee concrete?

MR. GRAY: When you say anomalous, could you give me an example?

DR. HINZE: Well, shear zones, faults, whatever.

MR. GRAY: Yes, there are shear zones and faults that are documented in the foundation level rock at Unit 1 that are now -- have been covered by fill concrete. We performed a detailed evaluation of the mapping that was performed under the QA program in place at the time that Cherokee was constructed. The mapping work that was there correlates very well with the subsurface investigation that we did. So we evaluated bore hole points to confirm lithology and then also structural features, such as shear zones or fractures, and plotted those in stereo nets.

And then specifically what we did is we performed a comparative mapping evaluation in the northern area at former Unit 2 for Cherokee. That rock was excavated down to foundation level. And we reconstituted the foundation level maps that were developed as part of the Cherokee project. We relocated fixed survey points, reestablished the survey grid that was used, and performed independent mapping in that area. And the rock features, including lithology, and structural features, such as shears and faults, correlated very well from the contemporary mapping to the historic mapping. So using that process, we confirmed and validated the mapping that was performed for Cherokee Unit 1 that has now been covered with the concrete materials.

DR. HINZE: Thank you. Very good explanation, I appreciate it.

MR. GRAY: So to reiterate the foundation conditions, we've got a uniform hard rock support for the nuclear island, with measured shear wave velocities beneath the nuclear islands ranging from 9,000 to 10,000 feet per second. And based on the differing foundation conditions that we've started to describe here, but will soon see in a cross-section, we developed individual foundation response spectra, or what we call FIRS, foundation input response spectra. So we developed one for Unit 1 and one for Unit 2 as well. And I'll proceed to describe the development of those now. Next slide.

So what we have here is it's a simplified map showing the limits of the Cherokee excavation in the dark line, the irregular polygon that surrounds the border -- or is interior to the border of the figure. Shown on here is the Unit 2 nuclear island location. Moving to the west or to the left is the Unit 1 nuclear island. Highlighted on this map in the light gray is the legacy concrete for Cherokee. Also shown on here are the outlines for the AP1000 power plant or power structures.

And then you'll see four yellow lines. The first one going east-west or through the center lines of the nuclear island, is what I will refer to as Cross-Section BB. And then we have another going north-south at Unit 1, that's Cross-Section EE. And then on Unit 2, the center line profile is Cross-Section F. And then we have FF. So throughout the discussion that will go on, we'll be referring back to these locations for reference. Next slide.

This slide John also showed, but it reiterates the point of all of the exploration points that were evaluated and used as part of the evaluations for Cherokee and then again for Lee. The black points represent Cherokee locations that were drill borings with boring logs produced through the quality assurance program at the time. And then the blue points represent exploration points associated with evaluations for safety related, Category I, Category II, and then adjacent structures as part of the Lee investigation. And then the red locations represent the relocation borings that were done to confirm the site conditions from the previous evaluations. Next slide.

So this slide shows the locations of the bore hole tests and surface tests that we did to evaluate the dynamic material properties, specifically to develop our shear wave and compressional wave and dampening properties for the site that were then used to build our dynamic profiles for the site. So at Unit 1, you'll see a location -- all the locations shown in green represent bore holes where we performed PS suspension logs. And then also in several instances, we performed down hole tests as well. So we're using multiple methods to develop our dynamic profile.

At Unit 2, all of the locations are shown in blue. Similar process there. The bore holes used PS suspensions logs coupled with down hole logs. But then more specifically, in the northern area of Unit 2 where we had rock exposed, we ran a series of SASW tests, so basically a surface geophysical test to evaluate the shear wave velocity and compressional wave velocity profiles. And we performed three tests up in that area.

The locations in the center of the excavation, the blue one there near Unit 2 and then to the left at Unit 1, those were deep boring profiles and I believe they went to depths of about 225 feet deep. So we have velocity profiles quite extensive below the foundation level for the facility. Next figure.

So here's one of the cross-sections that I was referring to earlier. This is Cross-Section B. It goes east-west through the Unit 1 and Unit 2 center. The red profiles represent the AP1000 structures in profile. We've got the Seismic Category I and the Seismic Category II portions of those structures depicted on the profiles. The red horizontal lines just represent the post-construction site grade. There was a question earlier regarding the placement of granular fill and the support. That's depicted in the, I don't know what you would call that, but it's the kind of bouldery looking pattern that's next to the nuclear island surrounding both the nuclear island 1 and 2 areas.

Beneath Unit 1 you'll see the concrete sections that we've been describing. So the upper section represents fill concrete that would be placed as part of the Lee construction. And then the lower concrete materials below that illustrate the Cherokee legacy concrete. And then the white space below that is what we're calling the competent rock or the hard rock, basically the foundation level rock that will support the Unit 1 and Unit 2 nuclear islands.

DR. HINZE: What are the question marks up there?

MR. GRAY: I'm sorry?

DR. HINZE: What are the question marks? Do they -- is that indicative of the fact that you don't know where the bottom of the legacy concrete is?

MR. GRAY: The bottom there is -- those question marks reference, yes, a little uncertainty associated with that thickness. We have good control immediately below the Unit 1 nuclear island. The density of borings as you move to the left of that drawing may not have penetrated fill concrete in all instances. So we're representing that with a query in that case right there.

MEMBER BLEY: Let me just follow what you just said, the question mark is right underneath. But you said you have good confidence right under --

MR. GRAY: We have a boring -- we have many borings that penetrate there.

MEMBER BLEY: Okay.

MR. GRAY: Yes.

MEMBER BLEY: So it's around the sides that you don't?

MR. GRAY: Yes.

MEMBER BLEY: Okay. Got it.

MEMBER RICCARDELLA: The question marks just are there just for the whole line.

MR. GRAY: Yes.

MEMBER SKILLMAN: Yes, that was my question too.

MR. GRAY: Okay.

MEMBER SKILLMAN: Thank you.

CHAIRMAN RAY: Just a time check. We'll continue, I think we'll finish this probably at 12:15 or so.

MR. GRAY: Okay.

CHAIRMAN RAY: And then take our lunch break.

MR. GRAY: So I'd like to describe the area under Unit 2. So you can see the center of Unit 2 will be founded on rock. And as we mentioned earlier, the eastern edge, the topography there is a little low and so what we'll do there as part of construction is we'll perform some detailed excavation there to create the support zone that's illustrated in that section there. So next slide.

So FIRS A1 or Unit 1, it represents the site response foundation input motion at Unit 1 center line. So it considers the ground motion coming up through the rock and then through the concrete profile section. The blue line that's shown represents the shear wave velocity profile. The gray horizontal line where the blue line terminates represents the top of rock and the Cherokee concrete interface. The concrete profile there is approximately 23.5 feet thick. Next slide.

So similarly, at Unit 2, we've got -- this represents the center line configuration and we have rock extending up to the base mat elevation as shown in that diagram. Next slide. So this slide represents the horizontal ground motion response spectra, which describes the input motion at Unit 2, what we're describing as Unit 2 FIRS. And the Unit 2 FIRS is depicted in the red dash line. Probably before I go into that, I should just explain this figure a little bit more thoroughly.

This figure represents the horizontal GMRS and the FIRS as I mentioned. Not only are we showing the results of our evaluation, but we're also showing the Westinghouse horizontal CSDRS or certified design response spectra. And then also shown on there -- and that line is show in blue, the blue dash line. The Westinghouse generic hard rock high frequency horizontal spectra is shown in orange. The GMRS, the Unit 2 FIRS, is represented in the red dash line that's shown on that plot. And then the FIRS A1 is represented by the solid black line. FIRS A1 if you recall is the input response motion at the center of Unit 1 at the top of the base mat concrete. In this diagram, we're showing the horizontal. The vertical representation is very similar and so for the discussion purposes, we'll show the comparison of the horizontal and verticals in the subsequent slides.

MEMBER RICCARDELLA: So the Unit 2 FIRS is essentially the same as the GMRS because it's sitting on the rock?

MR. GRAY: That is correct, yes.

CHAIRMAN RAY: You say you're going to compare the -- you're going to show the vertical versus the horizontal in a --

MR. GRAY: I'm going to show specific plots now of the horizontal GMRS and FIRS that we will --

CHAIRMAN RAY: Well, basically just tell me, are you going to show what fraction of the horizontal the vertical is at the far right side? Or --

MR. GRAY: Oh, for the --

CHAIRMAN RAY: -- the zero period?

MR. GRAY: For the values?

CHAIRMAN RAY: Yes.

MR. GRAY: Okay.

CHAIRMAN RAY: Is it two-thirds, three-fourths? What is it?

MR. GRAY: The frequency is shown on the bottom of the diagram. The far left side will be 0.1 hertz, the far right-hand side will be 100 hertz, representing PGA. So the PGA for the Unit 1 FIRS is 0.352.

CHAIRMAN RAY: Right.

MR. GRAY: Is that what you were --

CHAIRMAN RAY: Well, I'm asking what fraction the vertical is of that.

MR. GRAY: What the difference is between the vertical?

CHAIRMAN RAY: Yes. Just compare the PGA for vertical versus horizontal. That's all I'm asking.

MR. GRAY: Yes. So the PGA for the horizontal is 0.352. And then the representative vertical, I don't have that value tabulated, but it looks to be 0.32.

CHAIRMAN RAY: Okay. So it's a lot more

than two-thirds then? Okay.

MR. GRAY: Yes.

CHAIRMAN RAY: Yes. I'm not used to hard rock sites, that's why I need to be educated here.

MR. GRAY: As you can see on this diagram, we have exceedances not only of the CSDRS, with the dash blue line, but then also of the orange dash line, which represents the AP1000 hard rock high frequency spectrum. So for developing our design input motion, we created an envelope of the horizontal spectrum. So we've enveloped the values for the GMRS and the FIRS A1. And we did a similar approach for the verticals. And we refer to these as the nuclear island FIRS.

So we've enveloped the horizontal spectrum developed for the GMRS or Unit 2 FIRS and the Unit 1 FIRS. We've done this as a means to simplify, but then also represent what will be a consistent ground motion for Unit 1 and Unit 2. And these results were used to then use as an input for Westinghouse to perform their site specific analysis. Next slide.

So this slide here represents the design basis ground motion for the horizontal nuclear island FIRS. And as you can see here, it exceeds the AP1000 CSDRS at frequencies starting at about 14 hertz. The PGA is represented at 0.352 for the NI FIRS. And we also exceed the horizontal -- pardon me, the horizontal NI FIRS also exceeds the hard rock high frequency starting at about 3 hertz.

Similar plot for the design basis ground motion response spectra for the vertical. We have exceedances of the CSDRS starting at about 16 hertz. And then also for the hard rock high frequency from about 3 to 55 hertz and then again from 80 to 100 hertz. And the PGA value estimating off of this diagram looks like it's about I would say 0.3 for the vertical. And I'll find that value and have that for us after we come back from lunch.

CHAIRMAN RAY: That's fine. Thank you.

MR. GRAY: Next slide. So to summarize, the DCD site foundation support conditions are satisfied. We have a uniform hard rock site with a configuration just as represented in the AP1000 DCD. While our site specific input motions are greater than the AP1000 CSDRS and then also the HRHF, we will demonstrate the results of those analysis as part of some site specific analysis that will be presented as part of the Chapter 3 discussion. Next slide.

So in conclusion, we have a uniform hard rock site. The site has not experienced tectonic deformation since the Mesozoic, and likely not since 219 to 300 million years ago. The site characteristic GMRS and Unit 1 FIRS exceed the DCD CSDRS design response spectrum, or the certified design response spectrum. This is described as part of Lee Departure 2.0-1. And then site specific analysis for the Seismic Category I and II structures were performed to demonstrate adequacy and these, as I mentioned, will be described in the next presentation on Chapter 3, the Seismic Design. Thank you.

CHAIRMAN RAY: Okay. Let me start and make sure if Bill's still with us. Bill, you have any further questions in this discussion here on 2.5 for Duke?

DR. HINZE: Thank you.

CHAIRMAN RAY: Okay. We'll resume, of course, with the Staff presentation on 2.5. But did any of my colleagues have any questions on 2.5 for Duke?

MEMBER RICCARDELLA: Just as a sanity check, I went back and looked at what the CS GMRS predictions are for operating plants. And not surprisingly, the high frequency part of your spectra is very, very close to the ones that Duke has for Catawba 1 and 2, peaking at around 0.75 out at around 30, 40 hertz. But my concern, and maybe this will come with the NRC Staff's presentation, is that on that same plot, the Staff showed a much higher peak of their ground -- they calculated a GMRS for Catawba that was considerably higher. So hopefully we'll get into some discussion of that when the Staff comes up.

CHAIRMAN RAY: Okay. Anything else? All right then. We'll recess for lunch. We are ahead of schedule, but we will resume this afternoon at 1:15 to give everybody an hour for lunch break. We're off the record.

(Whereupon, the above-entitled matter went off the record at 12:11 p.m. and resumed at 1:16 p.m.)

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

1:16 p.m.

CHAIRMAN RAY: So we'll go back on the record and we'll resume our agenda with the Staff's presentation of Chapter 2.5, which corresponds to the presentation that occurred just before we broke for lunch. All right.

MR. HUGHES: My name is Brian Hughes. I am going to present the presenters. We have Dr. Stephanie Devlin-Gill, Gerry Stirewalk, and Weijun Wang. They'll be making the presentation for Geology, Seismology, and Geotechnical Engineering. And can we get the next slide. All right. And who starts?

MR. STIREWALT: I'll be delighted to start. I am Gerry Stirewalk, Brian, not Jerry. I know you know better.

MR. HUGHES: I know.

MR. STIREWALT: Anyway, I want to wade directly into 2.5.1 and 2.5.3 that are going to talk about what the site is going to sit upon. So geology is really a critical part of this. Let me go to the next slide so that I can introduce you to the concept of the regional tectonic setting. This is important because the site is sitting in a belt called the Charlotte Lithotectonic Terrane. That's a very, very old belt of basically ancient crystalline bedrock basement and it has a very long history of formation and deformation and metamorphism that goes back even to Precambrian, that's captured in the neo-Proterozoic name there. But through Paleozoic, when Africa collided with North America to produce the Appalachian Mountains, and then goes into Mesozoic, where the current ocean basin, the Atlanta, opened and you produced the Triassic basins.

So you might expect in this kind of tectonic setting where you have plutonic intrusive rocks and metavolcanic rocks and metasedimentary rocks, when it's this old with this kind of history, we can certainly expect to see tectonic features. Not a surprise, if we didn't find them, it would be weird, it would be unusual, it wouldn't happen. Okay.

Let's talk a little though about the younger features. There are 15 potential Quaternary tectonic features in the site region. Now let me remind you, Quaternary is the age range of 2.6 million up to the present. But the features, again, to remind you, and I know you probably remember, but features of Quaternary age are a primary focus for what we consider with the NRC relative to geologic structures because features of that age are considered to have a higher likelihood of inducing some geologic hazards than features that are older. Okay. Now, all of those 15 by the way have not proven Quaternary age, some may not even exist, and the bottom line is in fact that all existing data indicate that those particular features pose no safety or environmental or site suitability hazard for the Lee site.

Well, okay, speaking of the Lee site, let me walk you down to a little geologic map. We're going to look -- and you can see here there's an overlay that points out where Unit 1 and Unit 2 are sitting atop Unit Zto, that happens to be an igneous pluton. It's deformed, it's metamorphosed, it's greater than 300 million years old, and it's all cross-cut by more mafic dikes, diorite dicks. Granite, I think of it just sort of as a granite, it's just a granitic intrusive, composition specifically is granodiorite. Well, okay.

You probably expected I was going to walk you onto the outcrop, so let's do that in the next slide. In fact, this is going to address a comment that I was very pleased to hear Dr. Hinze make on the telephone, where I'm walking you to the southern end of the Cherokee concrete, Cherokee Unit 1, which is Lee Unit 1. And what I would like to show you is, Dr. Hinze asked, are there any structures that underlie the site?

Well, I'll admit I was tempted not to label it just to test you, but there was a very strong shear zone that trends N45W. It's at the southern edge of Lee Unit 1, CNS Unit 1. And it trends, but if you zip around 180 degrees and look from standing on the concrete, turn around this way, you note that, that same trend crosses directly beneath Lee Unit 1.

CHAIRMAN RAY: Gerry, hold on just a second.

MR. STIREWALT: Yes, sir.

CHAIRMAN RAY: Bill, are you with us?

DR. HINZE: I'm with you.

CHAIRMAN RAY: Okay. He's on Slide 43.

MR. STIREWALT: Okay. I'm sorry, was there a question, Dr. Ray? Okay. What we did -- well, we know if you look at the site location, and here we're looking at the periphery of the concrete, so the point is that we did look and every exposure even around Unit 1, we looked at the rock to see what was there. Well, now we audited the information on tectonic features and lithologies at Lee Unit 1. Well, gee, how did we do that? It's under concrete. I'm glad you asked.

What the Applicant did is they digitized the detailed geologic maps that were compiled from the original map data prepared for Lee Unit 1. It was very carefully done, very, very well done. All those maps, both for Cherokee and for Lee and the redigitization was done under an NRC approved QA program, so really a very, very rigorous look. So we actually looked at the maps of the foundation grade level bedrock beneath Lee Unit 1. Ah ha. Well, that was better than jackhammering the concrete. We also audited the data that documented the age of shearing.

Based on everything that we saw, and we did independent examination of everything in the field, which to a geologist is pretty darn important, but none of the faulting or the shearing is actually older than probably middle Mesozoic. So it's at least greater than 145 million. You heard the Applicant speak about some of the age dates.

Well, in fact, based on geologic field relationships and that information from the radiometric age dates, as the Applicant said, if you take mineral out of a shear zone, that mineral is not deformed, that is going to give you a minimum age, a bracket age, on when that little shear zone last moved. So that's really important data.

But we looked at all of that information. So basically then based on audits, including looking at the age data and the field observations, which we do, and again, field relationship, radiometric ages, Staff was able to confirm that no shear zones or faults that are younger than Mesozoic actually exist in Lee Units 1 and 2. And that, of course, addresses our goal of assuring that no tectonic features that are of Quaternary age actually occur in the foundation rock units.

Well, I haven't shown you enough rocks, so let me keep you on the outcrop in the next slide if I may. If you look at the slide on the right, the larger one, again, the concept of field confirmation of the characteristics, the lithologies, the structures, within the bedrock at Lee Units 1 and 2, that confirmation is in fact confirmation that no Quaternary age tectonic features exist in those rock units. And by the way, non-tectonic features are really not an issue in rocks like these. These are ancient bedrock, crystalline bedrock, that isn't the kind of rock that you might expect things like dissolution. These are intrusive rock, granites and dikes.

So if you look at that particular illustration, and I'm trying to sit down and not go point, but you can see a dike that's crossing, those dikes trend pretty much northeast, that's one of the diorite dikes. The inset on the left shows it at bit of a larger scale, very sharp contacts, very easy to pick these out because they're a bit more mafic, so they're darker color than the granodiorite. The granodiorite also has within it some of the -- when one of these major bodies crystalizes, you get last-stage fluids and these actually produce things like quartz veins and tegmatites that essentially quartz and potassium feldspar. But it's still part and parcel of that same intrusion.

And I should add, by the way, that this kind of rock unit, again, fold very, very deep in the crust and a unit like this, we're pretty much in the middle of it, we're not near the margins and we know that because of what the field relationships are. We're not getting lots of pieces of country rock included. And these things are for all facts and purposes to our brain, they're basically bottomless. They could drill very deep in this and still remain in this rock unit just because of the way a pluton forms. They're deep seated features that intrude the overlying rock mass.

Within this same figure there's one of the older pegmatites that has a slight offset. The one geologist on the left, I almost said in the blue shirt, but that works for all the geologists there, there's -- one of the pegmatite veins is actually offset. May I point? I won't talk. That's a very, very minor little fault zone. And again, it's part and parcel of the whole package of what you'd expect to see in rocks of this age.

And the little inset on the left margin is really great fun to a geologist because that single slide shows the entire intrusion history. You note that there's a little country rock sliver, it's a metasediment or a metavolcanic. So that's the rock unit that the granodiorite intruded. And then there's also a little piece of the diorite dike with a sort of irregular margin that intrudes the granodiorite as well. So you get the whole package built in right there. Okay.

So let's talk a little bit more about the field confirmation. If you look at the next slide, I want to make the point that both Staff and USGS geologists examined the tectonic features and the lithologies in the existing excavation for Lee Unit 2. As I illustrated earlier, in outcrops adjacent to the concrete at Lee Unit 1, as well as in exposures between Lee Units 1 and 2, that would have been the location of Cherokee Unit 2, in fact, and also within the site area and site vicinity.

What we were able to confirm is that the tectonic features and the lithologies at Lee Unit 1 match those in Lee Unit 2 and also match the features that are in the site area and the site vicinity. So, again, further information that confirmed that there are no Quaternary age faults or shear zones that exist in the excavation. And the two images on the right side of that simply show us in the field really doing what I just told you that we do.

I will point out that there's a little smidgen of saprolite in the lower right image.

That's the rock that's chemically weathered, in place, non-transported, and you get deep saprolite horizons very typically developed in the Southeast. So you can see where Morales happened to be standing at the contact of the granodiorite and the dike. There was saprolite that was over that prior to it being stripped off to get down to the foundation rock. Okay.

If I could look at one more slide then, please. We have already talked about the idea that the Staff considers the detailed geologic mapping for Lee Unit 1. It has been completed based on the information that's documented by the Applicant, related to the results of that excellent geologic mapping for CNS Unit 1 that they digitized. So we were able to look at all the maps, as well as look around it. So that means then that we aren't going to need -- well, we can't remap that. So the point is, that the mapping is done very, very well, very properly, very adequately for Lee Unit 1.

However, things like the Standard Review Plan Section 2.3 specifies the importance of the geologic mapping condition for COLs that have not completed the activity prior to the license issuance. And that's going to be related to Unit 2.

The Applicant has already mentioned to you that they're going to do that mapping. Just let me remind you of the impetus for that. They do plan to do that mapping, the reason is to assure that there are no tectonic or non-tectonic features that really might result in surface deformation at that location.

I know you've heard mention of the license condition before. All it says is that the licensee is going to do the mapping, they're going to examine and evaluate those geologic features, and they're going to let us know when it's ready for us to walk in and take a look at, just as I illustrated in these slides. That's actually it for 2.5.1 and 2.5.3. I've been more concise than normally, because it's fun to talk about rocks. But are there any questions or comments from any of the members, and Dr. Hinze too. I'm assuming, Dr. Hinze, you're still on the phone.

DR. HINZE: That's correct. Let me ask you one question that I asked this morning. Did you look at the geology associated with Make-Up Pond C that is a potential Make-Up Pond? Or did you look at the area in which they are going to build the dam? Did you have a chance to observe any of that?

MR. STIREWALT: Yes. Dr. Hinze, what we did is we looked at every exposure in the site area, quite literally. So we were able to --

DR. HINZE: When you say area, can you give me a clue as to what that --

CHAIRMAN RAY: And Pond C being outside what I would call the site area. Your Slide 42, maybe you can use it to help.

MR. STIREWALT: Okay. Where is -- well, we actually looked in both the site area and the site vicinity. So if there were exposures within the area of Pond C, and certainly everywhere we looked at an outcrop, there was absolutely no difference in the lithologies or in the structures that we see. I mean, right up to regional scale, we're in a crystalline basement all the way. These Units have the same deformation style because this is a regional deformation pattern that we're seeing. So there is no difference in the locations of the Ponds relative for the geology and the lithologies than what we find in the foundation.

DR. HINZE: Another question that relates to --

MR. STIREWALT: Yes.

DR. HINZE: -- the previous one. How

deep of a saprolite do you observe in this area?

MR. STIREWALT: As I'm recalling -- well, I mean, in general, on the average saprolite in some places might even tend to be 40, 50, 60 feet deep. It can be quite deeply weathered just because this is the Piedmont and you have good, hot, humid conditions. In fact, some of what used to exist in the old northwest corner, that soft zone in fact, was simply just, nothing unusual, it was just a thicker part where saprolite occurred. They stepped away from that when they moved the footprint. But it can get very, very deep and it can be certainly tens of feet. I have heard other parts of the Piedmont where it was 70 and 80 feet. But, again, obviously it's all been moved here and they won't be building on it.

DR. HINZE: So in reference to that, did you have a chance to look at the site where the dam is scheduled to go in for Make-Up Pond C? And do you have any feeling about what the saprolite thickness might be in that area or outcrops in that area? Did you see any of the neo-Proterozoic rocks?

MR. STIREWALT: Well, again, if there were outcrops, we did look at them. And what we're seeing are the same kinds of Paleozoic units that exist really through the entire site region.

DR. HINZE: Okay. Thanks.

MR. STIREWALT: Yes, sir.

MEMBER SKILLMAN: Gerry, on Slide 45, please.

MR. STIREWALT: Yes, sir?

MEMBER SKILLMAN: On the lower right-hand corner --

MR. STIREWALT: Yes.

MEMBER SKILLMAN: -- I see the dike that lies between two grandolite exposures.

MR. STIREWALT: Yes, sir.

MEMBER SKILLMAN: My question is, is the interface between the diorite dike and the granodiorite a sliding interface or is that a hard, fast, eternally bound interface?

MR. STIREWALT: I had actually hoped to get that question. It ideally is a very tight boundary, but as it turns out, much of the shearing is actually concentrated at that contact boundary. But still it's old kinds of deformation, it's still Paleozoic in age most likely. But you do get shearing concentrated right at that margin. Which I guess makes sense radiologically when you think about it. That's really a good question. That's something that we did observe. But in general, it's a good tight contact except you do have shearing concentrated there, but it hasn't really effected the quality of the foundation rock at all. It's a good question. Thank you for it.

MEMBER SKILLMAN: Thank you. Yes, sir.

MEMBER BLEY: I'm just speculating --

MR. STIREWALT: Yes.

MEMBER BLEY: -- and I'll ask somebody else about this later. But since you just said that, we had a discussion earlier about where Duke's going to pour the new concrete on top of the old concrete and that they would surface roughen before they did that and that, that would be on the order of inches in the roughening and that, that should pretty well avoid a shear problem between the concretes. I would expect where these formations come together was pretty rough too when they came together. I wonder if there's any implication of what we see with natural rock formation and what we'd worry about with this new concrete on top of the old. Any thought?

MR. STIREWALT: Not really. In the sense that the contacts -- again, this is all sort of well lithified old rock and these contacts are very, even where they're sheared at the dike margin, are very, very strong. Very strong everywhere we've looked at them.

MEMBER BLEY: Okay. So shear would -- it would take a lot to cause any motion there?

MR. STIREWALT: It would take probably a change in the regional stress field to do it, in fact.

MEMBER BLEY: Okay.

MR. STIREWALT: Which probably isn't going to happen in our lifetime.

MEMBER BLEY: Thank you.

MR. STIREWALT: Any other questions or comments? Okay. Thank you very much. That being the case, I will pass the speaker baton to Dr. Stephanie Devlin-Gill, who will speak to you about 2.5.2. Thank you.

DR. DEVLIN-GILL: Thank you, Gerry. I am Stephanie Devlin-Gill. I'm a lead reviewer for Section 2.5.2, Vibratory Ground Motion. I have a PhD in Geophysics from Cornell University and I've worked at the NRC as a geophysicist for seven plus years. I've reviewed multiple COLA and ESP applications, which includes the Levy application, the PSEG, and now the Williams States Lee application. In addition, I've worked on numerous hazard reviews, hazard reevaluations associated with the Near-Term Task Force Recommendation 2.1 that are currently ongoing at the Agency. Next slide please.

Regarding background on the Lee COLA application, the original COLA was submitted in 2007 and the Applicant had used at the time the EPRI SOG seismic source model. In January 2012, a new seismic source model, a regional model for the Central and Eastern United States was published in NUREG-2117. Consistent with the guidance in Reg Guide 1.208, the Staff asked in RAI regarding this new model. And it's --

CHAIRMAN RAY: Excuse me.

DR. DEVLIN-GILL: Yes.

CHAIRMAN RAY: You said 2117.

DR. DEVLIN-GILL: Oh, excuse me, it's 2115 is correct. The 2117 is the guidance on SSHAC, implementation of SSHAC. Thank you. So the Staff asked the RAI. In response, the Applicant changed its seismic source model from the EPRI SOG model to the newly published CEUS SSC model. This resulted in a complete reanalysis and revision of the COLA Section 2.5.2. Next slide please.

So the NRC Staff for 2.5.2 is only

concentrating on unique site characteristics for the Lee site. So here I'm highlighting one unique topic for the Lee site, and it's the new construction and operation of Make-Up Pond C, which has been brought up numerous times today already. Reservoir induced -- I'm specifically looking at Make-Up Pond C in terms of reservoir induced seismicity. This is triggered earthquakes by the physical processes accompanying the impoundment of reservoirs.

The Applicant evaluated the potential for reservoir induced seismicity associated with the construction and operation of Make-Up Pond C. The Applicant extensively reviewed reservoir induced seismicity in the literature and the scientific understanding of potential reservoir induced seismicity based on the crustal properties and reservoir operation.

The Applicant reviewed past worldwide cases of induced seismicity associated with reservoirs with similar and greater hydraulic heights to Make-Up Pond C. The Applicant analyzed seismicity associated with reservoirs operated in the Carolina Piedmont, the location of the Lee site, as well as Make-Up Pond B and C. They also analyzed dams and reservoirs associated with metamorphic terrains with hydraulic heights and operating configurations consistent with or exceeding that of Make-Up Pond C.

The Staff reviewed the Applicant's assessment. The Staff conducted -- the Staff concludes that the Applicant conducted a thorough review of reservoirs similar to Make-Up Pond C. The Staff concludes that since there is no active seismic faults near the location of the Lee site or Make-Up Pond C and that historic seismic activity is low, any triggered seismicity associated with the impoundment of Make-Up Pond C is likely to have magnitudes of less than or equal to 5.0. And that specifically for induced seismicity associated with reservoirs located in the Carolina Piedmont on metamorphic terrain in regions of low seismicity, reservoir induced seismicity magnitudes was less than a magnitude 4.0. The Staff concludes that there was no documented induced seismicity associated with the Make-Up Pond B.

Lastly, as shown on this table, this is the controlling earthquakes for the Lee site. The controlling earthquakes, the local event, the local sources, the high frequency sources all have magnitudes of higher than any expected seismicity that could be associated with the construction of Make-Up Pond C. Therefore, the Staff concludes it is unlikely that seismicity associated with the impoundment of Make-Up Pond C at the Lee site would exceed the magnitudes of the local controlling earthquakes and the potential for reservoir induced seismicity associated with Make-Up Pond C impoundment is low with a negligible risk to safe operation at the Lee site. I'm pausing if anyone has questions on this.

DR. HINZE: This is Bill Hinze. I'd like to ask a couple of questions briefly if I may. The Applicant makes a point of the lack of seismicity for the 30 year old Make-Up Pond B. What is that based on? What kind of instrumentation has there been for 30 years at the Make-Up Pond B? What kind of seismic evidence do we have? We know that a large number of these earthquakes start off at very low magnitudes and, of course, we have to have some nearby instrumentation. Was there nearby instrumentation to study the seismicity of Make-Up Pond B?

DR. DEVLIN-GILL: I don't know a direct answer to that question. My indirect answer to that question is that the seismicity throughout the

Central and Eastern United States was assessed in the CEUS SSC regional model. And in that assessment, they looked at specifically earthquakes that were and were not -- were associated with induced seismicity. And those were treated in a specific way in that model. So the Lee site, as well as the surrounding region, was included in that larger regional assessment.

DR. HINZE: If one compares the Make-Up Pond B with Make-Up Pond C, Make-Up Pond C looks to be a much larger -- will result in a much larger load upon the Earth's crust and, therefore, it may not be totally comparable with Make-Up Pond B. Did you evaluate that in any way? Has there been any real comparison of Make-Up Pond B with Make-Up Pond C in terms of the criteria that are evaluated for reservoir induced seismicity?

DR. DEVLIN-GILL: I believe that is why the Applicant also looked at reservoirs throughout the Carolina Piedmont and metamorphic terrains and looked globally for similar reservoirs. So that is not just -- the conclusion doesn't just hinge on a similarity to Make-Up Pond B, it hinges on the similarity to induced seismicity globally in similar geologic settings and terrains.

CHAIRMAN RAY: Well, at this point, I think we're pursuing the basis for what Duke has said about the experience of Pond B, correct?

DR. DEVLIN-GILL: Yes.

CHAIRMAN RAY: And I guess I would just say to Duke, that we'd wish them to address that question when they come back to the table. You're not able to offer anything specifically about why they said what they did about Pond B, not having resulted in --

DR. DEVLIN-GILL: I mean, generally the -- from my perspective, as far as I know, they did not instrument Pond B further than it already is instrumented regionally. So if -- I have a general understanding of why I think that seismicity -- there was no induced seismicity missed, larger magnitude 3.0 and above associated with Make-Up Pond B was not missed in the seismicity record.

DR. HINZE: Okay.

CHAIRMAN RAY: Anything further at this point, Bill? We'll ask Duke --

DR. HINZE: Sure. Thank you very much. Thank you.

DR. DEVLIN-GILL: Okay. So the next unique area for the Lee site is the Eastern

Tennessee Seismic Zone. And there is ongoing research in the Eastern Tennessee Seismic Zone that was published after the Central and Eastern United States model was published, as well as ongoing now. The Staff asked the Applicant to evaluate the potential for the significance of the recent geologic study in the Eastern Tennessee Seismic Zone and we were specifically asking about the Hatcher 2012 publication and we were asking specifically if this source zone fit into the model as an RLME or how the model's uncertainties were taken into account.

In response and to resolve this issue, the Applicant conducted two sensitivity studies to assess and evaluate the effects of the recent research results. The Applicant evaluated the Eastern Tennessee Seismic Zone as a hypothetical RLME or a source of repeated large magnitude event of 6.5 or more. The Applicant used the Eastern Tennessee Seismic Zone boundary as defined by the USGS National Seismic Hazards Mapping Program of 2008. They used that source for their sensitivity studies.

The Applicant performed two sensitivity analyses. First, the Applicant evaluated the magnitude frequency distribution for Eastern Tennessee Seismic Zone by calculating the magnitude frequency distributions for cells in the host zone of the Eastern Tennessee Seismic Zone, which is also the host zone for the Lee site. They calculated these cell centers within the boundary of the defined Eastern Tennessee Seismic Zone test RLME.

The Applicant observed that the NUREG-2115 model generates moderate to large magnitude events similar to that as shown in Hatcher or as documented with field observations in the Hatcher 2012, with occurrences of two events of magnitude 6.5 or greater in the late Quaternary period. So that sensitivity study showed that the CEUS SSC model is predicting earthquakes of that magnitude in that region with sufficient frequency as proposed by that published paper.

Second, the Applicant evaluated the sensitivity of the maximum magnitude distributions of the Eastern Tennessee Seismic Source. It first assumed that the Eastern Tennessee Seismic Source had a maximum magnitude distribution equal to that of the host zone for the Lee site. And then they tested it against the assumption of introducing a minimum maximum magnitude of 6.5 and adjusted the rest of the maximum magnitudes to higher magnitudes.

They tested these two sources -- this figure here shows one of the results from their sensitivity study. So this shows the test of the maximum magnitude at 1 hertz. And you see that while the Eastern Tennessee Seismic Source Zone, the contribution, the effect on hazard of this individual source does change due to maximum magnitude, that's the lower two lines, the blue and red lines. When you get to the total hazard at the sight, this impact is minimal. So it is not changing the total hazard at the Lee site. Pausing for questions.

DR. HINZE: This is Bill Hinze. Let me ask you briefly, I'm concerned about whether we should be or will in the future have to consider the Eastern Tennessee Seismic Zone as an RLME. The work of Hatcher, which is the basis of the sensitivity study of the Applicant, is now four to five years old. Subsequent to the publication of the Hatcher paper in 2012, there has been continued work. And I'm not familiar with all of that work and I suspect that you or your colleagues are much more familiar with it than I am, but on the Little Tennessee River and the terraces near Lenoir, Tennessee, the recent work has shown that there are some pretty interesting stress faults. Do you think that these would in any way affect the magnitude of the values that were used in the sensitivity study by the Applicant? Or is there even newer information that might impact this?

DR. DEVLIN-GILL: So the range in magnitudes that the Applicant tested for the Eastern Tennessee Seismic Zone ranged from, I think it's 8.1 down to the 6.5. So the tested magnitudes all range a little higher than -- so there's a magnitude range that's already incorporated in the sensitivity study. In addition, the NRC is staying on top of current research in the Eastern Tennessee Seismic Zone as well as we're currently funding research in the Eastern Tennessee Seismic Zone because we are interested in the developments that are ongoing at this site. I don't think that there's anything currently in the literature or a consensus in the scientific community that changes or that would change the results currently for the Lee site.

MR. GRAIZER: This is --

DR. HINZE: I couldn't find any peer-reviewed publication subsequent to the 2012 Hatcher paper. But there are some presentations, some posted papers.

DR. DEVLIN-GILL: Yes. And we --

DR. HINZE: Is there any peer-reviewed or are there any NRC publications that deal with this that might impact our consideration of this?

DR. DEVLIN-GILL: There are no currently published NRC documents on the Eastern Tennessee Seismic Zone. We're effectively funding the Hatcher work. So we are supportive of the ongoing research in the Eastern Tennessee Seismic Zone. I know of abstracts that are being published currently and presented at national conferences, but I don't know of any additional literature beyond the Hatcher paper that would need to be -- that would influence the outcome here at the Lee site.

MR. GRAIZER: This is Vladimir Graizer. I'm also a seismologist on this project. Okay. To add to the answer that Stephanie just presented to you, I just attended a conference in the Eastern Section of Seismological Society of America. It was two weeks ago in Memphis. And Bob Hatcher presented his most recent results on Eastern Tennessee Seismic Source Zone. I have to say he's a very careful researcher and his results are showing that potentially it can be a 6.5 repeated magnitude earthquake, but potentially. He doesn't insist on his results because he consider his results to be speculations in a good sense. It is his idea, his model, it is not a solid result.

And basically, again, to answer one of the questions that Dr. Hinze asked, he doesn't consider this to be higher than 6.5. He speculates that potentially it may be a 6.5. And it is based on a few faults. Anyway, this is as far as I know from the most recent presentation of this author. It is only his ideas and basically there is no consensus on this. Basically most researchers don't agree with this area to be repeated large magnitude earthquake. And as I say again, even the author of this idea doesn't insist on his findings. He considers this to be a potential model, but nothing more. Thank you.

DR. HINZE: Bill Hinze. I think that's very helpful, but it also points out the need to continue to monitor this. In many respects, the evidence that we see at the Eastern Tennessee Seismic Zone is the same evidence that we have seen in the Wabash Valley area, which is recognized in the CEUS SSC study as an RLME.

MR. GRAIZER: And as Stephanie mentioned

correctly before, NRC continues to support this research, research of Bob Hatcher. This is why kind of in no way we will be not aware of the latest results of his studies.

DR. HINZE: Excellent. No more comments.

CHAIRMAN RAY: No more you say or one more?

DR. HINZE: No more.

CHAIRMAN RAY: All right.

DR. HINZE: Thanks.

CHAIRMAN RAY: All right. Let's proceed then.

DR. DEVLIN-GILL: Thank you. Okay, so the Staff also performed confirmatory analysis. The Staff -- here is shown the Staff's, in yellow and red, the Staff's uniform hazard response spectra and the Applicant's in black. Both the Staff and Applicant's uniform hazard response spectras are in good agreement at the annual frequencies of exceedance at ten to the minus four and ten to the minus five. This is effectively the GMRS at seven specific frequencies. So that's why the lines are not as smooth, a little more jagged, than you see the GMRS. But these are the seven frequencies that we as well as the Applicant used to calculate the

GMRS. So next slide.

Regarding the site response, the majority of the shear wave velocities exceed 2.8 kilometer per second. The Staff concludes that the ground motion prediction equations are appropriate for direct use such that the UHRS reflects the hard rock condition. So we did not perform site response analysis for the GMRS. The Staff considers the presence of the pre-existing Cherokee concrete in its FIRS calculations and its confirmatory analysis, which we cover in 3.7.1, we don't typically cover it in 2.5.2. And that concludes my presentation. Are there any further questions? 3.7.1 will be presented this afternoon, so it won't be long before we discuss it.

CHAIRMAN RAY: I'm just pondering the -- does anybody have any questions about the site response? You said the Staff did not perform -- repeat that sentence, please.

DR. DEVLIN-GILL: Yes. The site response calculations for the GMRS.

CHAIRMAN RAY: Okay. Because I didn't see that up there and so I was listening and reading at the same time.

DR. DEVLIN-GILL: It's kind of implicit

in that they're using the ground motion prediction equations directly and that gives you to that hard rock condition, which we believe occurs at the Lee site. So it's not specifically stated on that slide, but it's definitely stated in the SER. So that is quite clear.

MR. HUGHES: Would you like some more clarification on that?

CHAIRMAN RAY: Well, maybe, but not right now. I'm just processing it and it takes me a while. Any other questions or comments from members? Okay. Thank you. Okay. It's 2:00, which means we're just an hour ahead of our agenda. Are you done for 2.5?

MR. HUGHES: No.

CHAIRMAN RAY: No?

MR. HUGHES: No, no.

CHAIRMAN RAY: Excuse me. I thought -- we got one more person here and I was paying too much attention to the clock and not enough to my presenters. So go ahead.

MR. HUGHES: Dr. Weijun Wang.

DR. WANG: Okay. Thank you. My name is Weijun Wang, geotechnical engineer at NRC. I joined NRC a little bit more than nine years ago and have been reviewing the D.C., the DSP, and the COR applications for about nine years. With the background of working in geotechnical engineering field for more than 30 years. So I am going to talk about Staff review on Section 2.5.4 and 2.5.5 regarding the Stability of Subsurface Materials and Foundations and Slopes. Next slide.

Like my colleagues, I will only talk about some potential topic of interest. The first topic here is the CNS foundation concretes underneath the Lee Unit 1 foundation. Like some ACRS members, the Staff also had concern regarding the, what we called the old concrete. So the issues here are, one is how good that old concrete is now? And will be the old concrete good enough for a new reactor built on that? And the second issue will be what the property of the new concrete should be and will the new concrete bond well with the old one? And then an associated question will be, what's the impact of the new and old concrete together on the site response and on the foundation stability?

So about those concerns, the first we reviewed the application and it's very clear to us the old concrete was placed on continuous rock. And there is no void underneath or between the old concrete and the rocks, which was confirmed by the site investigation. And to make sure the quality of the old concrete, the Applicant actually drilled 14 holes and on that old concrete and to get to the core of the concrete and the rock below. So our Staff very carefully examine the cut core and to make sure that the old concrete is stuck, there's no any indication of erosions or the cracks and the weakness of old concrete. And later on, I will show you some photos we took during our site audit.

So now, let's talk about the new concrete to be placed on that old one. The average thickness of the new concrete will be above 15 feet. And the Applicant's design that the new concrete will have the property of the sequence is like 2,500 PSI and the shear wave velocity of 7,500 feet per second. So in such a way, the property of the new concrete will be very similar to the old one. So that's actually is a good thing for the foundation because if you get the uniform material underneath your structure, it will good for the stability analysis and it's also good for the seismic or SSI analysis.

And then it come down to another issue is will the new concrete bond well with the old one?

So the Applicant designed the concrete mix following the guidance of ACI 318. But what it comes down to how to place the new concrete, they will follow the guidance in ACI 349. So that standard, 349, it's very detailed the description and the requirement on how you place the new concrete over the older one.

MEMBER SKILLMAN: Weijun, in that standard, ACI 349, is there a requirement for some form of bonding agent, an epoxy, some additive to the concrete to make sure that it bonds tightly to the old concrete?

MR. WANG: Normally, no, because when you first, according to the procedure to roughen the older concrete surface and then you pour the new concrete, it will, when the new concrete dry, it will form a very good bond between the new concrete and the older one. And there's no need to put any like epoxy or whatever. Another issue here is, so let's think about what's the function of the concrete fill? The concrete fill here is just as the one part of the foundation underneath the structures. It's not a part of the structure itself. It's just something, like you get a table here and then you put your structure on that table.

And if you think about, okay, what

happen if the bonding between the new concrete and the older concrete is not good? So think about what will happen. The only concern that you are concerned about is sliding between the new concrete and the old concrete. But that will come down to this, in the area of the new concrete is all over the old concrete. That area is, compared to structure itself, the structure footprint itself, is much, much larger than that one. And you build -- you're really concerned about sliding when the seismic loading come down from bottom to the structure, to the foundation. Because it's a much smaller area between the structure and the concrete fill.

So the sliding will first occur on the bottom of the structure, not between the new concrete and the old concrete. Because think about that is for the larger area and also another reason for smaller area and even if they have a similar, we call it coefficient of the sliding, or the friction force there, so we are more concerned about will the structure slide, and other than the new concrete, will that whole area slide?

MEMBER SKILLMAN: I thank you for the explanation. I was thinking of sliding and overturning.

MR. WANG: Okay.

MEMBER SKILLMAN: But you've addressed my concern. Thank you.

MR. WANG: You're welcome. And so, I think the -- I also answer the one question this morning from ACRS member which ACI standard that the Applicant used. So basically for the mix design, is ACI 318. For the placement of the new concrete, they following ACI 349. Next slide.

MEMBER RICCARDELLA: Before you leave this slide, the slide says the CNS concrete's about 15 feet thick and you said the Lee concrete. Are both layers about 15 feet thick?

MR. WANG: Well, both layer together the average is above the 25 feet.

MEMBER RICCARDELLA: Okay.

MR. WANG: So the average --

MEMBER RICCARDELLA: All right.

MR. WANG: -- it's not uniform because we saw the rock, the bottom rock is not hard on --

MEMBER RICCARDELLA: Okay. Thank you.

MR. WANG: Okay. This slide shows two figures to show the boring locations on the old concrete. So if you look the left figure carefully, the light shaded area is the old CNS concrete area. So on top of that area, there are a lot of dots. There's a black one and a blue one and a red one. They are all the locations of borings. The only dot with blue and red colors are those borings on top of the concrete. So there are total of about 14 borings penetrate the concrete. So we have plenty of sample to look at.

The figure on the right is one borehole log, the B-2000, which is right at the center of Unit 1 footprint. That's right there and if you look at that log carefully on the top, that's the concrete and below that is all the rock. So if you look at it also gave the shear wave and compression wave velocity profile there. If you really read that log carefully, you will see the concrete and the rock, they get it together very well and the concrete itself is also in very good shape. Next slide please.

So here, I mentioned that these two photos taken during Staff's site audit. So on the left-side one, you know who he is there, that is our rock expert there and he always get very excited when he see any rock there. So he is really pay attention to like where is the concrete, where is the rock, and how good those rock is. And on the right-side that's also our Staff. We're looking at some soil samples. By the way, this is no Starbucks. They are soil sample in jar. Okay, next slide please.

Next topic of interest is relocation of footprint. So our right lower corner, there is original footprint. Try to pay attention to Unit 1 on the northwest corner, there are some blue color there, so actually another blue color there is for -- blue color which represent lower elevation. And also you can see on that corner the elevation change is much steep than the rest area. Another thing is because that corner the weathered rock, saprolites are there. And so later on the Applicant proposed a relocation of the footprint. So basically, the relocation will avoid that weak northwest corner.

The purpose of the relocation has two-fold. One is avoid that we call the soft zone at the other corner. So that then the whole Unit 1 will be farther down the old concrete. It's no more any saprolite soil. And the second one is because the elevation change, we would like to see the subsurface material as uniform as possible underneath new reactor. So this relocation also avoid the area the uniformity is less desirable. So we look at the relocation and also because of the relocation, additional boring, and we are satisfied with all the additional information and the result. Next slide.

So, another technical topic is about the lateral earth pressure evaluation. The Applicant will conduct the --

DR. HINZE: Can I ask a question? This is Bill Hinze.

MR. WANG: Sure, go ahead.

DR. HINZE: If I might, the location of Unit 2 doesn't seem to coincide in the original footprint and the relocated footprint in comparison to the contours. What am I missing here?

MR. WANG: Okay. So the relocation -- actually they moved the original footprint for both Unit 1 and Unit 2.

DR. HINZE: Ah, okay. So 2 has been moved as well?

MR. WANG: Right. Yes.

DR. HINZE: All right. Thank you.

MR. WANG: You're welcome. Regarding the lateral earth pressure, so the Applicant conducted analysis and they considered all the possible loading combinations. So they found the under one out of seven load combinations does -- for one load combination the lateral earth pressure will exceed the standard design. So then later on in Chapter 3 presentation, the Staff will talk about that so-called exception.

And we look at the analysis and the Applicant also noticed that and they found out the exceedance was caused by the passive lateral earth pressure. So if you get a foundation in the soil, if you push one side move, on the opposite side they will generate, we call it a passive earth pressure there. The passive earth pressure is much, much larger than we called active earth pressure, which on the pushing side. But, the point here is, in order to get that high passive earth pressure, you have to have a relative large the movement of that soil.

And it follows that actually for that given loading condition, the passive earth pressure will not fully develop. If you do not have a fully developed passive earth pressure, then the actual total earth pressure will be much or at least will be smaller than you calculate. So because of that, so this is in the paper and you look at the calculated number, it exceeds the DCD, but in reality, that will not really occur in the field.

So anyway, the Applicant performed a sensitivity study and they showed that. And we look at the result and then we agree with the Applicant's conclusions. And anyway, the detailed evaluation will be presented in Section 3.8, I think probably later today. Next slide. Okay.

Section 2.5.5 is about the slope stability. And we conclude at this site that no flow is close enough to the Category I or safety-related structures. And there's no concern about the slope stability at this site. Next one. Okay. Now, that will be the Staff evaluation for the Section 2.5 and the last slide summarizes the Staff's conclusions. Because during the previous presentation, the Staff already talked about the Staff evaluations and I'm not going to read the conclusion line-by-line.

So I just would like to point out, the Staff very carefully reviewed the application Section 2.5 according to the regulations, Regulatory Guide, and also Staff conduct some confirmatory analysis for some of the important items. And we find -- our conclusion is the application 2.5 is acceptable because it meet all the criteria specified in AP1000 DCD and also meet the regulatory requirements. That end my presentation. Thank you.

CHAIRMAN RAY: Any questions further on Staff's position on 2.5? Okay. Bill, anything else from you? No. So with that, we will recess for the afternoon break and get geared up for the, should be interesting, remaining Section of the day, which is the 3.7, Departures 2.0, and 3.8. We'll start with the Applicant. Yes, do you have something Pete?

MEMBER RICCARDELLA: Yes, I just have a question. If I go back to Slide 50, Stephanie, you said that the Staff did not redo the Applicant's GMRS calculations.

DR. DEVLIN-GILL: No, this is effectively doing that.

MEMBER RICCARDELLA: That's what I was going to say.

DR. DEVLIN-GILL: Yes.

MEMBER RICCARDELLA: Because these two agree so well, are you concluding that if you did do it, you'd get the same GMRS?

DR. DEVLIN-GILL: Yes.

MEMBER RICCARDELLA: Okay. Thanks.

DR. DEVLIN-GILL: We got it with the

seven frequencies that they do their calculations at as well as we do. So, yes.

MEMBER RICCARDELLA: Thank you.

CHAIRMAN RAY: Okay. So with that, we'll take a 20 minute break. We'll resume after recess at 2:45. And we'll go off the record.

(Whereupon, the above-entitled matter went off the record at 2:25 p.m. and resumed at 2:46 p.m.)

CHAIRMAN RAY: Everybody ready? We're back on the record for our final session today. We'll proceed in sort of a -- we'll go back on the record for the final session of the day. We'll proceed in sort of a stepwise fashion.

Okay. We'll begin with any things that you want to add to the record from what's preceded us now in terms of follow-up items.

I'm thinking, for example, the Pool B question that was asked about why do we say what we do about that and so on. So, whatever you want to deal with and then I've got some comments I want to make to set the stage before we proceed with 3.7.

MR. THRASHER: All right. Thank you. John Thrasher again with Duke Energy. I want to follow up on two items.

The first one follow up in FSAR Section 2.5 when we were talking about questioning the roughening of the concrete.

And as the NRC staff pointed out, the ACI standard that we would follow for doing that where we're looking at pouring fill concrete on top of the existing Cherokee basemat is ACI 349. And that's in FSAR 2.5.4.5.3.2.

And the code requirements there looking at roughening basically the co-joint require a roughening of the existing concrete an amplitude of a quarter of an inch.

CHAIRMAN RAY: Okay.

MR. THRASHER: Also wanted to point out if you look at the slide that we've got pulled up here that we had in the intro this morning looking at recycling of material, in the lower right corner you see the top of the Cherokee basemat. And towards the center you can see where the concrete is up a little bit higher.

That was where the reactor vessel pedestal for the old Cherokee Unit 1 reactor vessel was going to sit.

So, we basically put fill concrete on top of the existing basemat. It's not one level surface like roughening up a quarter of an inch amplitude on top of a pancake surface.

There are some differences in elevations like this one area so when you look at pouring that and everything, it's kind of acting some way like a shear key.

And there's a few other places where there's either the concrete -- the existing basemat sticks up a little bit higher or maybe a little bit lower because of an equipment pit that we would fill in with concrete. So, there are some areas that in addition to the quarter inch roughening serve to help with that shear resistance.

Any further questions on that particular topic or clarifications?

CHAIRMAN RAY: Bill, are you with us?

(No audible response.)

MR. THRASHER: Okay. Thank you. Appreciate it.

CHAIRMAN RAY: Bill Hinze. Bill, are you with us?

(No audible response.)

CHAIRMAN RAY: We will proceed. There is a record. He can look at the record.

MR. THRASHER: All right. The second

item that I wanted to follow up on was makeup pond Bravo. There were some questions about statements had been made that there was no indication over the last 30 years of reservoir-induced seismicity and had Duke -- how did we know if we instrumented that.

And, basically, no, Duke Energy did not have any instrumentation. However, from what I understand, regional seismicity instrumentation since the 1970s would have detected any Magnitude 3 or larger type of seismic movement in that area.

So, Duke Energy didn't specifically have it instrumented, but existing regional instrumentation was of adequacy that would have picked up anything over the last 30 or 40 years.

CHAIRMAN RAY: Bill, are you with us now?

DR. HINZE: Yes, I am.

CHAIRMAN RAY: And that was a response to a question that you asked. To the extent that you statement you referred to implied that the pond had been monitored, of course that wasn't the case and that was correct to recognize that. But the answer to why they made the statement they did, you just heard.

Do you have any follow-up, Bill?

(No audible response.)

CHAIRMAN RAY: I don't know. We can't keep doing this. So, we'll just proceed.

MR. THRASHER: Okay. Those were the only two follow-up items that I had. I think he wanted to have the floor back.

CHAIRMAN RAY: Yeah. Well, I'm going to introduce the next section with basically -- so, Bill's with us again, perhaps. Is that you, Bill?

(No audible response.)

CHAIRMAN RAY: I said I'd quit asking. I'm going to quit asking now.

(Laughter.)

CHAIRMAN RAY: I need to seek your indulgence, and that of the staff, because we're into what, for us, is a new arena. I think you've recognized that to be the case for yourself in the past, too.

I'll explain what I mean by that, but you've had a long time to digest all the implications of it and we're trying to catch up.

So, with that, let me begin this way: In the justification for the seismic departure, Duke stated the following, among many other things: A site-specific analysis of the AP1000 Nuclear Island was performed similar to the analysis described in DCD Appendix 3I to demonstrate that dynamic loads from the high-frequency spectra exceedances are within the design margin of the AP1000 certified design.

The triggering thing that we've been wrestling with for the last week or so was the phrase "within the design margin," because that was something that was completely unquantified at that point. And the application of the design margin, in people's minds, is, for various purposes, usually not including site ground motion exceedances, but design manufacturing uncertainties and things like that, analysis simplifications.

So, we pursued that issue of design margin further, and personally I'm at the point of wanting to set that aside as a term that we're going to deal with. I mean, it's implicit in what I'm about to read, but it's not explicit.

What's explicit is the provisions in the design certification itself that deal with exceedances.

And for the record, I'm going to read it in here just now to -- so we can refer back to it later if we need to.

DCD 2.5.2.1 reads as follows: If a COL applicant has site GMRS, that's ground motion response spectra, exhibiting hard-rock high-frequency characteristics, but is not enveloped by the AP1000 hard-rock high-frequency envelop response spectra, or the AP1000 certified seismic design response spectrum, or has shear wave velocities that are not associated with hard-rock, the COL applicant may perform site-specific studies to demonstrate that the high frequency is not damaging. This may be accomplished by the following -- and there are two steps.

The first identified as A reads: Demonstrating that the site floor response spectra developed at the locations of the spectra given in APP-GW-GLR-115 Sections 5.2 and 6.3 using seismic input defined by the site ground motion response spectra are enveloped by the AP1000 hard-rock high-frequency envelope response spectra, or the certified seismic design response spectra, and; B, which I think is where we are, if it is shown in Step 1 that the spectra are not enveloped, evaluations similar to those described in Appendix 3I would be made to demonstrate that the high frequency input is non-damaging.

I think that is the protocol that we're engaged in here as we evaluate this application, that is, the last one that I read. And that's something that we haven't done before.

So, we're going to have a lot of questions, perhaps, and we're going to go into your backup slides in all likelihood to see how this has been done, because the performance of an analysis as described in Appendix 3I, or similar to that described in Appendix 3I, demonstrating that the high-frequency input is non-damaging, is not something that we're used to doing. And so, we are going to be quite tedious, probably, in going through how that's done.

So, that's the foundation that I wanted to lay for the discussion that we'll be having. It's we believe this is the -- defines what it is we're trying to do here. And what it takes to do that is going to be the subject of our scrutiny.

Now, there's one other thing that at least one of my colleagues and I have been discussing. And I'll preface it by saying I'm from the West and we have multiple specific seismic sources.

And when we get the response spectra

from each, we envelope them and that becomes the certified design spectra -- seismic design response spectra for the site. This is site-specific now I'm talking about.

Could you start by explaining why the AP1000's certified design doesn't just envelope the high-frequency response spectra over on the right side, and the certified seismic design spectra, why that doesn't envelope it the same way we do for multiple seismic sources and consider that to be the -- why are the two things kept separate, hard-rock high-frequency and certified seismic design response?

MR. THRASHER: I think it would be better to let Westinghouse answer that.

CHAIRMAN RAY: Well, that may be, because I asked that question three years ago when we were doing the --

MR. TUNON-SANJUR: I'll give it a shot. Hi, my name is -- is this on?

CHAIRMAN RAY: I believe it is. If you'll tilt it up toward you a little bit, it will be more responsive, perhaps.

MR. TUNON-SANJUR: Hi. My name is Lee Tunon-Sanjur. I was the licensed -- structural and layout manager during the certification.

CHAIRMAN RAY: Indeed you were.

MR. TUNON-SANJUR: What really happened was we had developed a lot of the design when -- and we were counting on a lot of the industry-wide initiatives to show that as we are structuring, high frequency is not damaging. So, a lot of the design calculations have been performed at that time.

And as the industry-wide initiatives seem to hit a roadblock with the NRC, we propose more of a site-specific comparison to just show that high frequency is not a damaging earthquake and why it wasn't and based on the sample comparisons.

The main reason it was is there's an awful lot of -- there was an awful lot of calculations that we needed to do. And it also affects seismic margin calculations when you combine both earthquakes.

CHAIRMAN RAY: Well, combining isn't quite the word I'd use. Just enveloping them from a response spectra standpoint and then putting together a time history for analysis purposes that fits that enveloping response spectra would be what I would expect and what we do for a site that has three different sources, for example.

One near that has high frequency, one far away with lower frequency, you just envelope them and I'm still struggling with why that isn't what we're doing here.

MR. TUNON-SANJUR: Well, here we are following the same procedure as there was in AP1000. A lot has to do, again, with the seismic margin especially because, if you notice, the high-rock high-frequency spectra really doesn't flatten out. It's a very sharp -- it has a very high zPA at a hundred hertz.

The zPA is probably much further down in that. So, those were some of the reasons why we didn't do it.

CHAIRMAN RAY: Well, okay. I don't want to prolong the inquiry, but my colleague here I'm sure is going to have a question.

So, if you'll just stand up there again, please, it still is perplexing because basically -- well, like I say, just instinctively one would say this is like having a nearby source and a distant source and you just envelope them to create a response spectra for the site and handle it that way rather than two separate response spectra, which makes it confusing.

MR. TUNON-SANJUR: A second point for structural engineers, if you don't mind, is the high -- for a lot of the analytical models, the sizes of the models are really dependent on what type of frequency you're dealing with.

When you're talking about 50 hertz peaks and a hundred hertz peaks, that would have changed a lot of the analytical -- we are not really, well, to be blunt, prepared to modify some of the analysis and testing that had been done here for low frequencies versus high frequencies.

For Westinghouse, it was easier to demonstrate that high frequency was not damaging by a force comparison.

I think when you see some of these comparisons, you will clearly see that for at least the majority of the components that we chose to perform the comparisons, the high-rock high-frequency is much -- generates much lower forces.

CHAIRMAN RAY: Yeah, I have looked at that and I recognize that's true. Not only that, but I've had the experience personally that it's a fact.

Pete, go ahead.

MEMBER RICCARDELLA: Let me ask the

question slightly differently. Can we please go to your slide Number 69 in your presentation?

Is it fair to say that the equipment that was certified for the AP1000 -- no, the next one -- is good for the blue dashed curve -- for a spectra that would consist of the blue dashed curve and the red curve -- I'm sorry, and the black, the lower black curve?

CHAIRMAN RAY: It's blue, actually.

MEMBER RICCARDELLA: That one come down and the purple one, yes. I mean, the equipment is qualified for that, right?

MR. TUNON-SANJUR: Yes.

MEMBER RICCARDELLA: So, to say that the Duke spectra exceeds the spectra for which it's designed at three hertz and above, is really not right. It doesn't exceed it until you get to 14 or 15 hertz, correct?

MR. TUNON-SANJUR: That's correct.

CHAIRMAN RAY: That's all right. Let me just prolong that question a little bit, because my instinct tells me that some equipment has been qualified that is believed to be sensitive to high-frequency curves, period.

So, the point is that I think there are

two groups of structures, systems and components that we're talking about here.

And that's what I interpreted the original comment to be which was that, you know, a lot of work had been done, they needed to address the issue of high-frequency curves like we see here, and to redo everything that had been done wasn't warranted.

MEMBER SANJOY: Well, Harold, you can ask the question directly. Did they qualify things for that purple curve and separately some other equipment for the dotted lines?

CHAIRMAN RAY: Structures, systems and components, yeah.

MEMBER BANERJEE: Then let's get the answer straight.

CHAIRMAN RAY: Well, I thought I was, but anyway --

MEMBER BANERJEE: Well, your question --

CHAIRMAN RAY: All right. Not clear enough.

MEMBER BANERJEE: Yeah.

MR. TUNON-SANJUR: The AP1000 we demonstrated that for the major components the forces were a lot lower.

And that satisfied the staff that really had we done all of the HRHF calculations for those components, they would have been -- the design would not have changed. So, in that sense we did qualify for all the major components.

CHAIRMAN RAY: Yeah.

MR. TUNON-SANJUR: For piping at the end, the NRC staff required us to perform an analysis for CSDRS, the dashed curve, and also for HRHF.

Out of all the piping analysis that was done, maybe I would say less than two percent the HRHF forces were slightly higher. And that really had to do with our analytical models.

We do a dynamic analysis method called response spectra. As you get closely spaced votes in response spectra methods, you pay a penalty. And, therefore, some of these -- there were a few piping -- small piping lines in which HRHF covered, but not enough to change the design significantly.

So, this is a sample over a thousand -- a significant amount, say 200 significant lines, in which HRHF never governed the design. And I am willing to say for those two percents, I think it was all a numerical increase.

And so, that should also satisfy the -- it's further confirmation that HRHF or high frequency is not a controlling earthquake for the AP1000.

CHAIRMAN RAY: Well, okay. But for somebody in a higher seismic region like me who's run a shaker table for years, there is equipment that's affected by the purple curve, but let's -- I just wanted to know what the answer was, not get into a debate.

MR. TUNON-SANJUR: So, in answer to your question for the equipment that is high-frequency sensitive, actually we did envelope the testing of that equipment.

The equipment folks enveloped the flow response spectras from CSDRS and also included the HRHF.

As a matter of fact, they increased the HRHF results by 30 percent, because at some point it was thought that the forces from HRHF were actually lower.

So, for what is considered high-frequency sensitive equipment, that has been enveloped.

CHAIRMAN RAY: Okay. Well, it's hard to

understand that from what we have to look at here. It's as if there are two different worlds. And how the two come together just isn't clear.

I think this has helped us understand it. But, like I say, for those of us who have dealt with different sources, some nearby with a high-frequency component, some far away, San Andreas with a very low-frequency component, and some dominate parts of the spectrum, some dominate others, the normal practice is to envelope those and then generate a time history for analysis purposes that matches the enveloping curve, and that's not what we have here.

And I think the reason is historical, like we just heard.

MEMBER BLEY: I'd say what we heard was reassuring, but is that story laid out in some of the documents that we could look at to really understand it? Because I can't say that I --

CHAIRMAN RAY: I only understand --

MEMBER BLEY: I don't see technical justification.

CHAIRMAN RAY: I only understand what they said, I don't -- but the question maybe we should ask the staff as well, I mean --

MR. GENES: Well, we're going to -- this is Blaise Genes. I'm with Westinghouse as well.

As we go through our presentation, we'll try to develop a path, if you will, that will include some introduction to what Lee was speaking about and how the low-frequency and high-frequency curves were accounted for --

CHAIRMAN RAY: Yeah.

MR. GENES: -- and how that applies to the Duke site. And as well as the -- as far as the AP1000, at least be able to speak to and demonstrate with site-specific analysis results that the curve that we will -- that is being shown in red, which is slightly higher than the AP1000, is generating forces that are still far less for structures than the CSDRS.

We will talk about piping systems and we will talk about equipment that have -- piping systems, as Lee alluded to, have been designed both for CSDRS and for HRHF. And our tested equipment was tested to both the CSDRS -- the combined CSDRS and HRHF.

So, in a manner of speaking, in some ways it has been enveloped for systems. The timeline and with regard to how -- certainly with regard to structures in their response in the two-to-eight or two-to-ten hertz range, the high frequency historically, as well as experience-wise, wasn't the issue.

As it evolved and became more of an issue, piping and equipment began that same enveloping process, if you will.

MEMBER BLEY: Well, when you talk about the testing that was done, I have kind of two things I'm interested in.

One is if it's really laid out somewhere in the FSAR that I didn't see, or if it's laid out in maybe a Westinghouse report, I'd be interested in the documentation.

And, two, the thing I'm thinking about for ranges up around 20 hertz approaching that area is electrical equipment hooked up in circuits.

Did the testing include just shaking the equipment, or did it include shaking the whole circuit that includes electrical equipment and mechanical equipment that's hooked to the electrical?

CHAIRMAN RAY: Well, in your backup slides you have a lot of TRS comparisons that are, I think, help illustrate what you're saying.

MR. GENES: That's correct.

CHAIRMAN RAY: And so, I just want you to recognize we need to go there and --

MR. GENES: Understood.

CHAIRMAN RAY: -- pursue some of these questions, because I think we understand it, but it's really hard to figure it out just from the words that are written on the page, how it happened and what happened along the way.

And then there's the other thing which I tried to introduce in what I said, which is when all is said and done, this is the first time lack of expected damage is a criterion for acceptability of the site response or the plant response to the site design conditions.

Normally, it's set as a site design requirement, if I can use that term, and then the plant is analyzed to that. But of course we're in a different world here now, and so we have to deal with that.

I'm curious also as to when it's all over and done with and assuming everything is just fine, which we can, I think, assume for starters at least, what then is the design basis of this plant?

Is it the certified design response

spectra, two of them, or is it the envelope that we've shown the plant is capable of meeting without damage?

That's a question that we can leave for a discussion with the staff, but -- and I know the reference is made here again to seismic margin, and "margin" is a tricky term. And I'd rather just look at what -- the testing when it was done and how the Lee plant compares with what has been qualified to test.

MEMBER BANERJEE: Can I ask a question, Harold?

CHAIRMAN RAY: Yes.

MEMBER BANERJEE: Because I'm getting more and more confused by this discussion and this is not my field, but generally I can understand things.

So, what I'm really asking, the question, is that is it significant that there is a deviation at three hertz, which goes up, which is where the red line is, and it may or may not be within whatever non-damage, et cetera, but is that significant, or is it significant at 14 hertz that you've got -- 15 hertz the envelope deviating from the envelope which is described by the dotted line and the purple line?

I just want a straight, simple answer. Which is important? The three hertz, or the 14 hertz?

MR. GENES: The 14 hertz.

MEMBER BANERJEE: The three hertz doesn't matter. We don't give a damn.

MR. GENES: Yeah, the short answer would be no.

MEMBER BANERJEE: Okay.

MEMBER SCHULTZ: And then a because would help.

(Laughter.)

MR. GENES: Because it's the blue curve above it.

MEMBER SCHULTZ: Okay, Blaise, as you started off your discussion, you're headed in the right direction for us. That is, you said you were going to step through this so that we would understand it.

MR. GENES: We'll do our best.

MEMBER BANERJEE: I think you've answered my question.

MEMBER RICCARDELLA: Just to be clear, the red curve at 10 hertz would not be called an exceedance; is that correct?

MR. THRASHER: This is John Thrasher. It depends on what you're comparing it to, because I guess we've got the DCD requirement that says compare your site spectra to see if you're enveloped by the CSDRS. We're not.

Then compare it to the hard-rock high-frequency spectra. Well, we're not, and those exceedances occur -- occur at different places.

So, when you put all the curves together, but to follow the step-through process that we'll try to step you through, you've got to compare it first to one.

If you're bounded by CSDRS, then you're fine. If you're not there, if you're not bounded by HRHF, then you go further.

CHAIRMAN RAY: Well, you did the Appendix 3I.

MR. THRASHER: Right.

CHAIRMAN RAY: But if, Sanjoy, there was a set of equipment that was just qualified to hard-rock high-frequency --

MEMBER BANERJEE: That's why I asked the question.

CHAIRMAN RAY: -- then the --

MEMBER BANERJEE: He said no.

CHAIRMAN RAY: I know that.

MEMBER BANERJEE: Yes.

CHAIRMAN RAY: But if there was, then the exceedance of three hertz would be --

MEMBER BANERJEE: Of course. Very important, but he told me it's not. So, we have it on the record. They're going to prove it now. They're going to prove why it's not important at three hertz, right?

MEMBER BLEY: To quote from the DCD that Harold read, in Part A as you compare, and it says, if you're enveloped by the HRHF envelope for the AP1000 or the CSDRS, you're okay.

Now, I don't know why that is. I'm kind of getting a feel for it here.

CHAIRMAN RAY: Lawyers wrote that and I'm afraid we're having to live with the consequences.

MEMBER SCHULTZ: but, again, what I heard you say, John, is that you were stepping through a process when you called out the exceedance at three hertz.

MR. THRASHER: Right.

MEMBER SCHULTZ: You were stepping

through a process. But, again, we want to understand whether this was mentioned first. Is that significant?

Because we shouldn't be getting excited if we should not be getting excited about that crossover --

MR. THRASHER: Right.

MEMBER SCHULTZ: -- and we just need to understand that.

CHAIRMAN RAY: Okay. Now, with all of this turmoil behind us, go ahead with your presentation as you wish, but you'll be hopefully able to anticipate the areas that we're most interested in.

And, like I said, my looking at it is that the backup slides help a lot to deal with the concerns that you've heard expressed here.

MR. THRASHER: Okay. And one of the questions, and you read the quote out of the DCD, one of the questions was, is there somewhere a document that kind of explains this? And that Westinghouse document that's listed there I would refer you to.

There's more detail in that document kind of explaining the entire process that we've, you know, we didn't put all those words into the Lee application and everything so that APP-GW-GLR-115, that technical report describes basically the development of the hard-rock high-frequency spectra and how that was justified as being non-damaging compared to the certified seismic design response spectra now that was incorporated into the DCD. So, I think that gives you some good background information if you want to refer to that document to help.

All right. Then we'll go ahead and start the presentation. I'm John Thrasher with Duke Energy. I'll do a high-level introduction to this. And it's going to be a lot higher level than the discussion we've already had.

Then I'll turn it over to Blaise Genes from Westinghouse to lead us through a more detailed explanation.

So, on Slide 61 after relocation of the plant, as we've already mentioned earlier today, the Lee site is a uniform hard-rock site with configuration just as described in the DCD.

However, when we developed our seismic hazards, we have a ground motion response spectra -- had a foundation input response spectra that we enveloped to make a nuclear island foundation input response spectra.

And both of those exceed the CSDRS, and also exceed the hard-rock high-frequency spectra in the DCD. And that led us to departure WLS DEP 2.0-1.

So, with that departure, this is a process stepping through again. We had to do site-specific analyses as required to show the design adequacy for deploying an AP1000 at the Lee site.

So, we had to do site-specific analysis for a Seismic Category I nuclear island, and also for the Seismic Category II portions of adjacent buildings at turbine building first bay and the annex building.

So, again, that process is we -- the words were read out of the DCD. If we have those exceedances, then the first step would be to look at in-structure response spectra at six key locations.

And if there are no exceedances at those six key locations when compared to the hard-rock high-frequency or CSDRS spectra at those locations, then we can stop the evaluation at that point.

However, as you've already noted, we had some exceedances in those areas. And that required us to move into doing more detailed evaluations similar to the evaluations described in Appendix 3I of the DCD.

CHAIRMAN RAY: Excuse me. I was both listening and reading at the same time.

MR. THRASHER: Okay.

CHAIRMAN RAY: I heard you say "six" and I was looking up there for the term "six locations."

MR. THRASHER: It's not actually in that statement, but that's what -- if you go to those references and everything, there's six key locations that in-structure response spectra are -- looked at.

So, the DCD talks about in more detail this first step. And you look at those in-structure spectra at six key locations.

Blaise is going to go over the details of that and show --

CHAIRMAN RAY: Okay.

MR. THRASHER: -- in some locations we didn't have issues, we had no exceedances, and some areas we had some minor exceedances, which throws us into the next step.

So, he'll run us through that whole --

CHAIRMAN RAY: All right.

MR. THRASHER: -- process on how we went

through Step A as described there, had minor exceedances. Then that drove us to go in through Step B.

CHAIRMAN RAY: Well, we're always, you know, willing to say there should have been ten or some other number, but that's where I wondered where the six came from.

MR. THRASHER: Right.

CHAIRMAN RAY: Okay.

MR. THRASHER: Well, that's in the certified design.

CHAIRMAN RAY: Okay.

MR. THRASHER: Assuming we have licensing finality with that.

All right. So, we'll move to the next slide just to the real high level again looking at the site-specific seismic analysis of the nuclear island.

Again, we look at those in-structure spectra. We do see minor exceedances over the corresponding spectra for those certified seismic design response spectra and the hard-rock high-frequency spectra.

So, that drove us to the next step, or Step B, which said review representative samples of structures, primary equipment and piping.

And we end up doing those reviews and show that the design forces are moments from the certified seismic design response spectra control. And, again, that evaluation is similar to that presented in Appendix 3I.

Going further we also look at where we had the exceedances of equipment qualification. And we look at those exceedances to show that the required response spectra for the Lee site is -- in all cases that were reviewed, the actual test response spectra that were used for qualifying that equipment exceed the required spectra for the Lee site. And, again, Blaise will go through some details of examples of that.

Duke Energy made a commitment that will ensure that all future test response spectra continue to envelope the Lee site-specific required response spectra.

So, let's say we move forward in construction and the equipment that's actually procured is maybe a little bit different and the design processes will take care of that in managing configuration, but we'll have to go look at another test.

Or 10, 20, 30 years down the road we have to do an engineering change to replace equipment, something that's worn out, we'll have to make sure that the test on that equipment -- the test response spectra envelopes the required response spectra for the Lee site or either we'll have to have, you know, additional testing done to envelope that.

CHAIRMAN RAY: Well, and I think that that illustrates what I was saying. We're actually establishing the required response spectra as the basis -- the licensing basis in this COL.

MR. THRASHER: Right.

CHAIRMAN RAY: And the old models are superseded by this required response spectra, which is specific to locations throughout the plant.

MR. THRASHER: That's correct. All right. Then on our next slide looking at site-specific seismic analysis for the Seismic Category II buildings, we did -- a high-level evaluation was performed by Westinghouse on this area.

Horizontal base spectra that were input are very similar to the AP1000 envelope criteria. However, the vertical spectra that -- from the Lee site were higher.

Relative displacements between the structures were found to be much less than the required space or gap between Seismic Category I and Seismic Category II structures.

We have high confidence that the AP1000 standard lateral force resisting system is adequate. The vertical spectrum exceedances may require the design details for the Lee site to be slightly modified to handle the vertical spectra exceedances.

And by way of those details, the floors, the roofs, we may end up having to increase reinforcing steel size, the floor thicknesses or something to accommodate higher vertical spectra.

Westinghouse is just in the final throes of completing some additional more detailed three-dimensional analysis in that area. And the results we're seeing from that are showing that the existing standard plant design of those Seismic Category II adjacent buildings will be adequate even for the higher vertical spectra that we're seeing at the Lee site.

So, as far as what's in our application, the Seismic Category II performance criteria has been identified and Duke is committed to confirmatory analysis.

And if any updates are required to the Seismic Category II adjacent building designs, those design updates will be completed before we start construction of the Seismic Category II areas.

So, I'll now turn it over to get into the wonderful details of how all this stirs in the spot. Blaise Genes from Westinghouse.

MR. GENES: Thanks, John.

Again, I'm Blaise Genes. I'm with Westinghouse. I have the enviable position, I'm trying to take a positive spin on this, to summarize the seismic analysis -- the AP1000 plant at the Lee site.

This effort was performed by numerous finite element and soil-structure interaction analysis. All this work was done in conjunction with and under the guidance of Mr. Lee Tunon-Sanjur.

Next slide. This process and the path that we're going to try to take you on here for how we addressed Lee seismic analyses, the talks that we're going to discuss, which we hope will be -- present some clarity to the overall -- overriding questions and concerns that you might have and ultimately to some results and conclusions that we'll ultimately draw.

We'll talk about some previous Lee seismic analyses that were done back in 2011-2012. We will touch on and get into an introduction of the AP1000 seismic analysis particularly as it relates to Hard-Rock High-Frequency.

We will discuss the details associated with the methodologies for Hard-Rock High-Frequency seismic evaluations.

We will summarize the updated central and eastern US soil-structure interaction seismic analyses.

Subsequently, we'll talk about how based on the results of our CEUS analyses, the screening evaluation, and we'll also talk about the -- and summarize the seismic analysis results.

We'll touch on our assessment of seismic margin, summarize our Category II adjacent structures, and then wrap up with some final conclusions.

Okay. Previously we have -- Westinghouse performed seismic analyses, site-specific analyses of the Lee Units 1 and 2 based on the original configuration that you heard this morning.

We did the Category I, the nuclear

island, and as well as the Category II, the turbine building first bay and the annex buildings.

The in-structure response spectra for that site-specific analysis, those were enveloped by the AP1000 CSDRS, as well as the HRHF envelope spectra, for the six key locations outlined in the DCD.

Essentially, we were done at that point -- well, the -- subsequent to that analysis it was reviewed and audited by the NRC and accepted in April of 2012. At that point, we thought we were done.

However, following the -- in 2012 and following that audit, there were changes to the seismic hazards particularly for the central and eastern US, which included the Seismic Source Characterization, the NUREG-2115, as it's been discussed at length this morning, as well as the updated EPRI Ground Motion Attenuation models that were developed in 2013.

So, I guess as a -- we felt that this was important, and obviously in the pre-discussions to the presentation an introduction to the AP1000 Seismic Analysis is quite appropriate at this point.

The DCD allows an applicant to compare

to the AP1000 plant certification, and there's two response spectra, their Ground Motion Response Spectra that they would compare to.

Those two spectra are the CSDRS curve, which we had seen. And we'll show that same graphic and a similar graphic in the next slide, but typically that is -- corresponds to a low frequency seismic input that generates high displacements and larger forces in moments.

And the second ground motion comparison is with the HRHF, or the Hard-Rock High-Frequency. Again, it's typically associated with the high-frequency input and generally low displacements.

The AP1000 -- for the AP1000, the design calculations for the majority essentially really, if not all of the AP1000 structures, systems and components, are based on or bounded by the CSDRS, but some sites -- the GMRS for some sites in the eastern US had higher amplitudes and a higher frequency.

Therefore, the HRHF curve came about, as well as the Hard-Rock High-Frequency evaluation methodology, which is described in ISG-01, as well as Appendix 3I of the DCD.

That was applied as John had -- that was applied to AP1000. And that's documented in the report that John had referenced which we refer to as Technical Report 115.

As part of that evaluation Hard-Rock High-Frequency methodology does not require us to evaluate the total plant, but selected -- a review of selected samples of systems, structures and components.

CHAIRMAN RAY: Can I interrupt you there for a second?

MR. GENES: Sure.

CHAIRMAN RAY: That's what I meant, Sanjoy, was what he just said by having some things that are not subject to what I refer to as an envelope, but they are identified as adequately addressed by one or the other of the response spectra.

MEMBER BANERJEE: Yeah. So, in those cases the three hertz would matter, right?

CHAIRMAN RAY: If it was the high frequency curve, yeah.

MEMBER BANERJEE: And why does it not matter then?

MR. GENES: The three hertz Hard-Rock High-Frequency curve, if you evaluate the Hard-Rock

High-Frequency curve, it's enveloped by the corresponding -- the CSDRS curve.

MEMBER BANERJEE: Yeah, I realize that, but some equipment is only qualified for the HRHF curve.

MR. GENES: There is not equipment that --

MEMBER BANERJEE: There is no such equipment.

MR. GENES: Well, there's no equipment that's only qualified to the HRHF.

CHAIRMAN RAY: There is stuff that's only qualified to the --

MR. GENES: To the CSDRS.

CHAIRMAN RAY: Yes.

MEMBER BANERJEE: Okay. So, the inverse is not true.

MR. GENES: Yeah. And the DCD spells out which equipment is sensitive to high frequency and which equipment is not sensitive to high frequency.

So, that may affect, you know, how those are tested, but certainly there is the combined -- the equipment that we reviewed and that was reviewed as part of the AP1000 Hard-Rock High-Frequency methodology and defined in TR-115 looks at the combined CSDRS and HRHF.

CHAIRMAN RAY: And that's the important point, yes.

MR. GENES: Take-away, yes.

CHAIRMAN RAY: But the inverse, as you say, there are some things that it would not make sense to analyze to the HRHF, because they are --

MEMBER BANERJEE: So, everything is qualified to the envelope of CSDRS and HRHF, except some equipment which is not qualified for the HRHF.

MR. GENES: Yeah, the structures are not designed --

MEMBER BANERJEE: Because that --

MR. GENES: -- to the HRHF.

MEMBER BANERJEE: Yeah, because the high frequency didn't matter to them.

MR. GENES: Exactly.

MEMBER BANERJEE: Right.

MR. GENES: Piping systems are qualified for both CSDRS and HRHF.

MEMBER BANERJEE: That's the envelope that he keeps talking about.

MR. GENES: Correct.

MEMBER BANERJEE: Which is what they did

at San Onofre, but there are other things which are not sensitive to high frequencies. And, therefore, are only qualified to the CSDRS.

MR. GENES: And I think that's true, yes.

MEMBER REMPE: And so, at the review of the selected sample of SSCs, could I reiterate Dennis' question on when you do that review, does that require testing, and then what is tested? Is it a whole system that's connected to things, or is it just a component?

MR. GENES: Well, that's a good question. I mean, as far as the specifics of -- I'm not prepared to be able to answer whether specific components or relays or -- I think that whatever -- it's my understanding that the component that is tested includes all of the aspects relative to what is a part of that component.

CHAIRMAN RAY: We may get some more comfort when you get to the TRS --

MR. GENES: Yeah, and I do have slides that will --

CHAIRMAN RAY: But these are things that bother people. So, just keep in mind --

MR. GENES: Understood.

CHAIRMAN RAY: -- that we're trying to understand are we just picking this and this and this and because they were okay, everything is okay and, you know. That's what's at the root of a lot of the problems.

MR. GENES: Understood.

MEMBER SKILLMAN: Blaise, let me ask this question: Ten years from now, eight years from now there's going to be an individual, man or woman, who is the engineering chief at one of these plants, presumably.

And if there is a seismic event as there was in Mineral, Virginia, what piece of paper or aggregate paper will this individual pull out and review for the determination of whether or not that ground motion exceeded the design basis of the plant?

Will it be TR-115 as amended over the course of construction, or will it be some other document that identifies these selected samples?

And if the ground motion at the plant exceeded the allowable ground motion for any one of those six samples, then there has been a true exceedance?

What will be to Harold, to our

chairman's question some hours ago, what will be the design basis? How will we know what that is?

CHAIRMAN RAY: I think it's the RRS, isn't it?

MEMBER SKILLMAN: Well, it seems to be a composite.

CHAIRMAN RAY: Required response spectrum is what I understood.

MEMBER GENES: Well, if it's a piece of equipment, it is. It's the -- the DCD, it would be the curves associated with -- let's put it this way: If it's the Lee site, it would be the Lee site-specific analyses that were performed and the Lee site-specific curves that would be -- that represented the design ground motion. That's one aspect of it.

Since -- and as we will talk about the -- all of the -- it's been enveloped, then the CSDRS and the HRHF curves become the design response spectra.

CHAIRMAN RAY: And in-structure it's called the RRS, right? Required response spectra.

MR. GENES: In this case down here I guess the required -- there's in-structure response spectra, which would be the response of the structure.

The required response spectra would be, as far as testing of equipment, incorporates that as well as margin factors to arrive at a required response spectra.

CHAIRMAN RAY: Okay. All right.

MR. GENES: So, there is some different -- there is some minor differentiation in the two.

CHAIRMAN RAY: That's fine.

MR. GENES: If we're talking strictly in-structure response spectra, then we're talking about the CSDRS and the HRHF, because they are the design criteria. And in the Lee site case they have been shown to be -- fall within those design criteria.

If it's testing of a specific piece of equipment, then maybe the test response spectra would become the controlling document, I would think, that would say this is what this specific piece of equipment was tested and qualified to.

And that would be the spectra that that particular piece of equipment -- so, it would vary as, I mean, it's kind of a multiple answer depending on the structure, system and component that you are trying to assess.

CHAIRMAN RAY: Well, I'm still clinging to this RRS as was described earlier as the reflection of the requirement for something in that location in the structure.

So, if you replace a piece of equipment, instrumentation, whatever, with another one, that's what it needs to be tested to as a minimum.

MR. GENES: Correct.

CHAIRMAN RAY: That's my --

MR. GENES: If I'm understanding you correctly, you're talking equipment-related.

CHAIRMAN RAY: Yeah.

MR. GENES: If we're talking about the shield building, then we're talking about the CSDRS.

CHAIRMAN RAY: Yeah. I'm talking about equipment replacement, you know, that sort of thing which was talked about previously. There is a defined required response spectra for that equipment.

MR. GENES: YES.

CHAIRMAN RAY: And a new vendor with a new piece of equipment, it has to be tested to that or better, is my understanding.

MR. GENES: As well as the CSDRS and HRHF.

MR. THRASHER: But I think -- this is John Thrasher again. Mr. Skillman's question, I think if I was, say, the engineer at Lee nuclear station down the road and we picked up an earthquake, I'd probably even go further upstream kind of like Mike Gray explained this morning with the Mineral, Virginia earthquake, you know.

How does the magnitude of that earthquake compare with the seismic source information that fed into determining my seismic hazards, because it may already be bound and it might be no impact at all from that.

I may have an earthquake that was, you know, 6.2 and I go back and look and, oh, well, the seismic experience already -- the CEUS seismic source characterization already assumed a 6.5 magnitude earthquake.

So, I'd probably go -- if I was looking at seismic data that I had from an actual experience at the site, I'd probably go up and say, okay, are my seismic hazards impacted first?

And then if they are, then I would have to get into the supporting analysis.

MR. GENES: Thank you. And I guess just the final point on here on this particular slide is based on our evaluation of Hard-Rock High-Frequency sensitive structures, systems and components within TR-115, again we're talking about AP1000, they were shown to be governed by the CSDRS.

I just -- the next slide is really the graphical representation where this is, again, this presents frequency versus acceleration.

It shows the CSDRS for AP1000 in the red dashed line. It shows the Hard-Rock High-Frequency GMRS seismic input, which is the blue dashed line.

Again, the AP1000 is -- the seismic analysis and design is based on the CSDRS. It corresponds to low-frequency seismic input, high displacements which typically -- which lead to higher building and equipment forces.

Our DCD Appendix 3I has allowed for the provisions of evaluating a Hard-Rock High-Frequency curve which -- and the steps associated and the methodology associated with that which corresponds to, again, high frequency, low displacements and is shown to lead to smaller, non-damaging building and equipment forces.

CHAIRMAN RAY: Well, yeah, let's bear in mind that a reactor plant is very stiff in the vertical direction. And this PGA in the vertical direction is very close to the PGA in the horizontal direction.

So, it's quite possible then you'll get some amplification from floors, for example, that are supported on vertical columns of a floor in between.

So, it's just not that easy to not be concerned about the high frequency if you're equipment-focused.

MR. GENES: Yeah, and that gets -- I think equipment-wise the Hard-Rock High-Frequency is combined and is part of that.

CHAIRMAN RAY: From my standpoint, it's only the equipment that matters. The structure is not going to be a problem.

MR. GENES: Right.

CHAIRMAN RAY: But the issue is what qualification requirements apply to equipment. And when you're, like I say, you have experience in the west where it's pretty damn high accelerations, finding equipment that will pass the -- what you call a GRS isn't that easy.

So, like I say, the building is -- in the west, the vertical component tends to be much smaller fraction of the horizontal, because you're not a hard-rock site. But here, you are.

MR. GENES: Right.

CHAIRMAN RAY: You're pretty close to the horizontal. So, you're getting high vertical accelerations even at high frequencies and -- because it's so stiff in the vertical direction.

So, anyway, that's just background, for what it's worth.

MEMBER BANERJEE: So, what was the point of your showing that red curve in the previous slide? Because in reality, it has no meaning except --

MR. GENES: I think he's talking about the next slide, which is actually -- which was the previous slide.

MEMBER BANERJEE: I'm going the wrong way.

MR. GENES: There we go. Let's just go to the next slide. This is the comparison of -- and as we had in the previous slide, those two curves are the basis with which the DCD is based on and, therefore, is the site -- the COL applicant can compare his Ground Motion Response Spectra to. This is that comparison.

This is the comparison of the two ground motions for AP1000, the blue dashed line and the solid purple line.

And the red solid line is the Lee site-specific --

MEMBER BANERJEE: But from the point of view of application of these, you really don't apply that red line up to above 14 hertz, right? Because it -- that other part of it is unimportant below the -- where it crosses that dotted line, right?

MR. GENES: Well, it's important in the sense of the --

MEMBER BANERJEE: Of the record, but I'm saying --

MR. GENES: Right.

MEMBER BANERJEE: -- from the point of practicality, from the point of view of qualifying your equipment, you use that dotted line to the point where it crosses that red line. And then some equipment will have to be qualified for that red line. And the other equipment will just follow that dotted line down.

Is that how I should understand it? I mean, from a practical point of view that's more or less what you said.

MR. GENES: Well, the equipment is

qualified to both the blue dashed line and the purple line.

MEMBER BANERJEE: Right, but now you've got the red line there.

MR. GENES: Right, which is compared to -- that required spectra is compared to the Test Response Spectra associated with the input that was generated by those two curves.

MEMBER BANERJEE: Yeah, I'm just trying to understand the significance of the red line. The red line is not significant until it crosses the dotted line, because everything gets qualified to that dotted line up to that point where it crosses. I mean, from a practical point of view, that's what happens.

Now, where it crosses, you should be qualifying some equipment for the red line, but other equipment for the dotted line. That's how I understood it that they go into two bins, more or less.

High frequency sensitive equipment gets qualified, let's say, to the red or the purple line. It doesn't matter. And the other stuff gets qualified for the dotted line.

Is that a correct interpretation?

MR. GENES: The short answer would be yes.

MEMBER BANERJEE: Okay.

MR. GENES: I think so. That's -- I think that's --

MEMBER BANERJEE: That's really the bottom line.

MR. GENES: Right.

MEMBER BANERJEE: So, we won't worry about it until it crosses. It's unimportant.

MR. GENES: Okay. Well, it's less influenced.

MEMBER BANERJEE: I have to put it in a bin in my mind. So, should I worry about it, or not?

MR. GENES: No.

MEMBER BANERJEE: So, you're telling me don't worry about it. So, after the --

MR. GENES: Okay.

MEMBER BANERJEE: -- 14 hertz, it matters. The rest of it doesn't matter. It's irrelevant. It's just you are putting it in because -- to show what your site is in comparison to the Westinghouse.

MR. GENES: Yes, the site -- the red

curve is the --

MEMBER BANERJEE: That's fine.

MR. GENES: All of the Chapter 2.5-related effort.

MEMBER BANERJEE: But I shouldn't use any of the little piece of grain left on that. Okay.

MEMBER RICCARDELLA: I think maybe if you look at the source of where these discussions came from is as we're reviewing this you said, well, we, you know, we had some exceedances at high frequency in the documentation.

MR. GENES: Right.

MEMBER RICCARDELLA: And then you say, well, it exceeds at three hertz.

Since when is three hertz high frequency? It's not, you know.

MEMBER BANERJEE: Right.

MEMBER RICCARDELLA: So, that's where that kind of discussion came from. And we really don't have exceedance, as I understand it --

MR. GENES: Oh, no, there are --

MEMBER RICCARDELLA: -- until we get to 14 hertz.

MR. GENES: Correct.

MEMBER BANERJEE: Yeah, I think that's the real point.

CHAIRMAN RAY: Well, but that's only true given what they've said here and that I never found anyway in the record, which is that they qualified stuff to both curves.

But that wasn't anything, I mean, I'm sure if you dig down into the -- into that referenced Westinghouse document that you talked about, I would have been able to find that.

But, you know, the idea that everything is qualified to both, except structures that are only sensitive to low, I can understand that.

It's easy to say, it's easy to understand, and it would save a lot of angst if we could understand that more easily. But, all right, let's go ahead, because I'm still wanting you to get to the TRS tables and stuff.

MR. GENES: We will get there.

CHAIRMAN RAY: I know. Take your time, but just keep going.

MR. GENES: That's fine. So, I guess when we made this comparison, and this slide is to show that, and, as Mr. Thrasher had alluded to, that this comparison does show that the Lee site-specific

-- this is the NI FIRS, which is the envelope of the Unit 1 FIRS and the Unit 2 GMRS, that does exceed.

So, which kicks us down then into a site-specific evaluation of a Hard-Rock High-Frequency site. So, we will then continue beyond that.

Now, that being the case, the methodology that was applied --

MEMBER BLEY: Excuse me. Your papers are hitting your microphone which --

MR. GENES: Oh, I'm sorry about that.

MEMBER BLEY: -- messes up our record.

MR. GENES: So, as part of our, you know, really the next step as we came down in the DCD flowchart, if you will, the evaluation of a Hard-Rock High-Frequency methodology that was used for Lee, the first step that we do is we perform a soil-structure interaction analyses to obtain the site-specific in-structure response spectra, which we call ISRS in this -- the acronym for in-structure response spectra, that being the response of the structure itself, the floors, the various nodes within our model.

Based on the results of those and to address any high-frequency exceedances that may exist, we select representative structures, systems and components.

And that screening process which was performed, the same or similar screening processes in TR-115 and the DCD Appendix 3I, the impetus or the basis for those were that those SSCs were important to safety and function during an SSE, they were potentially to high-frequency seismic input or they were in locations where we had seen some high-frequency in-structure response spectra exceedances.

We also as part of our evaluation and our SSI analyses, were able to obtain and compare the site-specific forces and moments for the critical building structures, the primary equipment and the primary equipment supports, the reactor coolant loop and piping in the reactor coolant loop nozzles.

The evaluation methodology also looks at performing evaluations of high-frequency sensitive equipment, as Dr. Ray is most interested in, and how that process is -- those comparisons made, as well as the piping systems.

And those evaluations are to demonstrate and confirm that the AP1000 CSDRS and/or HRHF bound the Lee site-specific results.

And as with the DCD Appendix 3I, these screen representative systems, structures and components, the sample that's provided in the DCD and applied to Lee was sufficient to demonstrate that the AP1000 design is, in fact, controlled by the CSDRS.

Okay. So, summarizing our site-specific SSI analyses, which is, again, it's the first step associated with our Hard-Rock High-Frequency evaluation, which we performed -- or we updated the Hard-Rock High-Frequency analyses. And, again, it's the similar methodology to AP1000 TR-115 as defined in DCD Appendix 3I.

There were some -- there were refinements made to the nuclear island model above our licensing basis, finite element model that really it just incorporated up-to-date design changes, detailed design changes. And that model is a more updated version of the nuclear island model for our evaluation of the Lee site-specific CEUS input.

Next slide. As was discussed in -- for the Chapter 2.5 information, there are two dynamic profiles associated with Lee Units 1 and 2.

As far as how we evaluated that in our

SSI analyses, we performed two different analyses each with a representative, the strain-compatible properties associated with Unit 1 and Unit 2 beneath the nuclear island.

We compared those SSI results and the corresponding in-structure response spectra and the results of those analyses indicated that both Unit 1 and Unit 2 provided a similar in-structure response spectra for the six key locations defined in the DCD.

So, based on that, we chose the Unit 1 dynamic profile, which included the -- an evaluation of the concrete as our -- the profile with which we ran our SSI analyses.

As part of that, as was previously mentioned, our SSI analyses also in addition to in-structure response spectra, give us forces and moments that we'll use for subsequent comparative Hard-Rock High-Frequency evaluations.

And just in general, the updated SSI analyses and our Hard-Rock High-Frequency evaluations as well for the Lee site, had a minimal effect on systems, structures and components when compared to the AP1000 CSDRS and HRHF, which we'll be talking about that screening and evaluation process in detail.

MEMBER SKILLMAN: Blaise, could --

MR. GENES: Yes, sir.

MEMBER SKILLMAN: Could you go back a slide, please?

MR. GENES: Sure.

MEMBER SKILLMAN: One more. There. The second bullet.

MR. GENES: Sure.

MEMBER SKILLMAN: May I ask you to please explain in general terms what refinements were met?

MR. GENES: Again, there's detailed design updates to the overall plant that were incorporated into the model from the original licensing basis time frame.

Things like equipment masses, primary component support stiffnesses that were as part of detailed design. And those updates made in this model since additional design information was available, those were just naturally incorporated into the model.

MEMBER SKILLMAN: Did you increase the number of nodes?

MR. GENES: No, there were no -- there

wasn't really an increase in the number of nodes. It was more of a refinement based on the detailed design analyses results that updated and refined the existing model.

MEMBER SKILLMAN: Thank you, Blaise.

MR. GENES: Sure.

CHAIRMAN RAY: Wait. Let's see. I've lost track again. I think the last bullet there, updated SSI analyses and HRHF evaluations indicate, blah, blah, blah, if you had a time history for analysis purposes that represented an envelope of the two curves we're talking about, you would have only had to do one analysis, wouldn't you?

I mean, is there any reason why two analyses were required other than that's the way it's set forth in the certified design?

But if you had an enveloping response spectra and the time history that gave you that, couldn't you just use that once and be -- John?

MR. GENES: Well, for the Lee site, it was just one time history.

CHAIRMAN RAY: Oh.

MR. GENES: For the Lee site-specific analyses, it was the Chapter 2.5 NI FIRS, which is the envelope of the Lee Unit 1 FIRS and the Lee Unit

2 GMRS.

So, the time histories used in those analyses was, in fact, one enveloped curve.

CHAIRMAN RAY: Okay. When you read that sentence, though, it's not what you -- not the conclusion you draw.

MR. GENES: Well, there's two dynamic profiles. We evaluate two dynamic profiles since there is -- one is a truly hard-rock all-rock profile, and the other one is a rock profile with concrete.

We wanted to evaluate --

CHAIRMAN RAY: Oh, you're talking about Unit 1 versus Unit 2.

MR. GENES: Correct.

CHAIRMAN RAY: Okay. All right. All right.

MR. GENES: Yes.

CHAIRMAN RAY: That answers my question. Okay.

MR. GENES: Good. Again, this is again a -- how we go about -- this goes back to the last bullet on the previous slide.

The screening evaluation that we do perform as part of the Hard-Rock High-Frequency methodology is -- looks at the in-structure response spectra and the forces and moments associated with that for building structures.

And we look at the auxiliary building, the shield building, the containment internal structure, the various primary equipment, look at piping systems and electromechanical equipment.

That represents really the four areas that we address as part of our screening evaluation for the Hard-Rock High-Frequency methodology.

Next slide, please. So, now we'll get into some results presentation. Our soil-structure interaction analyses and our -- for the Lee site generated in-structure response spectra. It's a site-specific response spectra that corresponds to that envelope curve of seismic input.

We compared those -- the response from the Lee site to the AP1000 design envelope spectra, which is both the CSDRS and/or HRHF. And we compare that at the six key nuclear island locations which, again, is defined in the DCD. So, those six locations is what we initially look at.

Next slide, John, please. This is a typical response -- in-structure response spectra curve comparison.

In the upper left is for this particular node that we're looking at, it's an aux building node in the northeast corner in the region of the control room floor at elevation 116 and a half. So, it -- that is a location.

The other three curves are the comparison of Lee site-specific response spectra in the X, Y and Z direction compared to the CSDRS and HRHF AP1000 design response spectra.

CHAIRMAN RAY: What is the number of that slide? I can't see it from here.

MR. GENES: 75.

CHAIRMAN RAY: We're getting down to the point where it's a real eye test.

MR. GENES: As a result of that and realizing that, go to the next slide. I blew one up. That way we can focus on -- in this particular one, this is the Z direction or the vertical direction that compares -- its frequency versus spectral acceleration.

We have three curves on here. The black solid line is the AP1000 CSDRS in-design curve, design envelope curve.

The red solid line is the AP1000 Hard-Rock High-Frequency design envelope. And the solid

-- I'm sorry, the dashed blue line is the Lee site-specific in-structure response spectra curve based on the, again, the Lee seismic input.

As you can see, all the way up to about 50 hertz the Lee in-structure response spectra is enveloped by either or both the CSDRS and the HRHF design envelope curves. And this is with a case probably for 98 percent of the nodes in the model.

There are in this particular case, and this is one that we obviously wanted to highlight, is there is a minor exceedance of both the CSDRS and the HRHF in about the above 50 hertz range.

Which then if you recall back to the description that John had read as well as you, Dr. Ray, this puts us down to the -- as far as the DCD, into the criteria of evaluating these high-frequency exceedances.

And, again, we're only talking about a very small percentage of exceedances relative to the overall evaluation of all the nodes within the model and this is a typical high-frequency exceedance.

So, our screening process then evaluates how does this impact -- are the forces associated with this -- it's a rhetorical question, but, you know, it's part of the process.

We screen that and look at forces and moments for the structure. We look at piping systems for --

CHAIRMAN RAY: Where exactly are we again? I'm sorry, you said it on the slide preceding, but I was too --

MR. GENES: 60 -- what's the number?

CHAIRMAN RAY: -- focusing on trying to see it.

MR. THRASHER: 76.

MR. GENES: 76. Slide 76. You're talking about where the node is located?

CHAIRMAN RAY: Yeah. Yeah.

MR. GENES: You have to go back to 75, yeah. The node is located -- that northeast corner is kind of the region of the control room. That, again, it's in -- within the auxiliary building. You can see the shield building is obviously the large circle.

CHAIRMAN RAY: Yeah.

MR. GENES: So, it's the northeast corner. That's at elevation 116 feet, six inches. And it's in the region --

CHAIRMAN RAY: So, it's 16 feet, six inches above the yard grade, I guess.

MR. GENES: Correct. Yes.

CHAIRMAN RAY: Okay. It was hard to tell quickly from this picture if we were looking at the basemat or what the heck we were looking at here, but that's 16 feet high.

MR. GENES: Right.

MEMBER RICCARDELLA: You show a total of five nodes on this figure for some reason.

MR. GENES: No, this one is the critical node. This is one of the DCD nodes. One of the six key locations.

And interesting that you mention if you -- I guess is everyone good with moving on?

MEMBER RICCARDELLA: Well, I'm just curious as to why you identify other nodes on --

MR. GENES: Well, it's just part of, again, a group that's part of the models, but the pink circle identifies the specific DCD node.

MEMBER RICCARDELLA: Okay.

MR. GENES: So, this -- we also summarize what we call the group nodes, which look at the in-structure response spectra for -- that was generated by Lee at multiple nodes within specific areas of the model and compared that against the AP1000 design envelope group spectra.

And the groupings are such that multiple nodes associated with the shield building at elevation 99, the five nodes associated with the control room floor that you had alluded to, all the various elevations above elevation 99 in the shield building -- I'm sorry, the aux building, as well as the containment internal structures and the reactor coolant loop hot leg piping and pressurizer. Those groups combine all the various nodes so that we get a group spectra.

The next slide is a typical example of -- our comparison of the group spectra. It compares the AP1000, CSDRS and HRHF design envelopes to the Lee site-specific group nodes. And this particular case is the nodes associated with the reactor coolant loop hot leg piping.

Again, typical -- it's in three directions. So, for illustration purposes we blew one up. This slide again is frequency versus spectral acceleration for the RCL hot leg group.

The solid black line again is our CSDRS design envelope. Our solid red line is our HRHF design envelope. And the dashed blue line is the Duke Lee group envelope for those piping nodes or that RCL piping group.

Here again we picked this as one to illustrate, because it is only one of a handful of exceedances, but we wanted to illustrate this and how we evaluate these -- identify and evaluate exceedances as part of our screening evaluation.

In this particular case we have X direction, which would be a north-south direction. We have a minor exceedance in the approximate 11 to 16 hertz range of that group, which we then will evaluate whether that particular high-frequency exceedance has an impact on structures, systems and components.

CHAIRMAN RAY: Go ahead, Joy.

MEMBER REMPE: Well, these plots say 10 percent margin not included. And the earlier set you showed us did not say that.

Are we looking at something that's not really apples to apples compared to --

MR. GENES: They aren't apples to apples in the sense of, you know, there is --

MEMBER REMPE: To be more realistic you've taken away the margin in this one.

MR. GENES: Not so much -- there's a, you know, the DCD allows for as-built reconciliation to have a ten percent margin evaluation.

I guess there's not -- it is apples to apples in the sense of this is the spectra. It's more of a generic note that was included for as part of our group nodes.

CHAIRMAN RAY: Well, I was going to ask the same thing, but maybe take it a bit further. What is the -- how do we view the margin then or the margin that you're referencing here? How should it be viewed?

Has it been not included because with this analysis it's no longer considered necessary, or because we're doing a more precise analysis, or what -- the margin is a big, fuzzy --

MR. GENES: Well, this doesn't address margin, per se. This is -- we look at it -- this is an exceedance that requires further evaluation.

CHAIRMAN RAY: Okay.

MR. GENES: So, that really is -- and it identifies a location, it identifies a frequency range and it defines a magnitude associated with that exceedance.

We then go to the next step as part of our Hard-Rock High-Frequency methodology and evaluations that address that narrow band of frequencies, what affect that narrow band of frequency, what affect that magnitude, its location.

In this particular case, we'll talk about this is a -- associated with the hot leg piping group. Well, there is a piping system that we evaluate that includes -- incorporates the spectra associated with the Lee -- that solid -- or, I'm sorry, dashed blue line gets incorporated into a subsequent evaluation to evaluate or -- and demonstrate, confirm that the piping stresses from those, that minor exceedance, are still bounded by the CSDRS and HRHF piping stresses.

So, it really is -- it identifies a problem, potential problem area for further reevaluation.

We then specifically evaluate that exceedance in a subsequent analysis of what it might impact the most. And in this case --

MEMBER SCHULTZ: Blaise, what does the note mean? In other words, the next engineer that looks at this, is that engineer going to say, gee, if the margin were included, everything would be fine and we're done, or what does the note mean that the margin was not included?

MR. TUNON-SANJUR: This really has to do with the design reconciliation that we have to do later on as part of the final ITAAC.

At the end of the design when the design is completed, we have to look at how the plan was actually built, rerun the seismic analysis if it was significant and assure ourselves that it hasn't changed by -- all of these locations in the building have not changed, the spectra has not changed by more than ten percent.

If it has not changed by more than ten percent, we assure ourselves that the design is still the same.

What this really means is actually a good note. It means this is a one-to-one correspondence. We haven't made them closer artificially to prove that we're within the design -- we are within the design margin.

This graph really represents apples to apples. It's just representing the spectra from HRHF directly compared to the spectra from Duke Lee.

This slide might have been borrowed from a lot of the work we were doing at the same time. As we do the building design, we were performing a lot of building seismic reconciliation assessing how is the building changing, will we have to do a different seismic analysis for the AP1000 design later on, but --

MEMBER SCHULTZ: So, what I heard you say was that all of the charts should have this note on it at this stage.

MR. TUNON-SANJUR: For Duke Lee it should not have that note. Duke Lee is just intending to do a one-to-one comparison.

MEMBER SCHULTZ: Correct.

MR. TUNON-SANJUR: And so, this note really doesn't mean anything in the context of Duke Lee. It is really for the AP1000 program building reconciliation which we are monitoring how the detail design is affected.

Like Ray says, you know, we order some equipment and we have made some assumptions in the models. As we order some equipment, though, the equipment mass is changing. We continuously continue to monitor how the design is evolving.

I think this note just kind of fell through the cracks. It really doesn't apply to this comparison.

CHAIRMAN RAY: Would you please -- you've identified yourself previously, but the record doesn't show who was speaking just --

MR. TUNON-SANJUR: I'm sorry. My name

is Lee Tunon-Sanjur of Westinghouse.

CHAIRMAN RAY: Thank you. Well, all of what you said is very hard for us to digest on the fly, believe me. But unless there are other questions right now, we'll go ahead and proceed.

MR. GENES: Well, the note -- I guess to answer the question, the ten percent margin not being included could be confusing in this particular slide. I understand that now being that you are confused.

CHAIRMAN RAY: Well, yeah, because, you know, again as I said at the onset the reference to margin and use of margin or inclusion or exclusion of margin is problematic, because people rely on margin often when they're dealing with uncertainty.

MR. GENES: Yes. Understood.

CHAIRMAN RAY: And --

MR. GENES: The fact that it wasn't included and, as Lee pointed out and we had said, this is a -- this is for Duke, it's a one-to-one comparison. So, it really doesn't belong in there. It just is.

And being that it is, it really has no bearing except to cloud the issue. And that wasn't purposely done.

MEMBER REMPE: But if I compare the plots shown here versus the plot that was shown like on Slide 76 that does not have that note, which line would move -- or lines would move because you did not include the margin?

MR. GENES: The black and the red line.

MEMBER REMPE: Okay. So, they would go higher.

MR. GENES: Correct.

MEMBER REMPE: Okay.

MR. GENES: Because of design reconciliation associated with the AP1000, which we did not incorporate in this comparison, and would not.

MEMBER REMPE: Okay.

MR. THRASHER: So, before we move forward -- this is John Thrasher -- let me refocus this on a couple points real quick.

On Slide 79, there's a minor exceedance there in 11 to 16 hertz range. And this is on the reactor coolant loop hot leg piping, as Blaise mentioned. So, it shows we've got an exceedance, we've got to do some evaluations, what's in that area? Well, there's some piping systems that are attached to that loop piping. So, it will show that.

If we revert back to Slide 76, okay, in this area we see we've got a minor exceedance above 50 hertz. And this is, again, was at the control room floor elevation.

So, in the area of 50 hertz, what's the impact to sensitive -- high-frequency sensitive equipment?

So, Appendix 3I and the DCD has a list of high-frequency sensitive equipment, what high-frequency sensitive equipment may be attached to this floor, and we need to evaluate these minor exceedances.

So, this is how we get into where are the exceedances and in what -- does that move us into further screening evaluation?

So, I just want to try to refocus us back on that, because I think we got distracted by the other comment.

CHAIRMAN RAY: What we may have done --

MR. THRASHER: The erroneous note that was on the drawing is --

CHAIRMAN RAY: But there's one other thing I'll say is, you keep referring to minor exceedances, which always then raises the question, well, when is it no longer minor?

To me, it's an exceedance that causes you to then have to take the next step, period.

MR. THRASHER: Right. That's correct.

CHAIRMAN RAY: We don't have to decide is it minor, is it major. It's an exceedance. It requires some further evaluation and, you know, we can -- I realize there are forms where calling something minor this or that may help communication, but it just raises issues that -- for us that aren't helpful.

So, I mean, it's an exceedance. Next step is analysis.

MR. THRASHER: Correct. Point well made. Thank you.

MR. GENES: So, just to put a final summary on our site-specific seismic analyses or SSI analyses, again the in-structure response spectra for Lee at the six key locations and all the other critical group locations are bounded by either the CSDRS or HRHF with limited exceptions. That might be a more appropriate term.

Again, it's like 98 percent, if I recall, of going through all the various nodes and directions. We were left with about two percent of the -- of the data which we had to then evaluate.

Those exceedances of the CSDRS and HRHF envelope were observed and mostly were above the 15 hertz frequency.

CHAIRMAN RAY: And we're still sticking with the six locations, are we, or --

MR. GENES: This is the six locations and all of the other group nodes and locations. We evaluate all the locations.

CHAIRMAN RAY: Very good.

MR. GENES: The six key DCD is just a -- it's the initial step of comparison.

CHAIRMAN RAY: All right.

MR. GENES: If we had enveloped the six key locations --

CHAIRMAN RAY: Then you'd be done.

MR. GENES: Yes.

CHAIRMAN RAY: All right. Well, that point, at least I didn't capture it, you're looking more broadly than just at six places.

MR. GENES: Yes, sir. And those limited number of exceedances, and that is I'm comfortable with that of the CSDRS and HRHF in-structure response spectra envelope, are addressed as part of the screening evaluation to demonstrate that Lee-specific high-frequency seismic input and the resulting in-structure response spectras are, in fact, non-damaging.

And we'll show, I guess, as part of our screening evaluation of building structures and comparison of forces, our piping analyses comparisons and our testing spectra comparisons. But in general based on these analyses, no specific design changes are required.

MEMBER SCHULTZ: So, just a moment, Blaise. Go back to that slide. There is a step between Bullet 3 and 4.

MR. GENES: Yes.

MEMBER SCHULTZ: To demonstrate that, in fact --

MR. GENES: Correct. Yes.

MEMBER SCHULTZ: -- no specific design changes are required. And that's the analyses --

MR. GENES: And that was really the, yeah, the limited exceedances. It was drawing the conclusion, if you will, prior to that -- us demonstrating that, but that is the case, yes.

MEMBER SCHULTZ: That's helpful.

CHAIRMAN RAY: And that will take us to these TRS tables.

MR. GENES: Yes. The next three comparisons that we do, right now we're going to -- we'll address force comparisons, which is associated with structures and major equipment.

So, our site-specific forces are compared to the AP1000 CSDRS design forces. And, again, you'll notice there are no HRHF. This is strictly the structure is designed to CSDRS.

So, we are comparing the building structures. In other words, the aux building, the shield building, the containment internal structure, all the major equipment and supports, the steam generator laterals and the column supports, the steel containment vessel, the loop nozzles, the pressurizer.

All of these primary equipment are designed to the CSDRS. So, our comparison of the Lee-specific Hard-Rock High-Frequency forces is what we're going to address now.

CHAIRMAN RAY: Yeah. So, essentially again you see he's got a limited set that are only subject to these and it's a force comparison as opposed to a test response spectra.

MR. GENES: Right. It's not a -- this is forces and moments at these particular locations, attachment points of the column supports, again, the nozzles. Maximum forces.

So, move on, John, if you would, please. And here we have a comparison of those forces, of the CSDRS versus the Lee site-specific forces. This happens to be at a location that is the shield building reinforced concrete and steel composite connection region.

That region includes three critical nodes -- or, sorry, four critical nodes around the perimeter of the shield building.

Within that table we have -- we have shear stresses -- I'm sorry, shear forces that are -- correspond to the Lee site-specific forces, as well as the CSDRS forces for those same nodes and same directions.

As you can see, and, really, we really wanted to point this out, but there -- based on forces the -- based on a force comparison there is a significant margin between the CSDRS forces and the Lee site-specific forces.

CHAIRMAN RAY: Okay. Now, let's stop here for a second and gain some understanding again.

MR. GENES: Sure.

CHAIRMAN RAY: This is a good

comparison, obviously, but why is the certified design -- why are the certified design forces so much higher given the use of the certified response spectra that they use?

In other words, what causes the certified design to have such higher forces?

MR. GENES: Well, if you recall the CSDRS curve in the low frequency range --

CHAIRMAN RAY: Right.

MR. GENES: -- it was much higher.

CHAIRMAN RAY: Yes.

MR. GENES: So, it is that low frequency, higher response spectra --

CHAIRMAN RAY: Yeah.

MR. GENES: -- that is generating those forces.

CHAIRMAN RAY: In other words, a hard-rock site doesn't transmit low frequency very well and --

MR. GENES: Correct.

CHAIRMAN RAY: -- so you've got lower forces. That's a simple way to say it.

MR. GENES: Exactly.

CHAIRMAN RAY: Okay.

MR. GENES: Yes. And we have, you know,

obviously we made comparison at multiple points that correspond to the same locations in the DCD Appendix 3I and all of them have very similar margins.

So, it reinforced and confirmed that this high-frequency input for the Lee seismic input and the forces associated with that were, in fact, generating less forces than the CSDRS.

CHAIRMAN RAY: From a structural standpoint you'd rather be on a hard-rock site than --

MR. GENES: Yes.

CHAIRMAN RAY: -- some other site.

MR. GENES: Correct. Absolutely.

MEMBER RICCARDELLA: And these are from a time history --

CHAIRMAN RAY: Please make sure you're speaking --

MR. GENES: Yes, this is from a 3-D --

MEMBER RICCARDELLA: From a time history analysis.

CHAIRMAN RAY: That's right.

MEMBER RICCARDELLA: Yeah.

CHAIRMAN RAY: No, I understand.

MR. GENES: Okay. I think we're ready to move on.

So, just summarizing our force comparison evaluation, you know, obviously maintaining structural integrity of the NI structures and equipment and supports, that's important to the safety of the plant.

As we had alluded to our screening evaluation, that was one screening even though it might not be sensitive to high-frequency or there were not high-frequency exceedances.

So, those portions of the NI were selected and evaluated to assess the effect of high-frequency input.

The forces and moments associated with this -- the Lee site and seismic input for those similar critical structures that were evaluated in Appendix 3I is -- and documented in TR-115 are bounded by the corresponding AP1000 CSDRS design forces.

And again, this -- based on this conclusion, this first aspect of the conclusion -- or first aspect of our evaluation, I'm sorry, the -- again, we allude to and note that there are no specific design changes required based on this evaluation. And then we'll just continue that as we go.

CHAIRMAN RAY: Okay.

MR. GENES: The second aspect of our Hard-Rock High-Frequency evaluation is to look at piping stresses and support locations.

As we had pointed out and demonstrated with limited slides, of course, our in-structure response spectra in most locations, again, not that 98 percent number, is enveloped completely by either the CSDRS or HRHF envelope spectra. So, we're really talking about these limited number of exceedances.

In one particular case to evaluate that horizontal in-structure response spectra for the hot leg and the pressurizer bottom, that had an exceedance at the 11 to 16 hertz range.

So, to evaluate that particular exceedance we chose two piping systems inside containment that were attached to the reactor coolant loop hot leg and at the pressurizer bottom to demonstrate that the CSDRS still governed the design of that piping system.

And those two systems were -- one was the ADS, or the automatic depressurization system, east compartment. That's rodded through the steam generator and the pressurizer compartments. That's a very stiff system, as well as the pressurizer surge line.

A third package was chosen as well within the aux, auxiliary building or the aux building, since it was potentially sensitive to high-frequency response.

And if you recall back to the exceedance above 50 hertz, that was how we were trying to -- was a system that we chose to evaluate these higher frequency exceedances for a system that could potentially be sensitive to high frequency. And that being the spent fuel cooling system.

Based on our evaluation, all three of the piping evaluations indicated that the AP1000 CSDRS and/or the HRHF seismic stresses and support loads are greater than those that resulted from the Lee seismic response. And, again, with margin.

I think it was -- the reason these next three slides -- next three bullets here are to -- were to demonstrate or to identify, point out that the AP1000 piping, and I think Lee had alluded to earlier, we designed all of the Class 3 -- 1, 2 and 3 piping systems are designed for both the CSDRS and the HRHF.

As part of our evaluation for Lee, we

looked at those piping systems in conjunction with and relative to the exceedances that were identified relative to the locations whether they -- what frequency range and made that comparison to those various piping systems.

And then based on the selected piping systems we again were able to demonstrate that the CSDRS did control those stresses and support loads.

And I guess the last bullet in cases when detailed analyses are required as part of the as-built reconciliation, that particular as-built configuration -- and that might be a limited case. Maybe it might only be one or two systems, however many it ultimately ends up being as part of the design -- as-built design reconciliation -- or as-built reconciliation. Sorry.

That as-built configuration will be qualified to the CSDRS, the HRHF, as well as the Lee site-specific requirements. Okay.

MEMBER SKILLMAN: Would you go back a slide? That first bullet, that tells me that the seismically-induced loading -- thank you, Steve.

That tells me the seismically-induced loading is greater than that for which the system is designed.

Is that what you're saying?

MR. GENES: No, not at all. I'm saying that the -- what we're attempting to say is that the stresses associated with the Lee seismic input for that piping system are less than the design stresses associated with the AP1000 CSDRS and HRHF seismic input.

MEMBER SKILLMAN: That's what that bullet is trying to say.

CHAIRMAN RAY: Yeah, and I think, Dick, it's understandable in the sense that the -- what the -- what Lee has as input in the frequency ranges that are most important to these three piping cases is lower frequency. And, therefore, below the design -- the certified response spectra.

And it's less sensitive to the high frequency, which is the only place where you've got either HRHF or Lee site-specific accelerations that are above the certified design response spectra. So, it does make sense to me, anyway.

MEMBER SKILLMAN: Well, I understand the last four bullets. The first one just threw me off. If I think of it that way, I think I'm okay.

CHAIRMAN RAY: Yeah.

MEMBER SKILLMAN: But just at first

blush, I don't know.

CHAIRMAN RAY: CSDRS and HRHF stresses are larger, but I would guess that the HRHF seismic stresses aren't governing in those three piping cases.

MEMBER RICCARDELLA: No, I think the operative word is and/or.

CHAIRMAN RAY: Yeah.

MEMBER RICCARDELLA: Right. It's not and, it's and/or.

CHAIRMAN RAY: Right. So, it does make sense to me.

MEMBER SKILLMAN: Words matter and this plumber is looking at that saying, it looks to me like on a shake I've got some broken pipes. Thank you.

MR. GENES: Okay. The final aspect of our screening evaluation is related to AP1000 safety-related electrical equipment testing.

CHAIRMAN RAY: Yes. So, heads up. Here's where it's important. The building is not going to fall down, but the electrical equipment may not work.

(Laughter.)

MR. GENES: As part of the DCD Appendix

3I and our technical report 115, it presented an evaluation of AP1000 safety-related electrical equipment.

And one of the conclusions, amongst many, was that load frequency seismic tests envelope the high frequency input, as you might expect has been the case, up to two Gs of spectral acceleration. And that was at five percent damping.

So, for accelerations below that level, no additional seismic testing is required when the HRHF seismic inputs, you know, are below that two g. It's just a general aspect of the applicability of the AP1000 testing.

There are high frequency sensitive equipment for the AP1000 which were listed in the DCD Appendix 3I that have been -- and qualified by testing to meet the combined CSDRS and HRHF. Now, we're talking a required response spectra.

And that required response spectra used for the AP1000, those particular AP1000 high frequency sensitive equipment is an envelope with the appropriate margin factors for whether it's CSDRS or HRHF.

As part of our comparison and site-specific evaluation of the selected equipment for

Lee, the Lee required response spectra is then compared to the AP1000 required response spectra and the test response spectra for that select -- those selected high-frequency sensitive equipment.

So, our evaluation looks at -- our screening evaluation looks at, again, those exceedances, locations, magnitude, frequency ranges, what equipment might be particularly set going back to the control room floor, that high frequency exceedance that was noted.

There was equipment within the high frequency -- or within that control room area that we wanted to evaluate to see if it had an impact on the test response spectra.

It wouldn't have an impact on the test response spectra. I should say if it encroached or exceeded the test response spectra. That's what I meant to say. Sorry.

CHAIRMAN RAY: Onward, sir.

MR. GENES: Onward. Thank you.

CHAIRMAN RAY: You've got some tables that would be helpful if you get to them.

MR. GENES: Yeah, that will occur right after this, I believe.

CHAIRMAN RAY: You have the results on

the backup slides --

MR. GENES: Yes.

CHAIRMAN RAY: There's tables there much like the structural tables, but these are TRS.

MEMBER SCHULTZ: Blaise, you slipped in here again the phrase "with the same margin factors." Can you describe what that means?

MR. GENES: Yes, I can. In order to have a one-to-one comparison of the required response spectra for Lee and the CSDRS and the HRHF required response spectra, there are margin factors associated with damping, with fragilities, the various margin factors that go into scaling up the particular in-structure response spectra to generate the required spectra for testing that becomes the input to the shaker table or the as-tested component.

So, that's -- those four or five words are there to make the point of that we made a one-to-one comparison between the Lee site-specific and the AP1000 required response spectra seismic input.

MEMBER SCHULTZ: Thank you. That helps.

MR. GENES: Okay. Great. So, as part of our comparison for comparing the site-specific RRS to the AP1000 CSDRS RRS, we chose four selected high-frequency sensitive equipment.

I can read those, and you can as well. So, I'll just note that those, again, were selected because of, number one, they are sensitive to high frequency. And second, as I had alluded to, they are in an area where we did have a high frequency exceedance of the in-structure response spectra.

So, as we'll see in the next slide, we -- the results for these comparisons for these components do show that the AP1000 required response spectra and the Lee required response spectra are similar particularly in the high-frequency range. That's really what -- and that comparison demonstrates that the equipment that was evaluated was qualified to a higher test response spectra than the Lee required response spectra. And, again, with margin. That would be the difference between the test response spectra and the Lee required response spectra.

So, if we go to the next slide, we can look at a comparison of a particular test response spectra.

This curve, again, is frequency and spectral acceleration. The red solid line and the greenish solid lines are the AP1000 test response spectra for the main control room floor, the remote shutdown room transfer panel. So, that is the tested response spectra.

The blue, the lighter blue solid line is the combined AP1000 CSDRS and HRHF required response spectra. And the solid purple line is the Lee site-specific required response spectra.

CHAIRMAN RAY: Here called the Duke CEUS.

MR. GENES: Yes, the Duke CEUS.

MEMBER BLEY: So, now we're seeing from the red and green that the equipment has survived much larger spectra than any of the things they're required to meet.

MR. GENES: Correct.

MEMBER BLEY: These weren't tested to failure, or were they?

MR. GENES: I believe they are tested to failure.

MEMBER BLEY: Does anybody know? This is where they survived, though.

MR. GENES: Yes.

MEMBER BLEY: They did survive at the red and green levels. Okay.

CHAIRMAN RAY: Well, it's good to see

the margin, but it's not what you think something you didn't need to pay attention to. I mean, you need to make these comparisons --

MR. GENES: Of course.

CHAIRMAN RAY: -- because you're not that far away from TRS.

MEMBER RICCARDELLA: The reason those test response spectras are so choppy.

MR. GENES: I believe they are time history tested. I'm not familiar with the exact procedure, but it's my understanding that is the case because they're given a -- they're given that spectra.

MEMBER RICCARDELLA: Shaker tables.

CHAIRMAN RAY: Shaker tables.

MR. GENES: Yes.

CHAIRMAN RAY: That's right. That's what I'm used to.

MR. GENES: Okay. So, summarizing our evaluation of -- our screening evaluation for electrical equipment for the Lee Hard-Rock High-Frequency site, based on our evaluation supplemental seismic testing of high-frequency sensitive equipment is not needed since the Lee required response spectra was shown to be enveloped by the

AP1000 TRS.

There is high -- we do have a high confidence interval that the TRS for future qualification tests will also envelope the Lee RRS.

CHAIRMAN RAY: Why?

MR. GENES: And that gets back to I think what John had alluded to. If a -- down the road a different piece of equipment is chosen or needed, that the -- that would be tested as well, but at this -- based on the evaluations that we perform, that we do and the margins that we've seen in between the test response spectra and the required response spectra, that has given us a confidence level that the TRS will envelope the Lee RRS.

MEMBER SKILLMAN: It's more than high confidence, isn't it? I mean, you're going to require it.

MEMBER BLEY: I think that's the key. I look at that last figure you had up and at some frequencies you're well above the required response spectra, but at others you're not so far above. But if these weren't test to failures, you know, you probably got more room.

MR. GENES: Yes.

MEMBER BLEY: So, maybe that's where you get your confidence.

MR. GENES: Well, that's really the -- maybe if I just simply stated that it was based on those that were qualified by testing, we have a --

MEMBER BLEY: You made it on everything you tested. So, you kind of think you'll probably make it on everything else.

MR. GENES: That would have been a more concise, simpler answer, yes.

MEMBER BLEY: Okay.

MR. GENES: And, again, as Peter had mentioned for future testing in the event that there are exceedances of the TRS, those locations will be evaluated.

But if it's determined that retesting is needed, then additional qualification testing will be performed and Duke Energy has committed to ensure that all future TRS are higher than the Lee site-specific RRS.

Shifting gears a little towards a -- this was an assessment of seismic margin. And this is a seismic margin in the sense of Chapter 19.

We did look at seismic margin. In general, seismic margin is the reserved capacity of those structures, systems and components that can bring the plant to a safe shutdown following an SSE or an SSE greater, actually, than -- an earthquake greater than the SSE.

That seismic capacity is what's defined as the High Confidence of Low Probability of Failure. That value reflects a 95 percent confidence of not exceeding a five percent probability of failure.

And the HCLPF values of the structures, system and components shall be beyond 1.67 times the ground motion of the AP1000 CSDRS. And, again, that's in accordance with ISG-20.

And we're looking at an acceleration that's 1.67 times the 0.3 g AP1000 design spectra of a level of 0.5 g.

So, as far as our evaluation of this assessment of Lee seismic margin based on the results of all the various analyses that we have done for Lee, the site-specific analyses, including generating in-structure response spectra, the forces and moments comparison for the structures, stresses associated with piping and our testing comparison, all of that being evaluated, the Lee CEUS seismic input based on those evaluations are, in fact, non-damaging and that the AP1000 CSDRS seismic response bounds the Lee seismic response. And the AP1000 CSDRS controls the design.

CHAIRMAN RAY: Well, I'm not sure why you'd want to say that, to be honest with you. It's the combination of both the controls and designs. Some things I think few things, two percent I think maybe are controlled by the HRHF.

MR. GENES: Well, two percent were -- exceeded the HRHF.

CHAIRMAN RAY: Yeah.

MR. GENES: But based on the screening evaluations and further evaluations, it still was showed that the CSDRS forces, the CSDRS stresses in piping, the combined CSDRS and HRHF as far as testing, yes.

CHAIRMAN RAY: Could you go to line -- when you're done with this page, I'd like you to go to Page 117.

MR. GENES: Okay.

CHAIRMAN RAY: Slide 117. I'm sorry. You can come back. Okay. 117 on mine isn't 117 on yours. I guess I'm in the backup. I just thought it continued on into the backup.

It's just more of the same data. This

happens to be the PMS cabinet, horizontal direction.

I'm sorry. I thought it just ran on into the backup. Anyway, here's the kind of thing that I guess for me, anyway, is what I'm looking for and is more satisfying than anything else is to see specific -- this is a PMS cabinet test. It's not unlike what you showed, but there's several of them here. In this case, you've got the horizontal and vertical direction.

The vertical direction, the next slide, shows this big resonance in the equipment, at least that's the way I interpret it, in the vertical direction so that it -- you're still well bounded by what the plant is going to expose the equipment to. So, that's not a problem.

In other words, the input frequencies at that resonance aren't getting through. So, that's fine. But the data that you had here in the backup adds to what you've been saying and provides, I think, more examples of --

MR. GENES: Well, we appreciate you looking.

CHAIRMAN RAY: What?

MR. GENES: We appreciate you looking.

CHAIRMAN RAY: Well, we do look and ask

questions when -- but, anyway, I've looked through this and it, I think, is consistent with everything that we've said back and forth here.

So, you can go back to the other slide now and continue what you were going to finish up on, I guess.

MR. GENES: So, just to reorient, all of our analyses do suggest that the AP1000 CSDRS controls the design.

The seismic margin for the AP1000 and the HCLPF values associated with it are based on the AP1000 CSDRS.

So, since the CSDRS controls the design, the HCLPF values associated with Lee would be higher than the HCLPF values of the CSDRS.

The next thing we wanted to do was present a summary of our Seismic Category II adjacent structures analyses. So, now we're talking about a site-specific evaluation for the Category II turbine building first bay and the annex building.

And the backfill -- we talked about cross-sections and backfill. And the backfill configuration and the backfill properties beneath those two structures are uniform and consistent with those that were evaluated in the AP1000 DCD.

MEMBER SCHULTZ: Blaise, can we just go back one slide? It just bothers me that in summary we're providing some fairly sweeping statements about HCLPF values and so forth for Lee station versus the design and that's all conditioned upon Duke satisfying its commitments that are in the previous slides in terms of --

MR. GENES: Yes, agree.

MEMBER SCHULTZ: -- moving forward and assuring that what is being installed and tested and everything that goes along with seismic --

MR. GENES: And we agree, yes.

MEMBER SCHULTZ: -- design, installation assurance. Then, you can make these statements, but --

MR. GENES: Well, I guess the first bullet is what really --

MEMBER SCHULTZ: Yes, exactly.

MR. GENES: That's the emphasis of our assessment of seismic margin.

MEMBER SCHULTZ: But then you drop down and you make a statement that it controls the design. I got that.

I think that's fair to say, but one gets concerned that, again, without the entire program being fully understood and everything we've discussed this afternoon in terms of analysis being fully understood, that the entire program needs to be monitored, obeyed --

MR. GENES: Well, I think that there will be a PRA, seismic PRA.

MEMBER SCHULTZ: I don't want to go that far. I just --

MR. GENES: But I think that's where --

MEMBER SCHULTZ: I just want to fully understand that these general statements are not free and clear and stand on their own. They depend upon the program.

MR. GENES: And we agree.

MEMBER SCHULTZ: Okay. Thank you.

MR. GENES: Okay. Continuing again with our Category 2 adjacent structures, the bearing capacity of the adjacent structures backfill material was shown to be greater than the calculated bearing demand of each of those structures, the site-specific demand.

The maximum horizontal seismic relative displacements between the nuclear island and the Lee Seismic Category II adjacent structures, in other words, the turbine bay first building and the annex building, those relative displacements at the foundation level and at the top of structure are less than the two-inch and four-inch gap respectively that is provided between those structures.

And the in-structure response spectra in the horizontal direction for the turbine building first bay and the annex building are very similar to the AP1000 Category 2 design envelope foundation spectra.

And that horizontal spectra controlled the interaction between the adjacent structures and the nuclear island as evident by the relative displacements.

However, there was an exceedance of vertical spectra for the Category 2 turbine building first bay and annex building. They exceeded the AP1000 corresponding Category 2 DCD envelopes.

The vertical spectra typically contributes less to the potential interaction between the Seismic Category II adjacent structures and the nuclear island, again, as evident by the low relative displacements.

That being said, the vertical spectra and our evaluations set the performance criteria that we have identified and Duke has committed to for performing confirmatory analyses to, in fact, demonstrate that the Category 2 design of the AP1000 seismic -- I'm sorry, the AP1000 turbine building first bay and annex building, that those confirmatory analyses do, in fact, are enveloped by the actual design envelopes. And that would be done before the start of Category 2 construction.

So, just to wrap up a lot of information on our seismic analysis, again, getting back to -- after Lee was -- plant was relocated, now the Lee nuclear station is on -- is considered a uniform rock site with a configuration that is as described in the AP1000 DCD.

The site-specific inputs based on the new CEUS source characterizations resulted in a site characterization GMRS and the Unit 1 FIRS that are higher than the DCD CSDRS spectrum that Mr. Thrasher will address in the departure cited there.

And that site-specific spectra seismic input is also higher than the DCD Hard-Rock High-Frequency spectra.

Consequently, site-specific analyses were required for the nuclear island and for the adjacent structures to demonstrate design adequacy.

Those analyses were performed and for the nuclear island the site-specific in-structure response spectra showed exceedances over the corresponding AP1000 CSDRS and HRHF envelope spectra. However, they were limited in numbers and in a very narrow band of frequency range.

Those exceedances were reviewed and a representative sample of structures, equipment and piping evaluations were performed and demonstrated that the AP1000 CSDRS controls the design forces, moments and stresses.

There was a review of equipment qualification and the practices showed those exceedances do not affect -- did not affect equipment qualifications since in all of the completed tests the test response spectra is higher than the Lee site-specific required response spectra.

And finally, again, Duke has committed to that all future TRS be higher than the site-specific RRS.

CHAIRMAN RAY: Good.

MR. GENES: Finally, just one last conclusion relative to the Category 2 structures. Again, the horizontal spectra was similar to the

AP1000 envelope spectra, but we had exceedances in the vertical direction.

However, from an interaction standpoint, the relative displacements between the nuclear island and the adjacent structures are much less than the space provided. Therefore, there is no interaction between the structures.

Based on the -- based on our evaluations we have a high confidence that our -- that the lateral force system within the adjacent structures will be adequate. However, the vertical spectrum exceedances could affect the details associated with the floors and roofs of those adjacent structures.

And based on that and the development of a performance criteria, confirmatory analysis and updates, if any, will be completed before the start of Category 2 construction.

CHAIRMAN RAY: All right. Now, you've got one additional topic here, lateral earth pressures. Do you want to include that as part of this discussion, or save it for later?

MR. THRASHER: We can go ahead and do it, if you want, and get it over with now.

CHAIRMAN RAY: Well, probably we do, because what we're going to do is we're going to have the staff come up tomorrow morning first thing and go through the same scope that you've just now gone through since our break.

So, why don't we do the lateral earth pressures one, and then I'll have some comments and others will. We'll open the public line to see if there's anyone who wishes to give us comments on what we did today and we'll wrap it up.

But if you'd like to do this lateral earth pressures, I think it's straightforward. You can do that.

MR. THRASHER: Okay. I'll go ahead and cover that. Again, I am John Thrasher with Duke Energy.

The lateral earth pressure slide here talks about a departure 3.8-1. Staff introduced this a little bit this morning and said they'd bring additional details about the departure back in their Chapter 3 update, but basically we had different load cases that were evaluated.

And with the design groundwater level at the Lee site being six feet lower than the DCD level, we ended up with a result then of six feet of non-buoyant soil, which is heavier than the soil that was considered in the DCD. So, theoretical full passive pressure is higher for this heavier soil.

We had one load combination which would be the upper most two lines on this graph, load combination 7.

The full passive pressure is higher than the AP1000. The passive pressures are not relied on for stability of the nuclear island.

We've already talked about we had site-specific seismic displacements that were very small. And so, we really don't mobilize theoretical full passive earth pressure. So, we never really see this case realized.

So, actual site-specific lateral earth pressures are still less than the AP1000 design, but we wanted to point this out theoretically. This one load case could -- would be considered an exceedance. So, we've presented this as a departure even though we'll never really due to not having displacements to mobilize theoretical full passive earth pressures, we'll never really experience this exceedance.

That's all I had to present on that topic.

CHAIRMAN RAY: Does anybody have any

questions about the lateral earth pressures?

(No audible response.)

CHAIRMAN RAY: Okay.

MR. THRASHER: Thank you.

CHAIRMAN RAY: Go back to 95, would you? Now, there's something here that -- 95 on my page looks like this.

MR. THRASHER: There you go.

CHAIRMAN RAY: 95, okay. I just wanted to draw attention to the phrase at the top "corresponding AP1000 CSDRS/HRHF envelope spectra." That's the way I think about it.

I just -- the way that we talk about the exceedances so often gets into these things like we were struggling with the three hertz and so on as a detail which is fine for us here, but I wanted to make the comment that we're going to have to take this, the full committee, as just one of many things that we get through in a couple of hours at the most.

And in doing that, we, you, the staff, everybody is going to have to figure out some way to talk about the essential points in a way that is as succinct, bottom line and raises as few unnecessary sidetrack questions as possible.

And at least as I read this as simply an example, we are looking at a situation in which for practical purposes we're enveloping the certified design spectra as a comparison basis. And where there are exceedances, we're dealing with them.

There are few in number, but they have to be dealt with no matter what significance one may assign to them.

That's been done. The results are satisfactory, but, I mean, you got to get across that kind of a message fairly succinctly. Not simplistically, but with -- explained with care and accuracy, but without, like I say, creating a lot of -- because there are a number of others, obviously, on the Committee that have to understand sufficiently what we're talking about that they're comfortable with a conclusion, but without taking two days to do it or, in this case of seismic, taking what would amount to a day by the time we get done with the staff tomorrow.

So, anyway, I just wanted to pass that along to you. I mean, I think this has been at the right level and has conveyed to us a lot of understanding, but somehow we got -- all of us have to find a way to boil it down into something that we can communicate to the full committee when that day comes, because there will be a lot of other things on the table at the same time and we'll need to get across on that quickly as we can.

With that, Peter, would you open the line? Let's see if there's any public comment. Then I'll go around and get any comments from members and Bill, if he's still with us.

DR. HINZE: I'm still with you.

CHAIRMAN RAY: All right. And then we'll recess for the day and resume tomorrow with the staff's presentation of their review of the same material we've been discussing this afternoon.

MR. KITCHEN: Sure. This is Bob Kitchen. There are a couple follow-up items I wonder if I could confirm. I'm not sure when the right time is.

CHAIRMAN RAY: Okay. Why don't you do that now or at least tell me what the topics are.

MR. KITCHEN: We simply discuss during Chapter 6 the wind direction speed prevalent at the site.

CHAIRMAN RAY: Okay.

MR. KITCHEN: I talked to Dr. Banerjee and the site area contours, we're going to try to provide that.

I'm not sure we'll be able to provide that tomorrow, but we'll maybe provide that to the ACRS --

CHAIRMAN RAY: All right.

MR. KITCHEN: -- as a subsequent -- also, there's a question I believe Dr. Hinze asked about the geologic survey for Makeup Pond Charlie.

And I just want to confirm if that's really an open question, a couple of points that is, as you noted, the non-safety structure there is no risk of flood from the dam failure.

And this is a preconstruction situation. So, we would be doing detailed geologic surveys at the time of construction.

So, I'm just wondering is that something that we need to follow up on?

CHAIRMAN RAY: Bill, can you comment and respond to Bob?

DR. HINZE: Well, I think it would be helpful to state that there has been a geological mapping of the area, which I assume that has been done from the information that Gerry Stirewalt mentioned. And I think that would be sufficient.

MR. KITCHEN: Okay. All right. That's

all I had.

CHAIRMAN RAY: Yeah, just get it on the record that that's the case.

All right. Is the phone line open, Peter?

MR. WEN: Yes, it is.

CHAIRMAN RAY: All right. Is there any member of the public who has been with us today who has any comment that they'd like to give the Committee or Subcommittee at this time?

(No audible response.)

CHAIRMAN RAY: Hearing none, we can close the line again and we'll start with any comments, Bill, that you wish to make at this time. And then I'll ask the members of the Subcommittee the same question.

Anything you want to say, Bill?

MR. HINZE: Well, just briefly as I said in my report, I think the applicant and the staff have done a good job. And there are a few minor tweaks that I would suggest. And I have provided that information to them. That's it.

CHAIRMAN RAY: All right. Joy.

MEMBER REMPE: I appreciated everybody's participation and presentations to try to explain a lot of things that aren't really my area of expertise.

It's interesting to see another example of a design certification that's a bit different. It does sound like that there is an assumed success path here and I hope your assumptions are correct as you finish all your analyses and evaluations.

CHAIRMAN RAY: Pete.

MEMBER RICCARDELLA: Yeah. If we could turn to Slide 61 just for a minute, I want to highlight something.

(Pause.)

MEMBER RICCARDELLA: Yeah, 61. The last two words on this slide refer to design adequacy. And I like that choice of words, you know.

Prior to the meeting we were seeing words like seismic margin and non-damaging and I think "design adequacy" is a much better choice of words, you know.

For an existing plant, we go back and evaluate the CS. The CS I can see, you know, saying things like, you know, design adequacy or seismic margin analysis, things of that sort, but this is a new plant and I think we ought to stick with that concept of demonstrating design. This becomes the design basis for this plant.

CHAIRMAN RAY: Yes. And as I said at the outset, how it's described is something I'm still groping with, because I think I need to somehow say that in the letter that it ultimately emerges as how do we define the design basis here.

And I'm going to have to work on that some more. We may discuss that with the staff in the morning. I'm still not sure.

Dennis.

MEMBER BLEY: Yeah, just a few things. I thought what we got on Chapter 2 was really good. I followed that completely.

We've got a little mixing of words maybe among ourselves and others. There is a thing called seismic margin study, which is like a shortcut PRA kind of thing which they also have to do and peek at that later.

The things we went through on 3.7 this afternoon, I think I'm on board with what you've shown us. I need to go back and study that Appendix 3I of that and maybe your document 115 to make sure I -- it all fits, but I think we're getting there and I appreciate this afternoon.

CHAIRMAN RAY: Steve.

MEMBER SCHULTZ: My comments are similar to what's been said. I really do appreciate the thorough discussion on 3.7. Stepping through this in a very structured way has been very helpful to firm up my understanding of what has been done and what its meaning is.

I would recommend that we do focus on the way in which this is communicated in terms of choice of words. It's very important.

And also assure that we summarize, which has been done on the last several slides, Duke's commitments to what is going to be done to assure that the conditions for construction and installation and future understanding of the seismic design is maintained.

CHAIRMAN RAY: Dick.

MEMBER SKILLMAN: I appreciate Dr. Hinze's comment of the thoroughness of this presentation and of the preparation of the material. It's very thorough and comprehensive.

I appreciated Bob Kitchen's comment regarding the items that have been forwarded to the Levy work that will come in the future.

I thought the presentations by the staff and by the Duke team were excellent. Thank you.

CHAIRMAN RAY: Sanjoy.

MEMBER BANERJEE: So, some of the things I'm interested in will probably come up tomorrow, but I found the presentation quite illuminating because I didn't know very much about the subject.

And so, thank you for explaining how to go about dealing with this exceedance and why the low frequency exceedance is not that important.

That's, I think, a very important point which you got across which was confusing at least to me. I don't know about the rest of the Committee.

And in view of that, the sort of analysis and things you've been doing seem to be, you know, addressing the issues.

Again, this is not my field. It's much closer to Pete's. So, that's really all I can say. Let's see how it pans out at the end.

CHAIRMAN RAY: Thank you. Is there anything more that Duke would like to say at this point? We're going to have another whole day tomorrow.

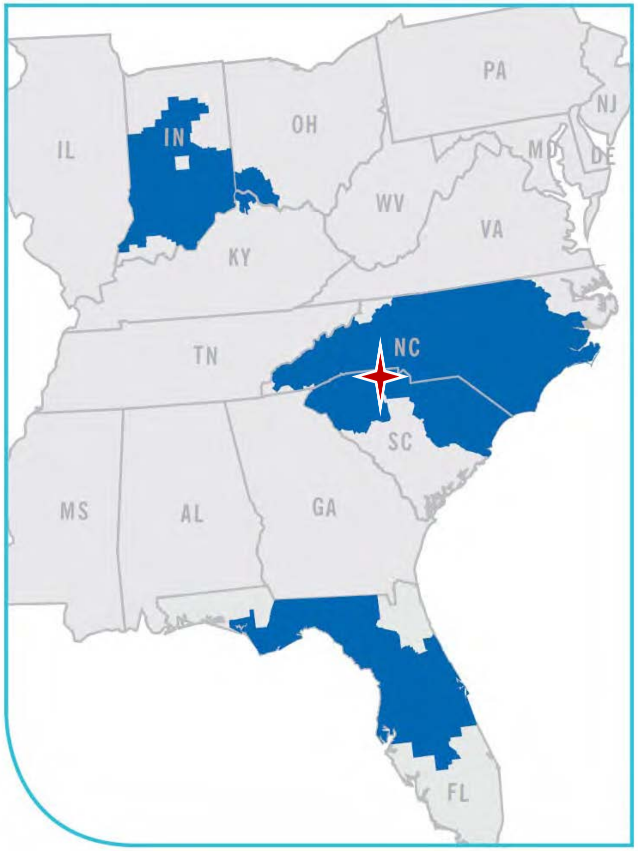
MR. THRASHER: No further comments at this time. We appreciate your questions and attention today.

CHAIRMAN RAY: Okay. Then we'll recess

until 8:30 tomorrow morning.

(Whereupon, the above-entitled matter went off the record at 5:14 o'clock p.m.)

Lee Nuclear Station Introduction/Overview

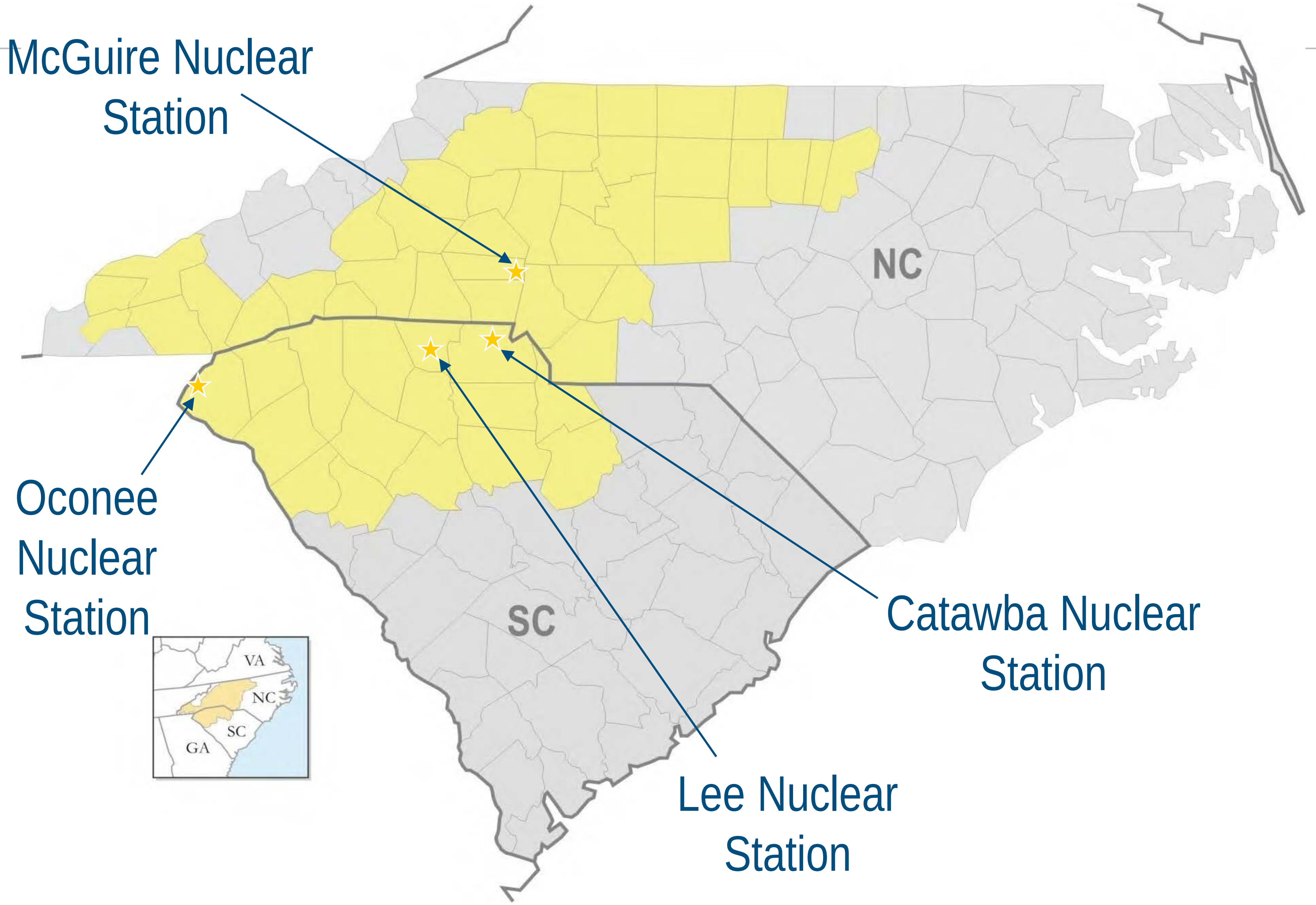


Bob Kitchen

Director Licensing

Nuclear Development

Duke Energy Carolinas Nuclear Fleet



Lee Site Background

- Site previously developed for Cherokee Nuclear Station
- NRC issued EIS (NUREG-75/089) and Construction Permit [1975]
- USACE issued 404 Permit [76-4A-115] in 1977
- NPDES Permit issued in 1977 and 1986
- Site partially developed including:
  - Nuclear service water pond
  - Cooling water sedimentation basin
  - Excavation of power block
  - Partial construction of Unit 1 containment

Site Cleanup

COLA Investigation

Former Cherokee Unit 2
Excavation Cleaning

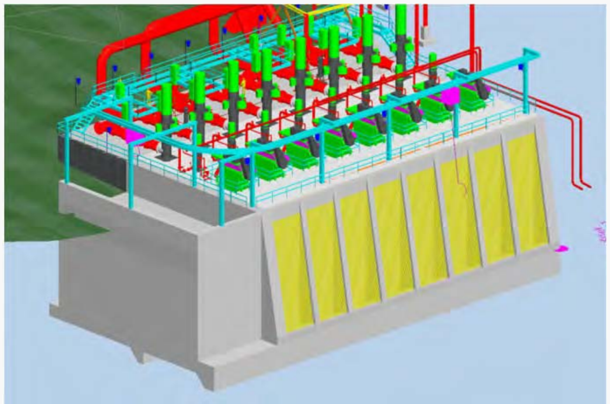
Existing Lee Unit 2
Excavation Cleanup

Recycling of Material

Engineering and Construction Planning

Site Specific SSCs Design *__70% Complete__*

- Circulating Water System (CWS)
- Storm Drain System (DRS)
- Potable Water System (PWS)
- Raw Water System (RWS)
- Liquid Radwaste System (WLS)
- Waste Water System (WWS)
- Offsite Retail Power System (ZRS)



Infrastructure Design *__(90% Complete)__*

- Commercial Buildings
- Water and Sewer
- Rail and Road Improvements
- Make-Up Pond C Dam

Site Construction Plan *__(70% Complete)__*

- Site Construction Schedule
- Construction Staffing & Training
- Temporary Buildings
- Assembly Pads, Areas & Modules
- Laydown & Staging Areas
- Excavation/Backfill
- Heavy Lift Crane
- Batch Plant Concrete Qualification

(Incorporates lessons learned from Vogtle and Summer Projects)

Lee Site Layout

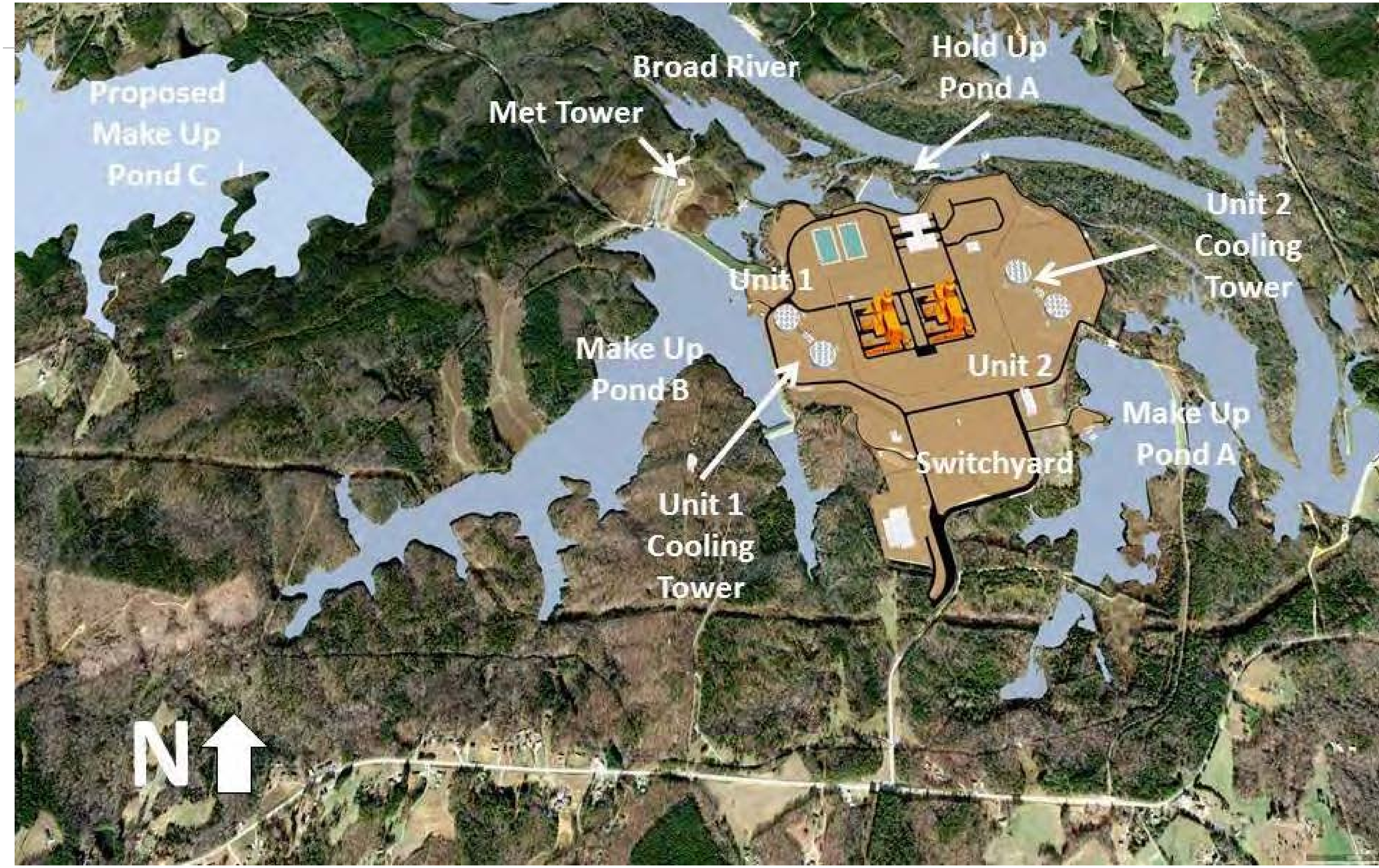
Lee COLA Changes Since R-COL

- Fukushima and Central Eastern US Seismic Source Characterization Model
- Emergency Plan Rule Implementation
- Electrical Bulletin 2012-01 Response
- AP1000 Generic Design Changes (Reviewed on Levy Docket)
  - Condensate Return & Passive RHR Cooling
  - Main Control Room Operator Dose
  - Main Control Room Heat Load
  - Hydrogen Vent In Containment
  - Plant Monitoring System (PMS) Flux Doubling to comply with IEEE 603

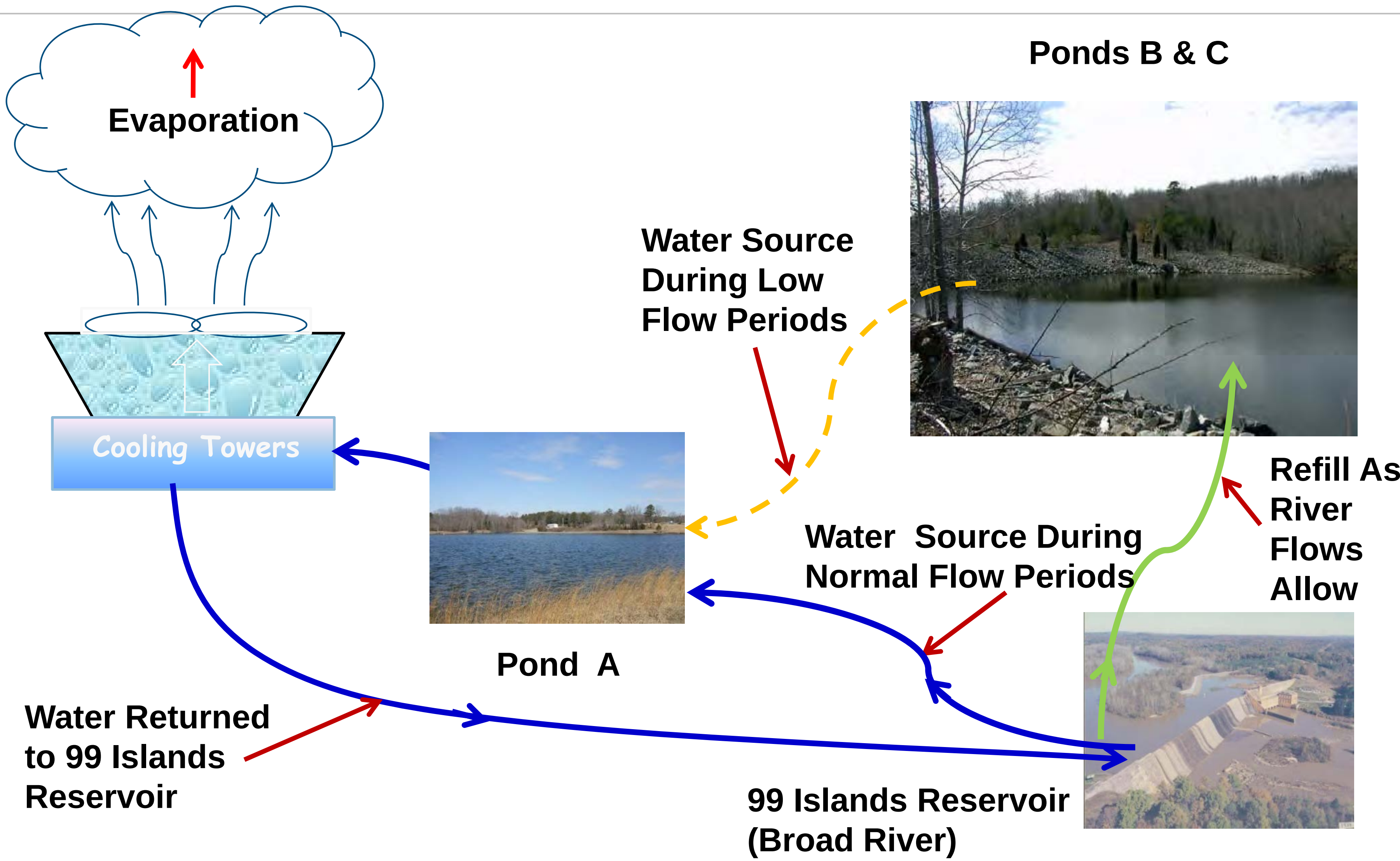
Lee Project – Challenges

- Water management
- Plant relocation
- Seismic
  - Updated CEUS-SSC model
  - Plant foundation over Cherokee foundation
  - High frequency response exceeds DCD

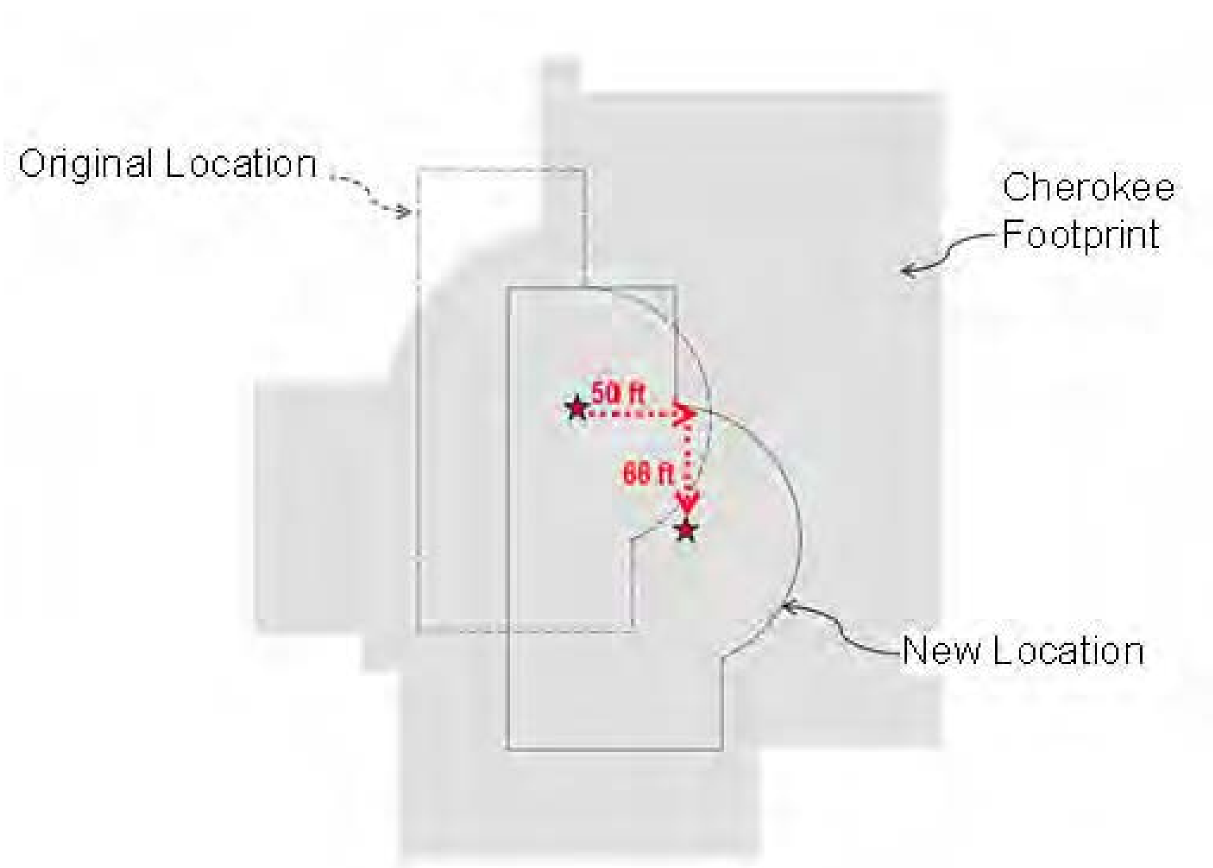
Water Management



Water Management



Plant Relocation



- Relocation was needed
- Relocated Unit 1 is entirely underlain by former Cherokee foundation over previously-mapped continuous rock
- Site Specific Configuration aligns with DCD

Plant Relocation

- Licensing impact evaluation included:
  - Seismology and Geology
  - Groundwater and Flooding
  - Meteorological
  - Routine Dose
  - Security
  - Environmental
- No significant COLA impact due to location change
- Change results in uniform site conditions
  - Resolves geotechnical concerns with NW corner

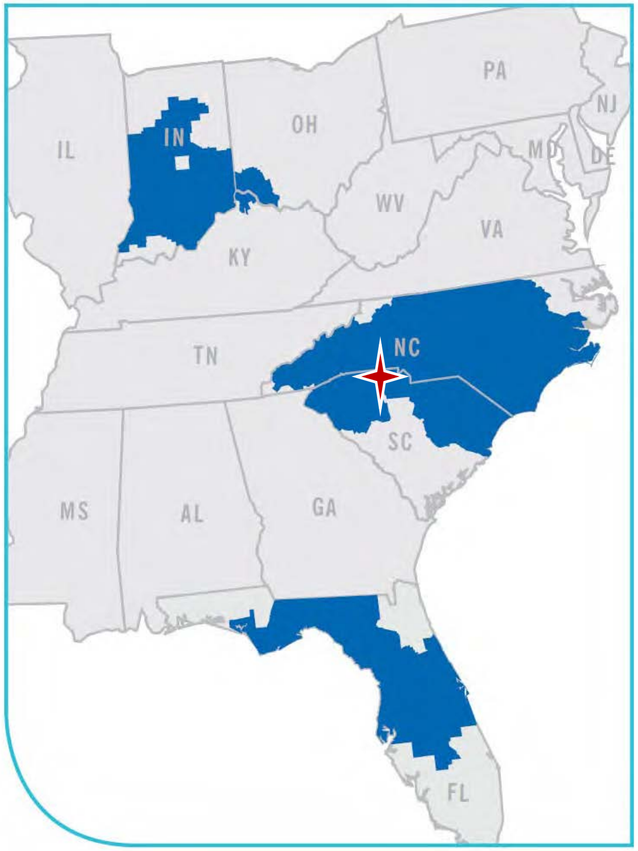
Chapter 1 – Introduction and Description

- DCD Incorporated by Reference
- Standard material incorporated (including supplements, departures and exemptions)
- Additional site-specific material contained in Sections:
  - 1.2 – Site Layout
  - 1.4 – Identification of Agents and Contractors
  - 1.8 – Interfaces for Standard Design

Section 1.4
Identification of Agents and Contractors

- COLA Development
  - Enercon Services, Inc.
- AP1000 Standard Plant
  - Westinghouse Electric Company
- Technical Services in support of the COLA
  - Chicago Bridge and Iron (Stone & Webster)
  - HDR/DTA
  - Atkins
  - Burns & Roe Enterprises, Inc.
  - Fugro Consultants Inc.
  - Lettis Consultants International, Inc.
  - AMEC/Foster Wheeler (MACTEC)

LEE NUCLEAR STATION
FSAR CHAPTER 2
Sections 2.0 – 2.4

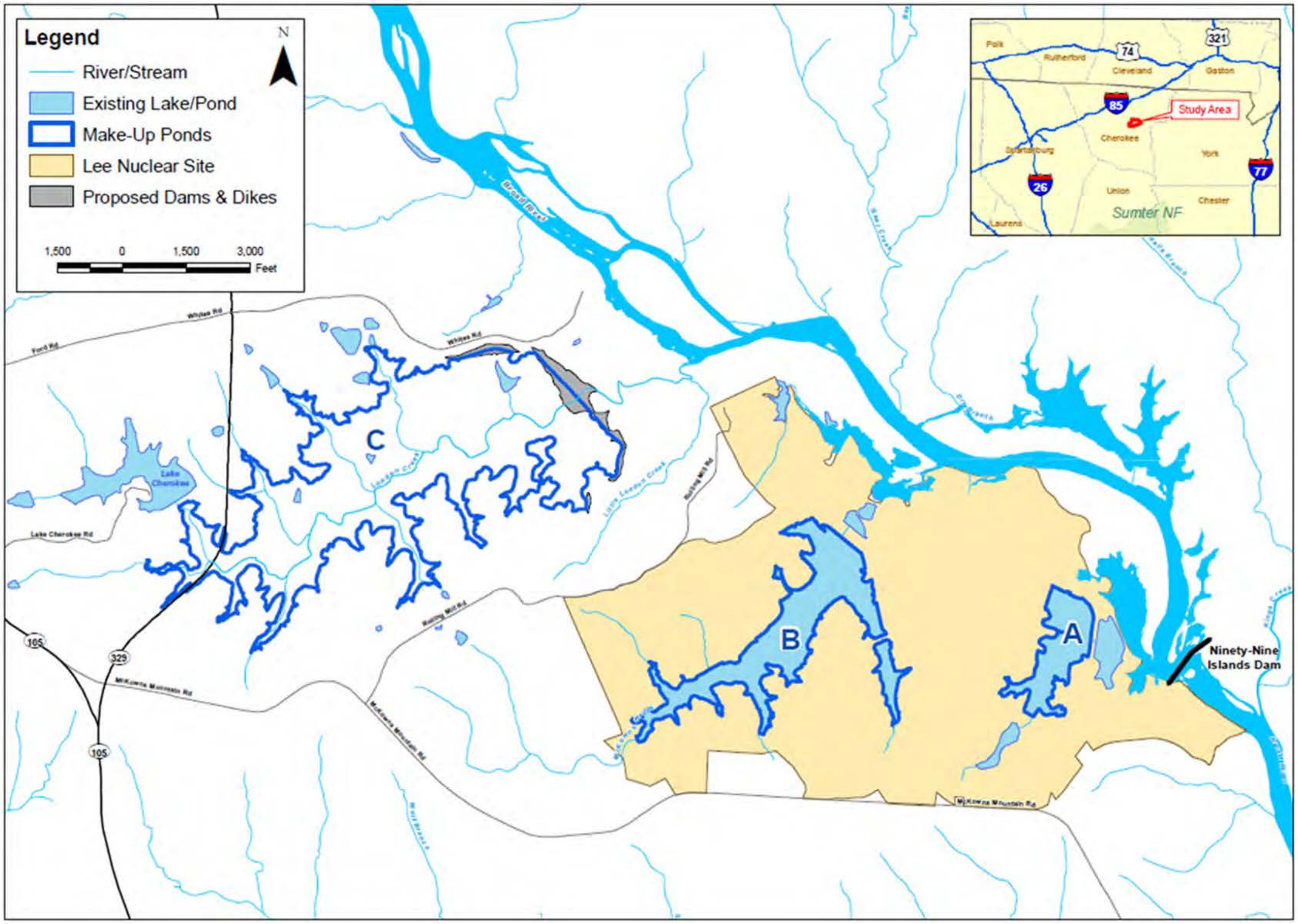


John Thrasher
Director Engineering
Nuclear Development

Section 2.0 Site Characteristics

- Table 2.0-201 compares site-specific characteristics to the AP1000 required site parameters found in DCD Table 2-1
- All site-specific characteristics are bounded by AP1000 site parameters for Lee Nuclear Station except for seismic hazards
- Seismic inputs are identified as a DCD Departure
- Site-specific seismic analyses have been performed to demonstrate acceptability of the standard design for the site-specific demands

Section 2.1 Geography and Demography



Section 2.2 Nearby Industrial Hazards

DUKE ENERGY®

- Evaluated nearby industrial hazards in accordance with Standard Review Plan
- Sources of potential hazards within five miles:
  - Road and rail transportation of explosive material
  - Failure of nearby natural gas pipelines
  - Toxic material release from closest point of passage of Route 329 (~3.2 miles)
- Analyses show that effects of explosions and flammable vapor clouds do not pose a threat to any safety-related SSCs
- Analyses show that toxic vapor clouds do not exceed toxicity limits in the control room, and do not pose a threat to control room operators

Section 2.3 Meteorology

- All site-specific meteorological characteristics are bounded by the AP1000 standard plant design parameters
  - Air Temperature
  - Wind Speed
  - Precipitation
  - Atmospheric Dispersion Factors (Chi/Q)

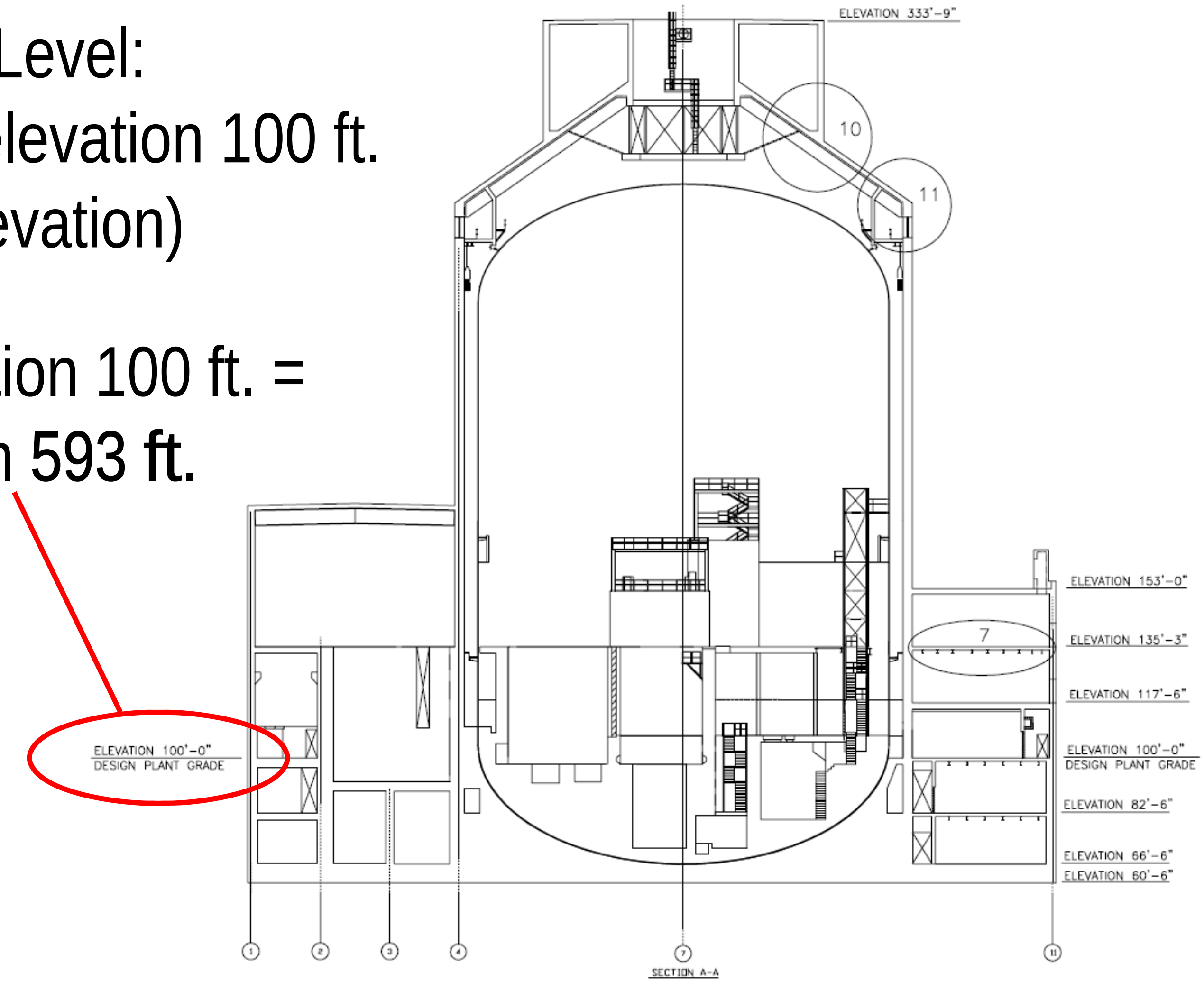
Section 2.4 Hydrologic Engineering

- AP1000 DCD Site Parameter for Flood Elevation
- Hydrologic Description
- Site Flooding Evaluations
- Maximum Flood Level
- Flooding Evaluation Results
- Groundwater
- Accidental Releases of Radioactive Liquid Effluents

AP1000 DCD Site Parameter

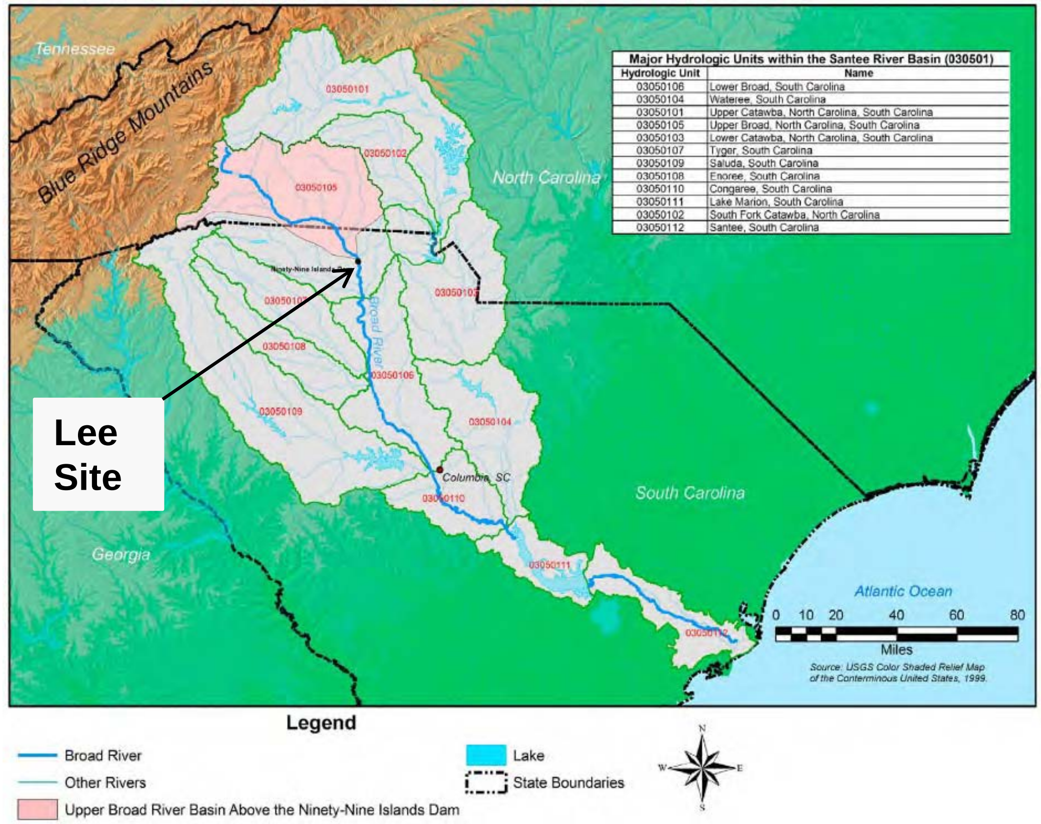
Maximum Flood Level:
Less than plant elevation 100 ft.
(design grade elevation)

DCD plant elevation 100 ft. =
Lee site elevation **593 ft.**



Hydrologic Description

- Upper Broad River Basin
- Applicable watershed is 1550 sq. mi.
- Watershed includes portions of North Carolina and South Carolina
- Elevations range from 1200 ft. to 511 ft. upstream of Ninety-Nine Islands Dam



Major Hydrologic Units within the Santee River Basin (030501)	
Hydrologic Unit	Name
03050106	Lower Broad, South Carolina
03050104	Wateree, South Carolina
03050101	Upper Catawba, North Carolina, South Carolina
03050105	Upper Broad, North Carolina, South Carolina
03050103	Lower Catawba, North Carolina, South Carolina
03050107	Tyger, South Carolina
03050109	Saluda, South Carolina
03050108	Enoree, South Carolina
03050110	Congaree, South Carolina
03050111	Lake Marion, South Carolina
03050102	South Fork Catawba, North Carolina
03050112	Santee, South Carolina

Site Flooding Evaluations

- Lee designed as a dry site (finished floor elevation = 593 ft.)
- **Maximum flood level = 592.56 ft.** (Local Intense Precipitation)
- Adjacent surface water bodies evaluated; lower water surface elevations
  - Broad River
  - Make-Up Pond A (MUPA)
  - Make-Up Pond B (MUPB)
- Flooding phenomena evaluated
  - Probable Maximum Precipitation (PMP)
  - Probable Maximum Flood (PMF)
  - Dam Failure
  - Coincident Wind Wave Activity
  - Other (Surge, Seiche, Tsunami, Ice Effects, Channel Diversions)
- Flooding evaluations conform to Regulatory Guide 1.59 and NUREG/CR-7046

Flooding Evaluation Results

- WLS designed as a dry site (finished floor elevation = 593 ft.)
- **Maximum flood level = 592.56 ft.** (Local Intense Precipitation)
- Adjacent surface water bodies, resulted in lower water surface elevations

Adjacent Water Body	PMF Elevation (ft.)	Dam Failure Elevation (ft.)	Wind Wave Elevation (ft.)	Margin (ft.)
Broad River	551.49	576.50	585.36	7.64
MUPA	558.15	576.50*	585.36	7.64
MUPB	584.40	585.06	589.10	3.90

*MUPA inundated by Broad River PMF/dam failure result

- Other phenomena bounded by PMF/dam failure results
- No flood protection required

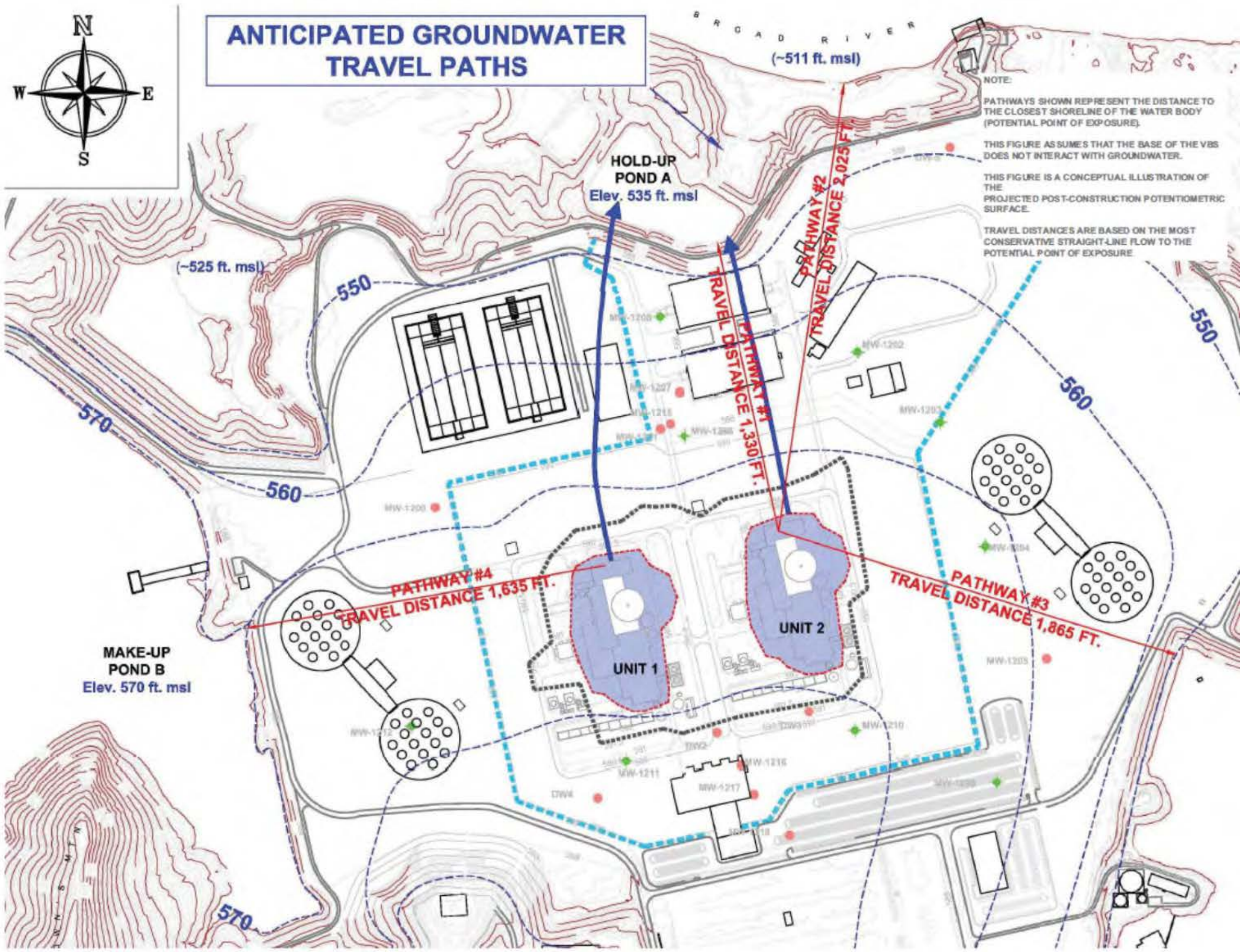
Section 2.4.12 Groundwater

- DCD requires the maximum groundwater elevation to be at least 2 feet below plant grade elevation
- Plant grade elevation is 593 ft. msl
- MODFLOW used to evaluate maximum post-construction groundwater level
- MODFLOW analysis considers:
  - Maximum historic regional precipitation event
  - Post-construction site grading and ground cover
- Maximum post-construction groundwater level estimated to be approximately 584 ft. msl

Section 2.4.13 Accidental Releases of Radioactive Liquid Effluents

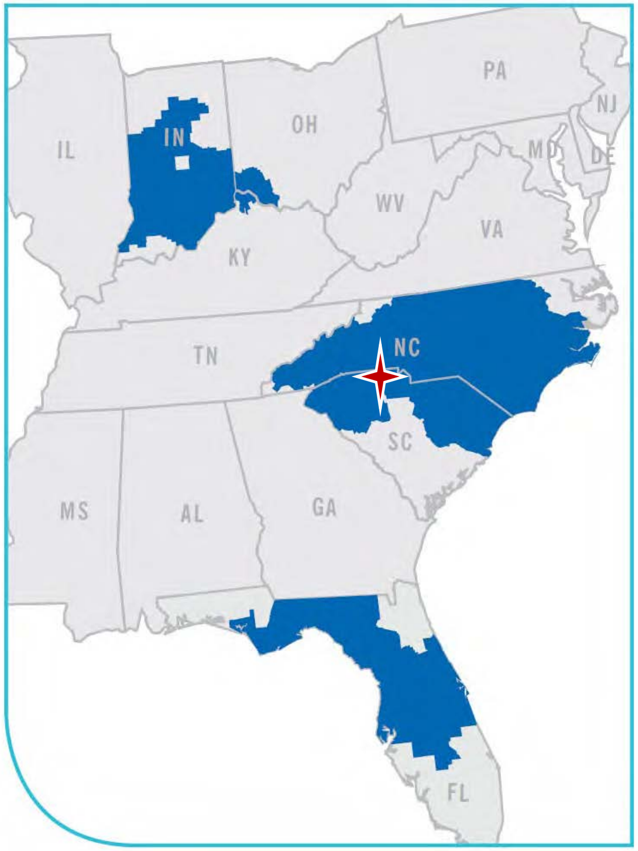
- RESRAD-OFFSITE Version 2.0 used to evaluate transport pathways to the nearest potable water supply
- Failure of Unit 2 effluent hold-up tank to Hold-Up Pond A determined to be limiting pathway
- Evaluation methodology consistent with the guidance in Branch Technical Position 11-6
- Radiological consequences do not exceed 10 CFR 20 Appendix B, Table 2, Column 2 limits at Hold-Up Pond A
- Nearest potable water supply from Broad River is located approximately 21 miles downstream

Section 2.4.13 Accidental Releases of Radioactive Liquid Effluents



FSAR Figure 2.4.12-208

LEE NUCLEAR STATION
FSAR Section 2.5
Geology, Seismology and Geotechnical Engineering



John Thrasher
Director Engineering
Nuclear Development

Foundation Conditions

- Uniform, hard-rock site with conditions just as described in the AP1000 DCD
- No tectonic deformation experienced since early Mesozoic (252 to 66 Ma) and possibly not since 219 Ma to 300 Ma
- Site characteristic GMRS (Unit 2 FIRS) and Unit 1 FIRS exceed the DCD CSDRS spectra (WLS DEP 2.0-1)
  - Site spectra are also higher than DCD HRHF spectra
- Site-specific analyses were performed for the SC-I nuclear island and for the SC-II adjacent buildings to demonstrate design adequacy

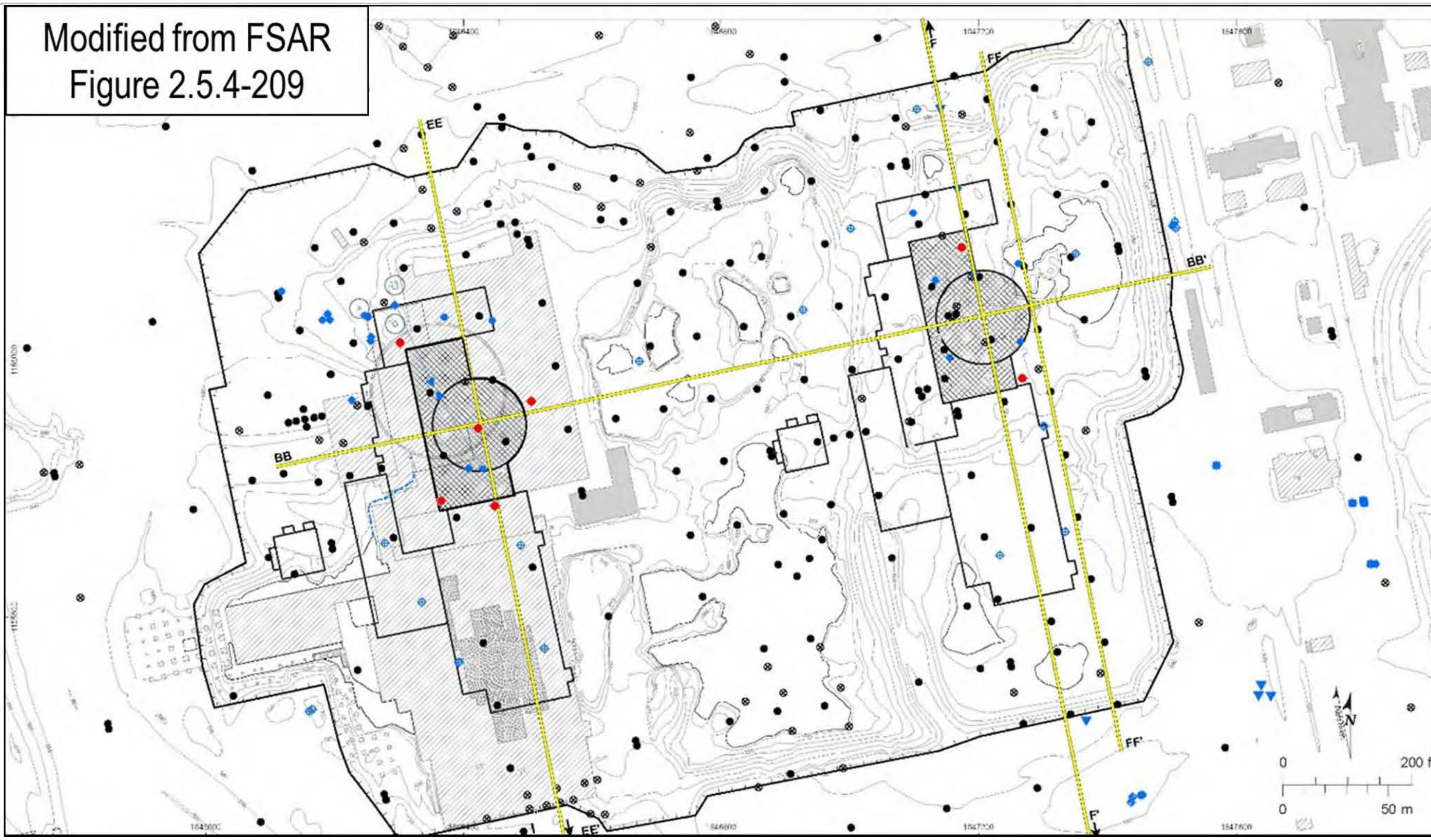
Critical DCD Site Parameters Satisfied

- Seismic Category I Nuclear Island
  - Uniform, hard rock support conditions
  - Static bearing capacities exceed DCD static bearing capacity requirements of 8,900 lb/ft^2
  - SSE bearing capacities exceed DCD SSE bearing capacity requirements of 35,000 lb/ft^2
  - Shear wave velocity exceeds DCD minimum low strain shear wave velocity of 1,000 fps
  - No liquefaction potential for hard rock foundation
- Seismic Category II Adjacent Buildings
  - Uniform fill concrete to level of base of nuclear island, providing DCD-like uniform support conditions
  - Granular fill has V_s greater than 500 fps and adequate bearing capacity
  - Negligible liquefaction potential for engineered granular fill material

Site Explorations

- Site explorations and laboratory testing performed in accordance with Regulatory Guides 1.132 and 1.138 and satisfies 10 CFR 100.23(c)
- Information assembled in three phases:
  - Site explorations for Cherokee Nuclear Station
  - Site explorations supporting initial Lee Nuclear Station COLA submittal
  - Supplemental site explorations for power block relocation
- Properties of Cherokee basemat and fill concrete are documented in Pre- and Post-Demolition Testing Reports
- Mapped rock underlying Cherokee foundation is well known and has been documented in a mapping report
- Relocated Unit 1 remains inside the areas that have been mapped and reported during Cherokee construction activities

Exploration Site Map – Power Block and Adjacent Areas



Foundation Rock Conditions

Unit 1

- Entirely underlain by legacy Cherokee foundation concrete over previously-mapped hard rock
- Legacy Cherokee concrete will remain in place, and new fill concrete will be added

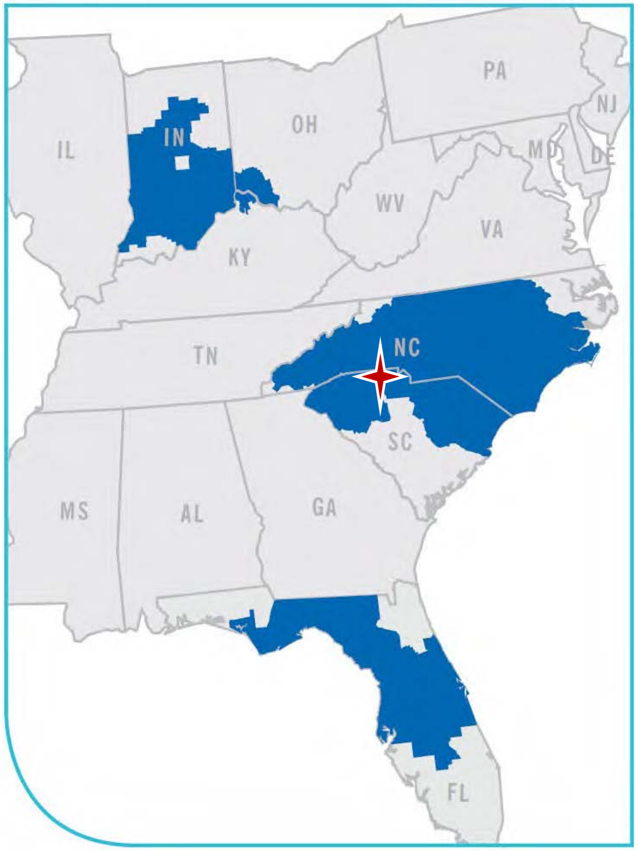
Unit 2

- Foundation rock will be mapped as a construction activity after excavation
- Eastern edge of NI will require localized area of fill concrete, with no significant effect

Summary of Foundation Conditions

- Properties of the Lee Nuclear Station foundation conditions are fully investigated, well known and well understood
- All AP1000 DCD site foundation support parameters are satisfied
- Uniform, hard-rock site with configuration just as described in the AP1000 DCD
- Determination of the site characteristic GMRS (Unit 2 FIRS) and Unit 1 FIRS to be explained in detail
- Site-specific analyses performed to demonstrate design adequacy to be explained in detail

LEE NUCLEAR STATION
FSAR Subsection 2.5.2
Vibratory Ground Motion



Michael Gray
Lettis Consultants International

Presentation Outline

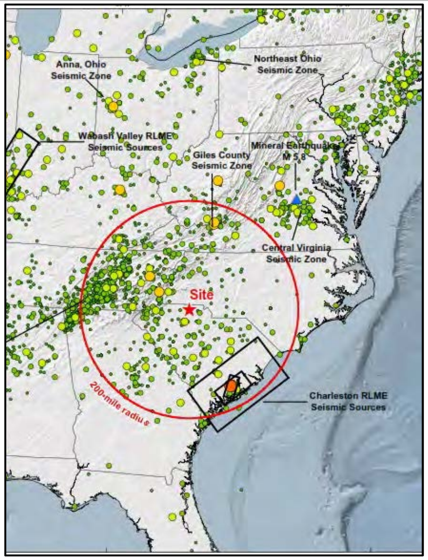
- Introduction
- CEUS SSC Model
- Post CEUS SSC Studies
- Ground Motion Evaluations
- Foundation Conditions
- Seismic Design

CEUS SSC Model Overview

- CEUS SSC Model Characteristics
  - Co-sponsored by EPRI, US NRC and US DOE
  - New SSC model published as NUREG-2115 (2012)
  - SSHAC Level 3 study (NUREG-2117)
- Earthquake catalog through 2008
  - Converted multiple magnitude scales to expected uniform moment magnitude E[M]
  - Updated seismic source geometries and rates
- Replaces EPRI-SOG seismic source model
- CEUS SSC model implemented directly

Post CEUS SSC Study – FSAR 2.5.2.2.5.1 Eastern Tennessee Seismic Zone (ETSZ)

- Linear band of seismicity within the Valley and Ridge and western Blue Ridge physiographic provinces
  - High rate of seismic activity
  - Largest historical earthquake in the region M 4.6
- Instrumentally located epicenters indicate the majority of earthquake hypocenters occur beneath the 5-km-thick Appalachian fold-thrust belt in Neoproterozoic basement rocks
  - Mean focal depth ~15 km
  - Earthquakes correlated with potential aeromagnetic anomalies



FSAR Figure 2.5.2-259

Implications for SSC Model and PSHA

- ETSZ is not defined as an RLME in CEUS SSC
- Parameters needed to demonstrate that the ETSZ produces RLME events as defined in NUREG 2115 are not quantified
- PSHA models ETSZ as part of MESE Mmax and PEZ (N-narrow and W-wide) seismotectonic zone using smoothed seismicity as applied in CEUS SSC
- No modification to CEUS SSC model

Post CEUS SSC Study – FSAR 2.5.2.2.5.2 M5.8 2011 Mineral Virginia Earthquake

- M5.8 event located in an area of increased seismicity within the Central Virginia seismic zone (CVSZ)
- Main shock hypocenter originated at 6.0 ± 3.1 km depth
- Using CEUS SSC methodology Mineral earthquake is assigned E[M]5.71
- Location is common to several of the CEUS SSC model background zones
  - ECC_AM seismotectonic zone with Mmax distribution M6.0 to M8.1
- Mineral event is below the lower magnitude range defined for ECC_AM in CEUS SSC

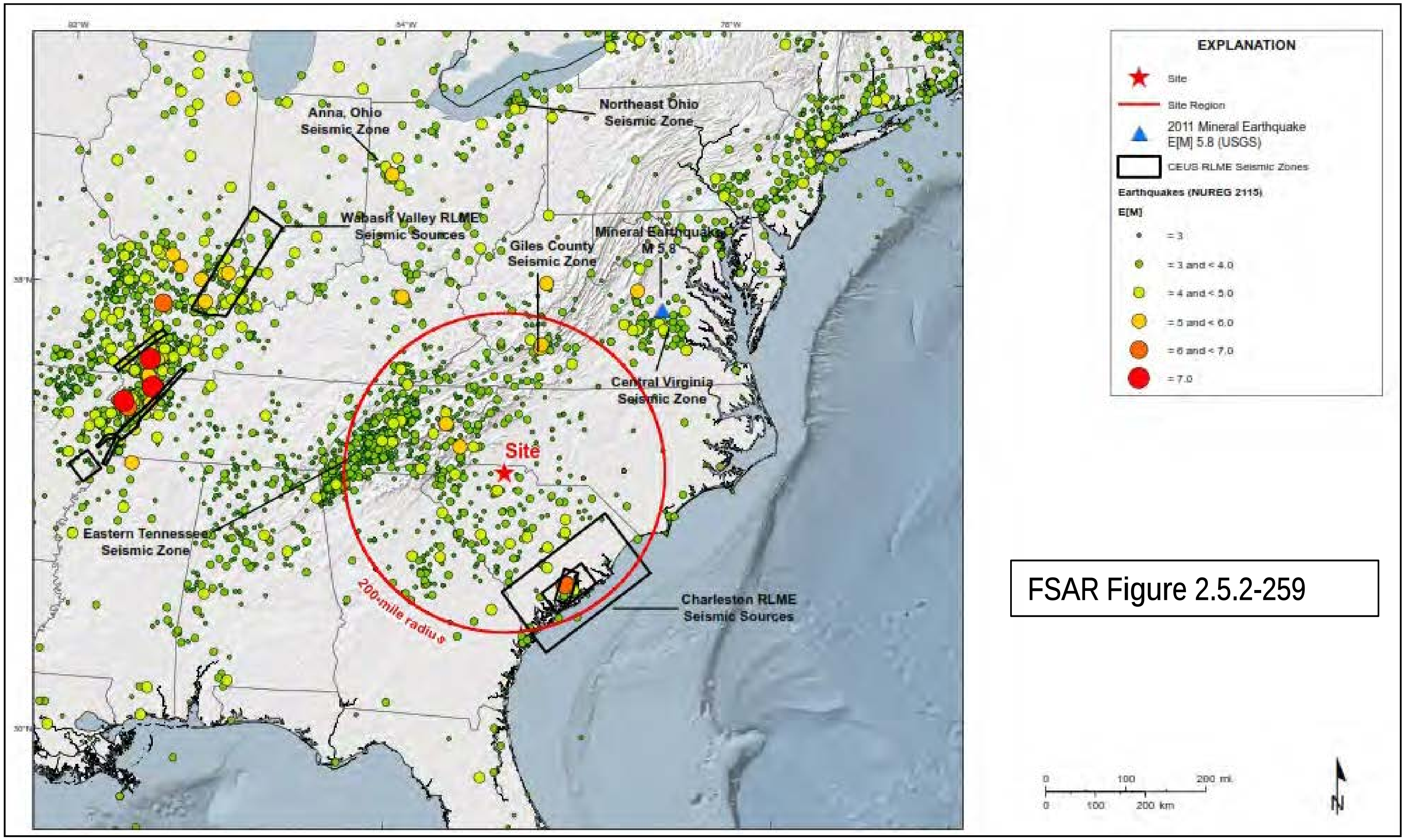
Implications for SSC Model and PSHA

- Mineral earthquake is not included as a new fault or RLME source in the site PSHA
- Event captured by the host zones (ECC-AM, MESE-N, MESE-W, and Study Region) in the CEUS SSC model framework
- No change to CEUS SSC model
  - Distance of earthquake to ~450 km
  - Earthquake magnitude lower than the Mmax magnitude distribution for ECC-AM source zone

Seismic Hazard – Hard Rock Site

- Lee is hard rock site
  - Rock underlying the foundation of the plant consists of uniform, hard rock (Vs $\geq$ 2.83 km/s, 9,282 fps)
  - No site response performed
- PSHA based on
  - CEUS SSC (NUREG-2115)
  - Updated 2013 EPRI Ground Motion Model (GMM)
  - NUREG-2117 guidance used to evaluate new data
- Uses lower bound moment magnitude E[M] 5.0
  - Cumulative Absolute Velocity (CAV) filter was not used
- Considers distributed seismicity source out to 520 km
  - Exceeds 200 mile (320 km) guidance in RG 1.208
  - Expanded radii selected to capture potential hazard from background sources that occur just beyond the 200 mile (320 km) distance
- RLMEs
  - Charleston
  - New Madrid fault system

Regional Seismicity Map

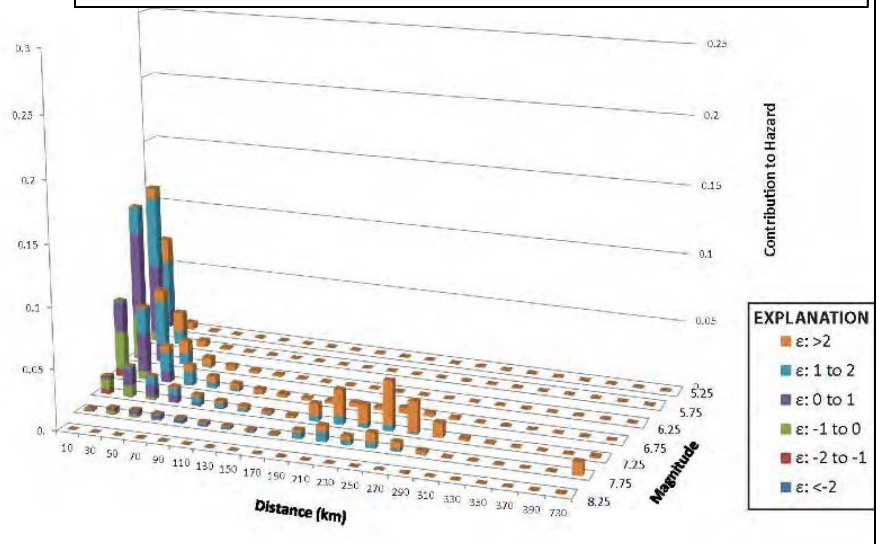


FSAR Figure 2.5.2-259

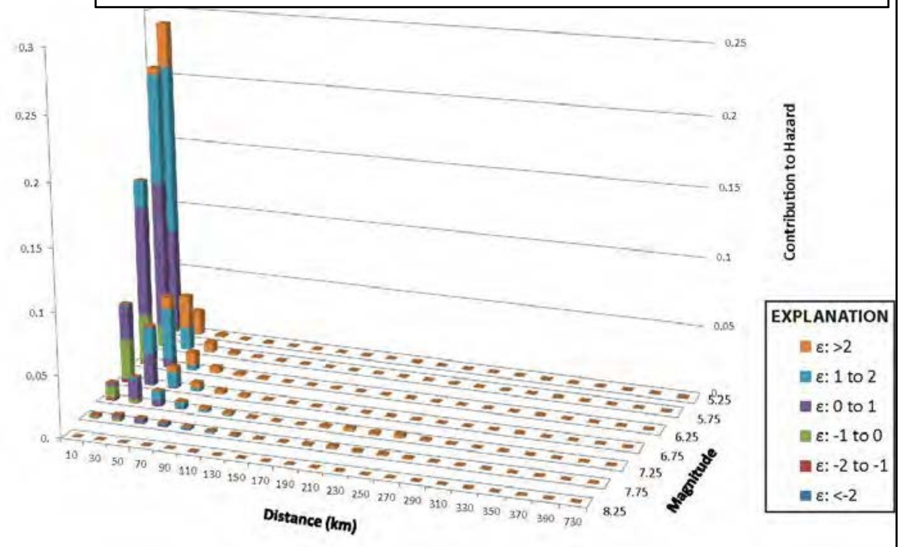
PSHA and Deaggregation

Seismic hazard is deaggregated following the guidelines of RG 1.208.

Low Frequency (1 and 2.5 Hz) FSAR Figure 2.5.2-233



High Frequency (5 and 10 Hz) FSAR Figure 2.5.2-234



Combined Deaggregation of Mean Rock Hazard for 10^{-5} M-R-deaggregation:

- The deaggregation results indicate that the local background, Charleston and New Madrid RLME seismic sources contribute to seismic hazard at Lee.

Foundation Rock Conditions

Unit 1

- Entirely underlain by legacy Cherokee foundation concrete over previously-mapped hard rock.
- Legacy Cherokee concrete will remain in place, and new fill concrete will be added.
- Approximately 23.5 ft. of fill concrete (composite – new and CNS legacy).

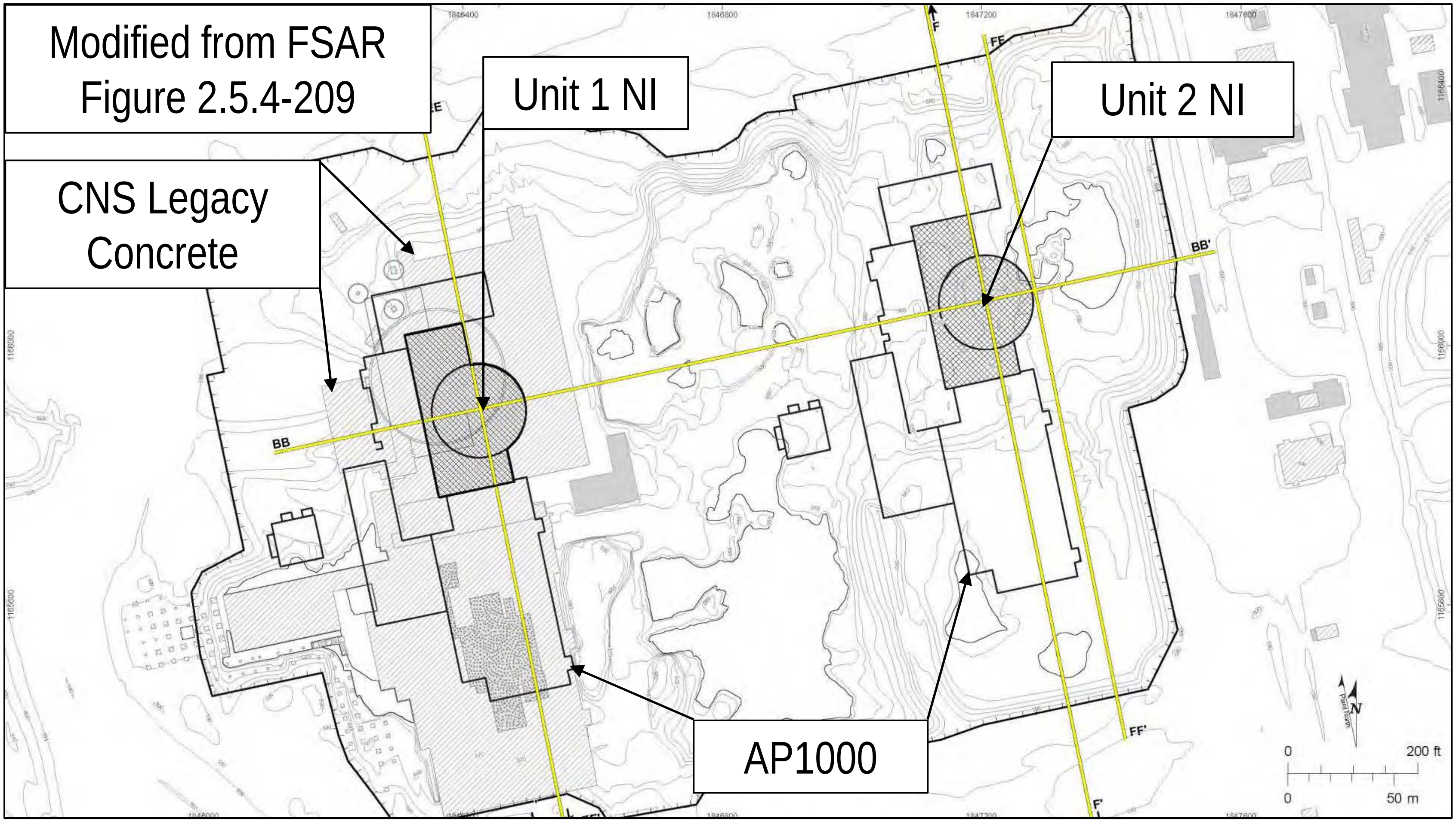
Unit 2

- Foundation rock will be mapped as a construction activity after excavation.
- Eastern edge of NI will require localized area of fill concrete, with no significant effect.

Foundation Conditions

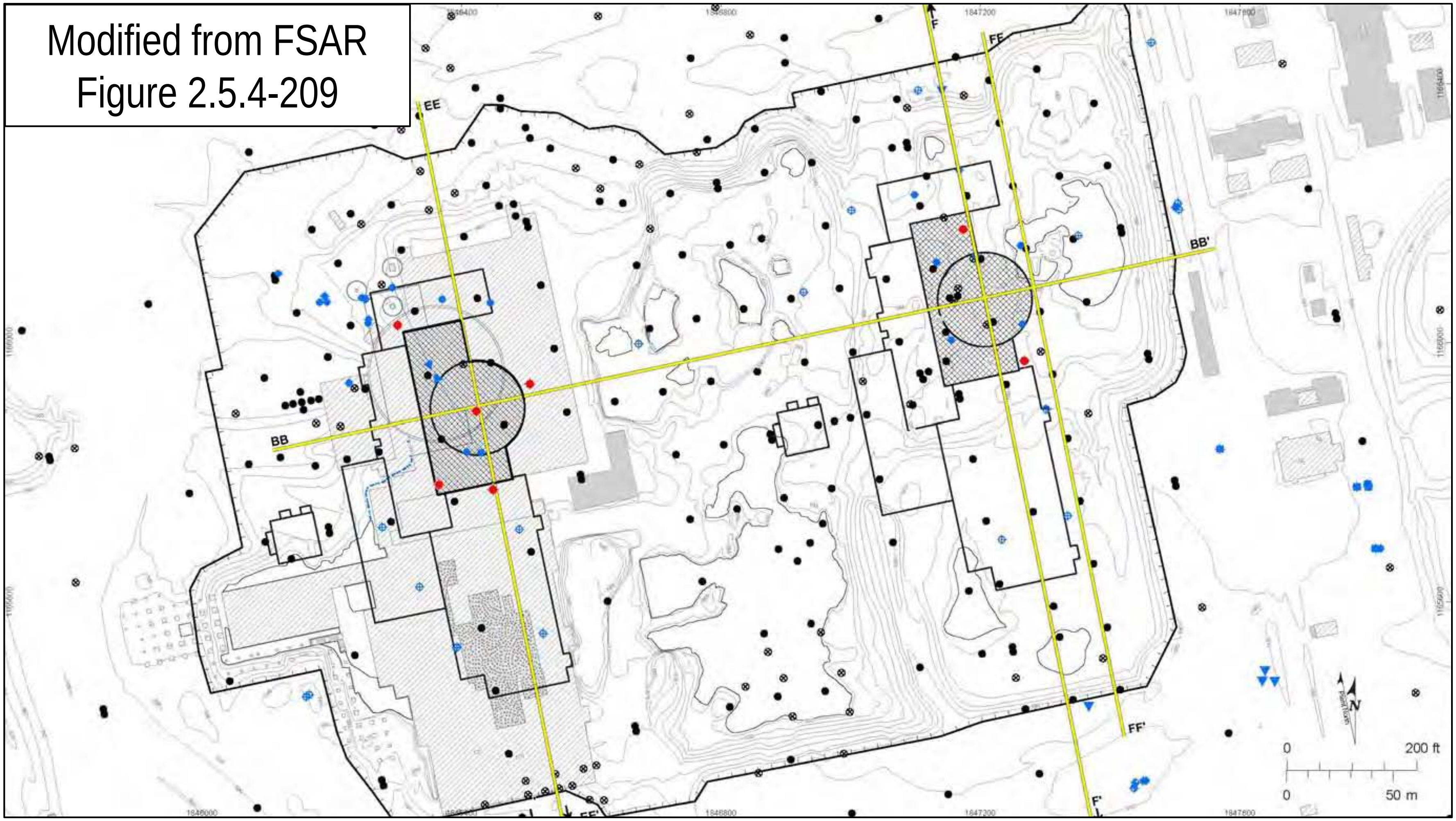
- Site provides uniform, hard-rock support for the nuclear island with measured shear wave velocities for continuous hard rock underlying nuclear islands ranging from about 9,000 to 10,000 fps
- Based on differing foundation conditions between Unit 1 and Unit 2
  - Individual foundation response spectra are computed for the certified design portion of the plant at Units 1 and 2
    - Site GMRS defines the input motion (FIRS) at Unit 2
    - FIRS A1 associated with dynamic profile A1 defines the input motion at Unit 1

Site Map – Power Block and Adjacent Areas



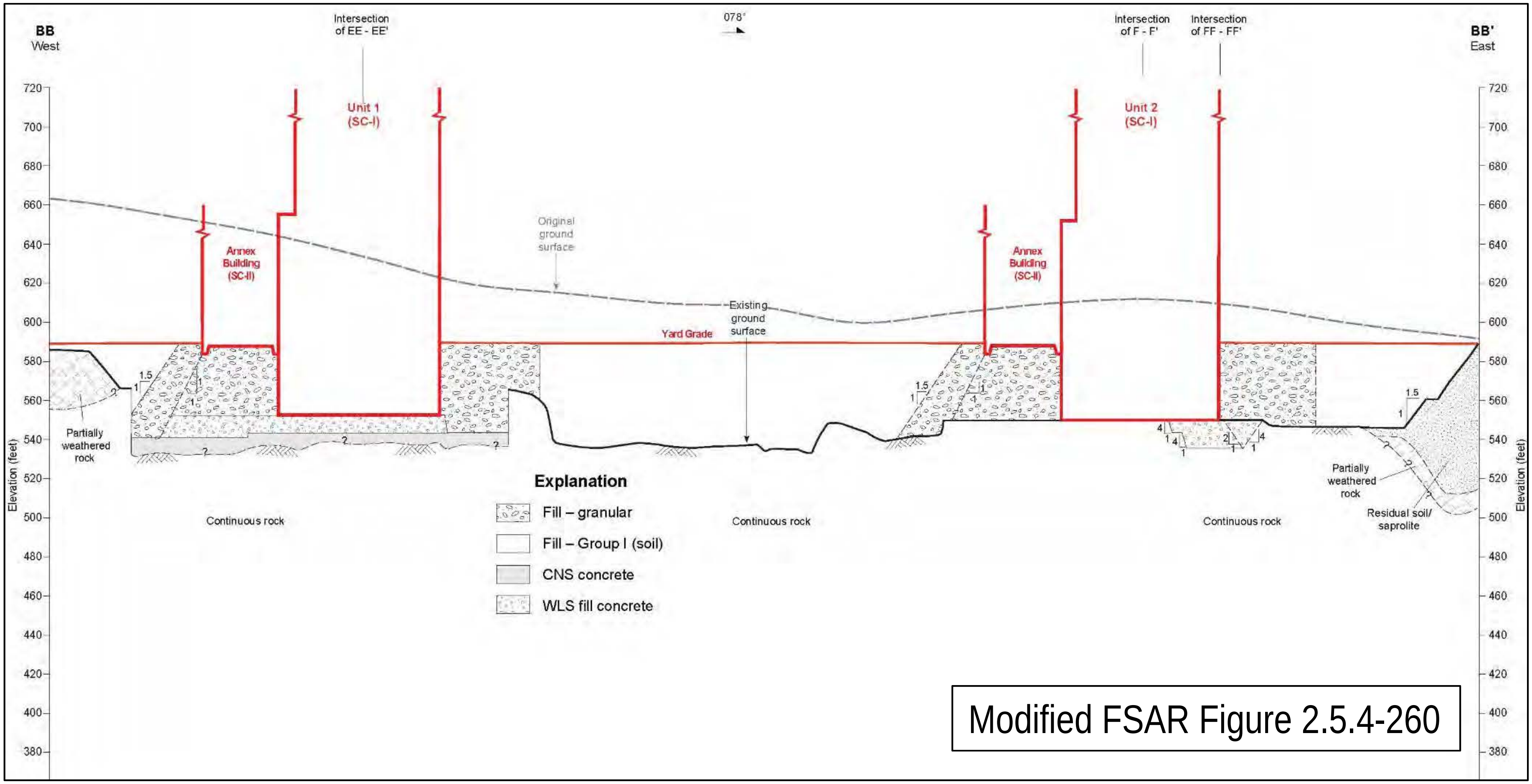
Exploration Site Map

Modified from FSAR Figure 2.5.4-209



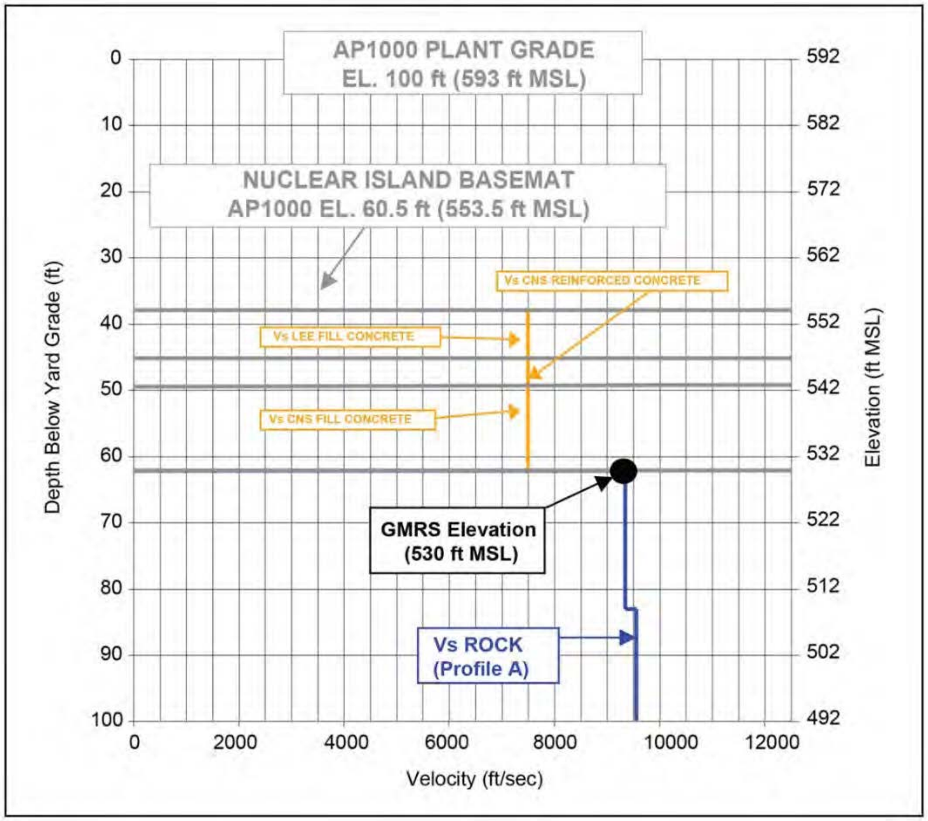
Locations of Dynamic Velocity Profiles with Cross Sections

Section thru Units 1 and 2 Center



Unit 1 – FIRS A1

Defines the site response foundation input motion for Unit 1 NI centerline

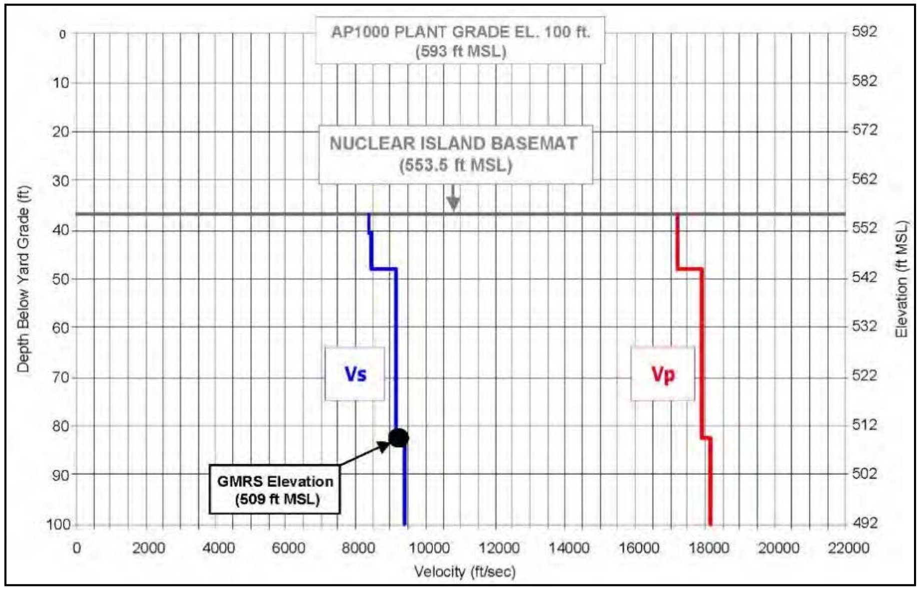


- Fill concrete over continuous hard rock
- Based on GMRS developed at the top of a hypothetical outcrop (e.g. continuous hard rock) fixed at 530 ft NAVD
- Transferred up through previously placed and new concrete materials to the basemat foundation level at 553.5 ft NAVD

Modified Figure 2.5.4-252a (Profile A)

Unit 2 – FIRS (GMRS)

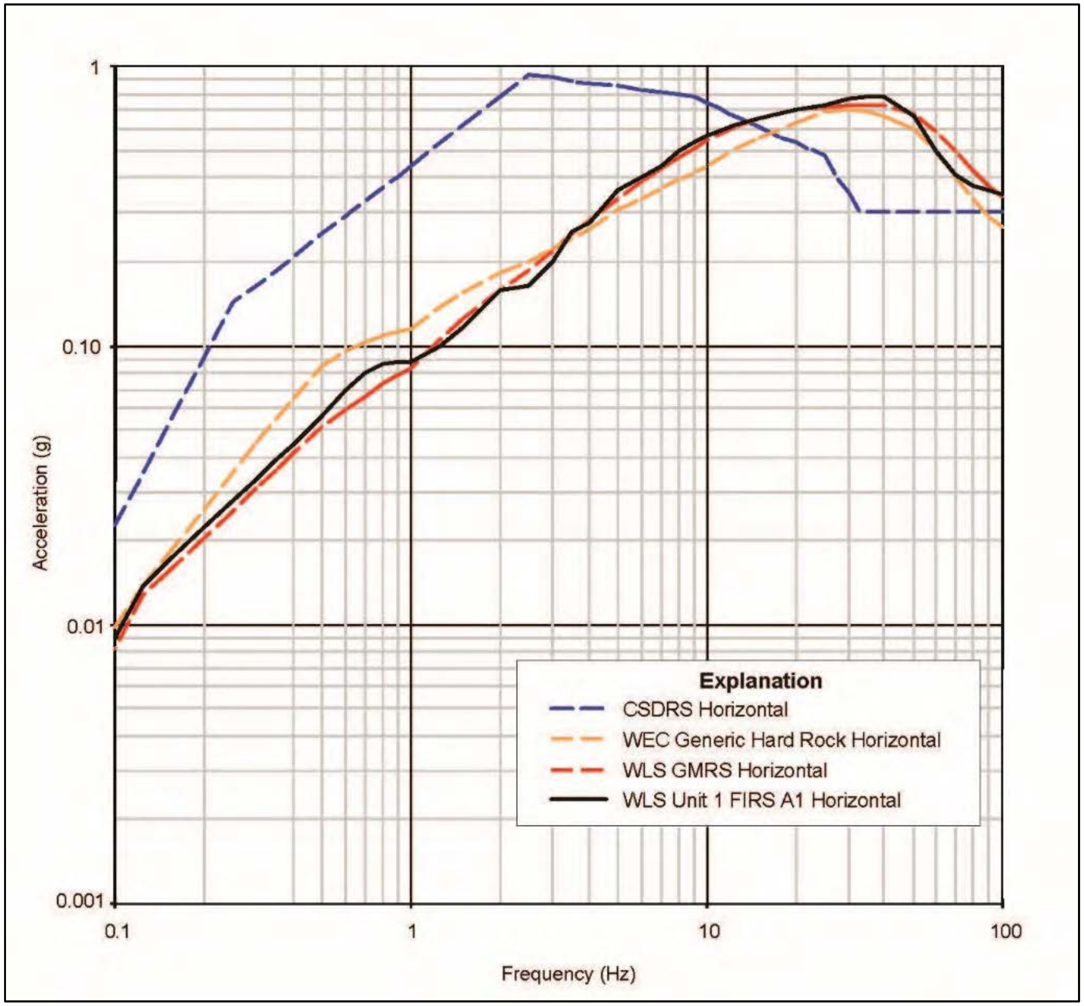
Defines the site response foundation input motion for Unit 2 NI centerline



Modified from FSAR Figure 2.5.4-250, Profile C

- Unit 2 FIRS relies on the GMRS
- Developed at the top of a hypothetical outcrop of competent material (e.g. continuous hard rock) fixed at the basemat foundation level at 553.5 feet NAVD

GMRS and FIRS (Horizontal shown, Vertical similar)



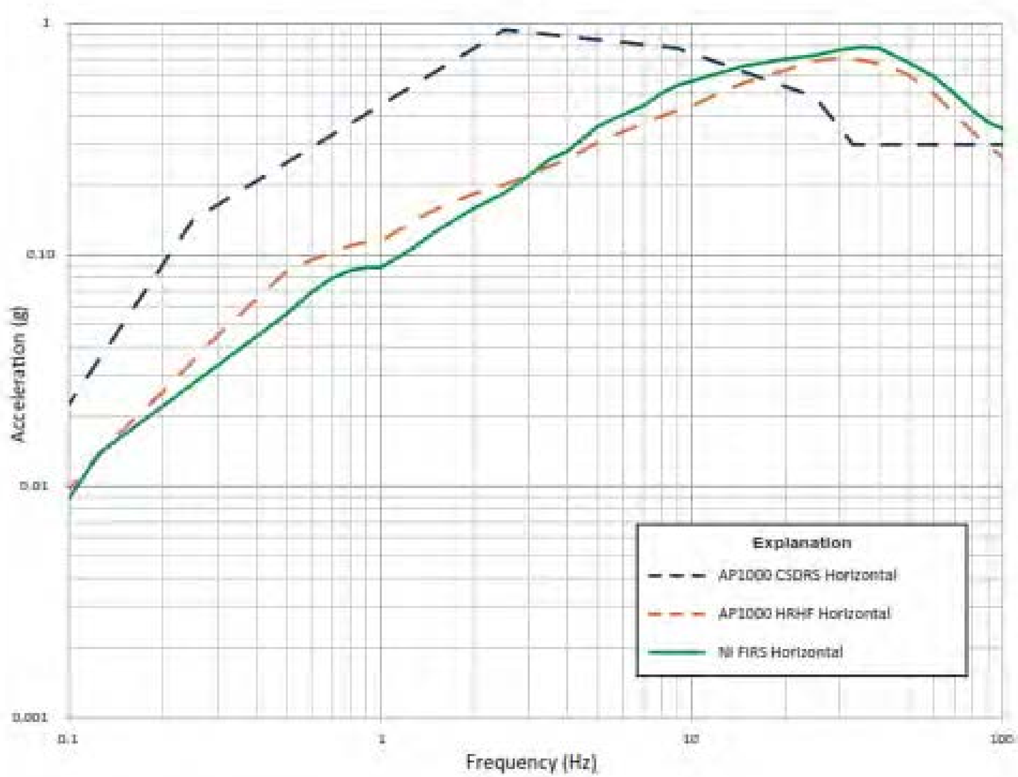
- GMRS (Unit 2 FIRS) and Unit 1 FIRS (FIRS A1) exceed the AP1000 CSDRS
- Alternate AP1000 DCD HRHF spectrum is also exceeded.

Development of Site-Specific Foundation Input Motion for Units 1 and 2

GMRS (Unit 2 FIRS) and Unit 1 FIRS (FIRS A1) exceed the AP1000 CSDRS and AP1000 HRHF at higher frequencies

- Site-specific foundation input motion for both Units 1 and 2 is represented as the horizontal and vertical envelope of the GMRS (Unit 2) and Unit 1 FIRS, referred to as “NI FIRS”
- Horizontal and vertical NI FIRS spectra are considered to be applicable to both units
- Duke performed a site-specific analysis to address high frequency exceedances

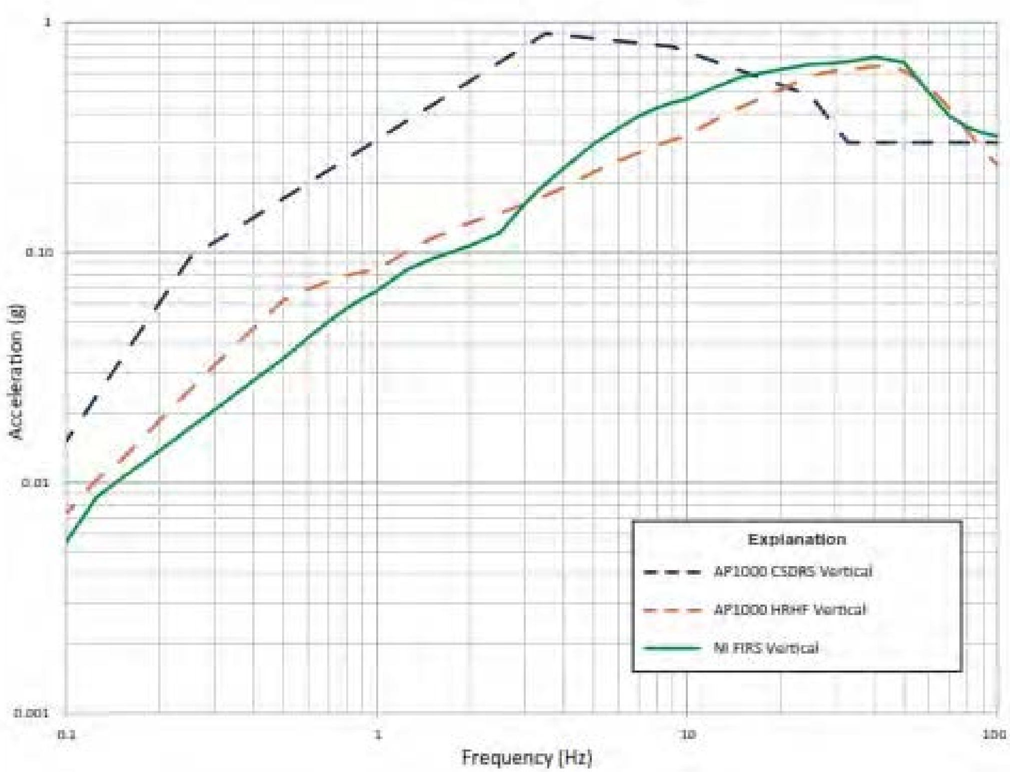
Design Basis Ground Motion Response Spectra – Horizontal



FSAR Figure 3.7-201

- Horizontal NI FIRS exceeds the horizontal AP1000 CSDRS at frequencies above approximately 14 hertz
- PGA at 100 hertz of the NI FIRS is 0.352 g
- Horizontal NI FIRS exceeds horizontal AP1000 HRHF for all frequencies above about 3 hertz

Design Basis Ground Motion Response Spectra – Vertical



FSAR Figure 3.7-202

- Vertical NI FIRS exceeds the vertical AP1000 CSDRS at frequencies above approximately 16 hertz
- Vertical NI FIRS is above the vertical AP1000 HRHF for frequencies between about 3 to 55 hertz and 80 to 100 hertz

Design Basis Ground Motion Response Spectra – Summary

- DCD site foundation support conditions are satisfied.
- Uniform, hard-rock site with configuration just as described in AP1000 DCD.
- Site-specific input motions are greater than AP1000 CSDRS.
- Site-specific input motions are also greater than the alternate AP1000 high frequency spectrum (HRHF).
- Site-specific analyses of AP1000 with Lee support conditions and input motions is required.

Summary of Lee Nuclear Station Foundation Conditions

- Uniform, hard-rock site with conditions just as described in the AP1000 DCD.
- No tectonic deformation experienced since the Mesozoic (252 to 66 Ma), and possibly not since 219 Ma to 300 Ma.
- Site characteristic GMRS (Unit 2 FIRS) and Unit 1 FIRS exceed the DCD CSDRS spectrum (WLS DEP 2.0-1).
  - Site spectra are also higher than DCD HRHF spectrum.
- Site-specific analyses were performed for the SC-I nuclear island and for the adjacent SC-II buildings to demonstrate design adequacy.
- These analyses will be described in the presentation on FSAR Chapter 3.

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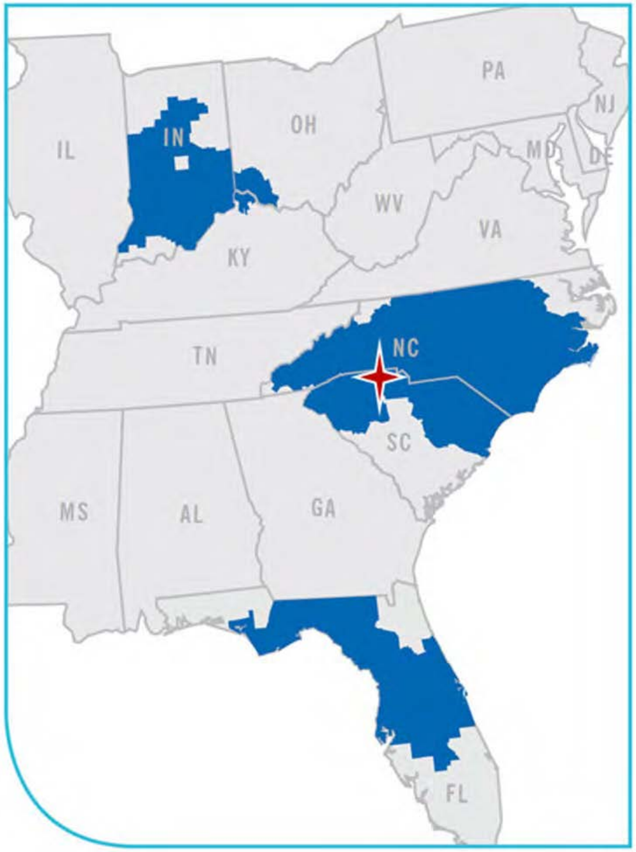
LEE NUCLEAR STATION
FSAR Section 3.7
Seismic Design



John Thrasher
Director Engineering
Nuclear Development

Site-Specific Seismic Analyses

- After relocation of the plant, Lee Nuclear Station is a uniform hard-rock site with configuration just as described in the AP1000 DCD
- Site-specific seismic inputs based on CEUS SSC (NUREG-2115) and 2013 GMM update result in a site characteristic GMRS and Unit 1 FIRS that are higher than the DCD CSDRS spectra (WLS DEP 2.0-1); site spectra are also higher than DCD HRHF spectra
- Site-specific analyses are required for the SC-I nuclear island and for the SC-II adjacent buildings to demonstrate design adequacy

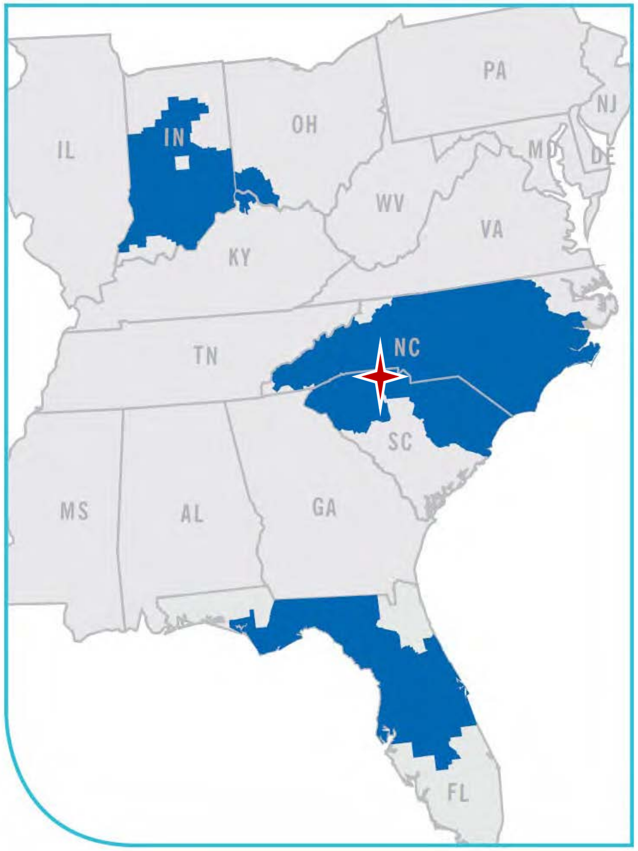
Site-Specific Seismic Analysis (NI)

- Site-specific in-structure spectra show minor exceedances over corresponding spectra for CSDRS
- Review of representative sample of structures, primary equipment and piping shows that CSDRS controls design forces and moments
- Review of equipment qualification practices shows that exceedances do not affect equipment qualification, since in all completed tests the Test Response Spectra (TRS) are higher than site-specific Required Response Spectra (RRS)
- Duke Energy will ensure that all future TRS are also higher than site-specific RRS

Site-Specific Seismic Analysis (SC-II)

- Horizontal base spectra are very similar to AP1000 envelope criteria, but vertical spectra are higher
- Relative displacements between structures are much less than space provided
- High confidence that AP1000 standard lateral force resisting system is adequate
- Vertical spectrum exceedance may affect design details of floors and roof
- SC-II performance criteria are identified; confirmatory analysis and design update will be completed before start of SC-II construction

LEE NUCLEAR STATION
FSAR Section 3.7
Seismic Design



Blaise Genes
Westinghouse Electric Corporation

Lee Seismic Analyses Discussion Topics

- Previous Lee Seismic Analyses;
- **AP1000** Seismic Analysis Introduction;
- Hard Rock High Frequency (HRHF) Seismic Evaluation Methodology for Lee;
- Lee CEUS Soil-Structure Interaction Seismic Analysis;
- Lee HRHF Screening Evaluation and Seismic Analyses Results Summary;
- Seismic Margin Assessment for Lee;
- Lee SCII Adjacent Structures Seismic Analysis Summary; and,
- Final Conclusions.

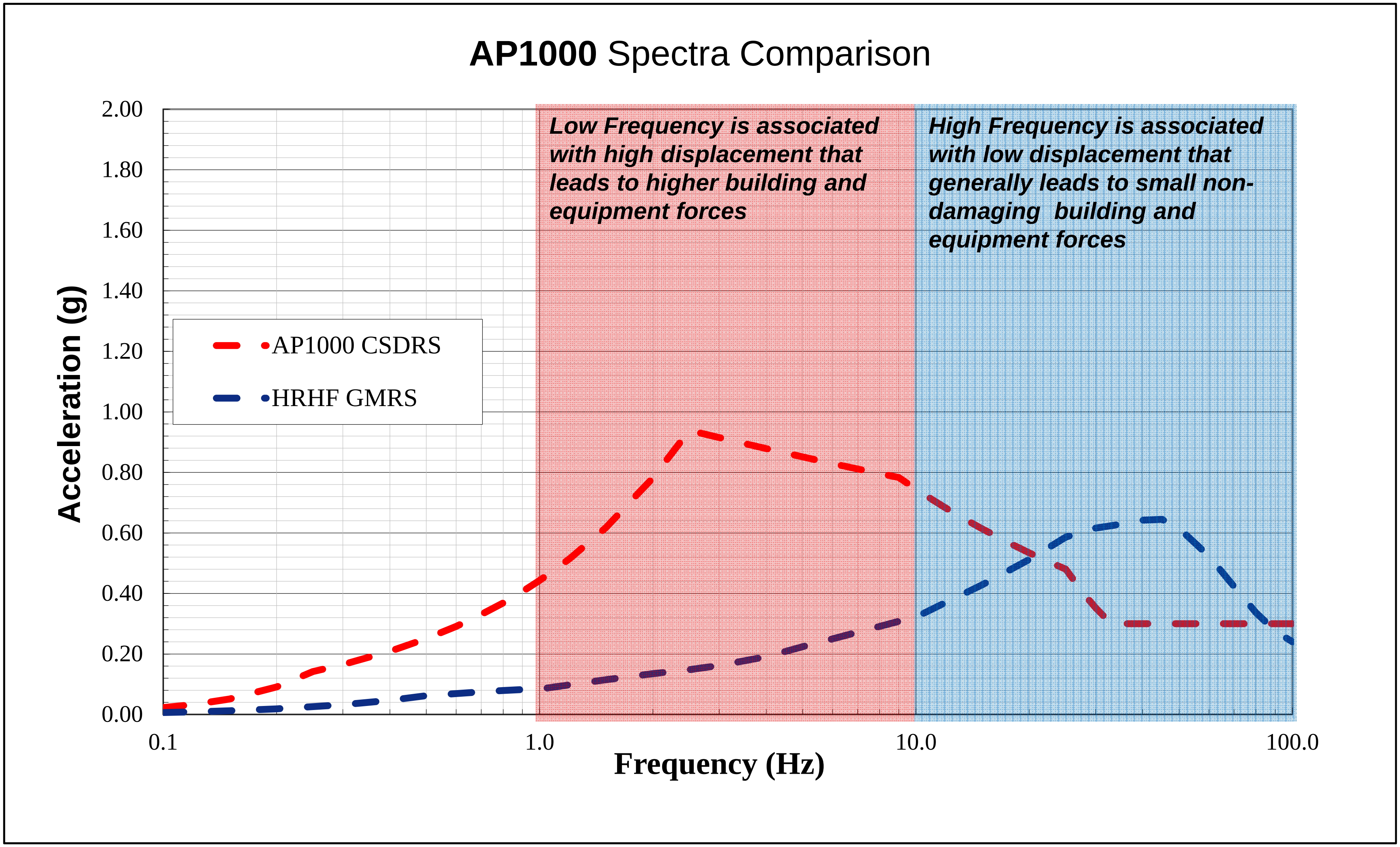
Previous Seismic Analyses

- Westinghouse performed seismic analyses of the Lee Units 1 & 2 Nuclear Island and SCII Turbine Building First Bay and Annex Building adjacent structures in 2011 – 2012.
- The resulting Lee in-structure response spectra (ISRS) was enveloped by the **AP1000** Certified Seismic Design Response Spectra (CSDRS) and Hard Rock High Frequency (HRHF) envelope spectra.
- Lee Nuclear Island and SC-II adjacent structures seismic analyses were audited by NRC in April 2012.
- Following the 2012 Lee audit, changes prompting seismic re-analysis of Lee were:
  - CEUS Seismic Source Characterization (NUREG-2115)(2012);
  - 2013 EPRI Ground Motion Attenuation model project updates.

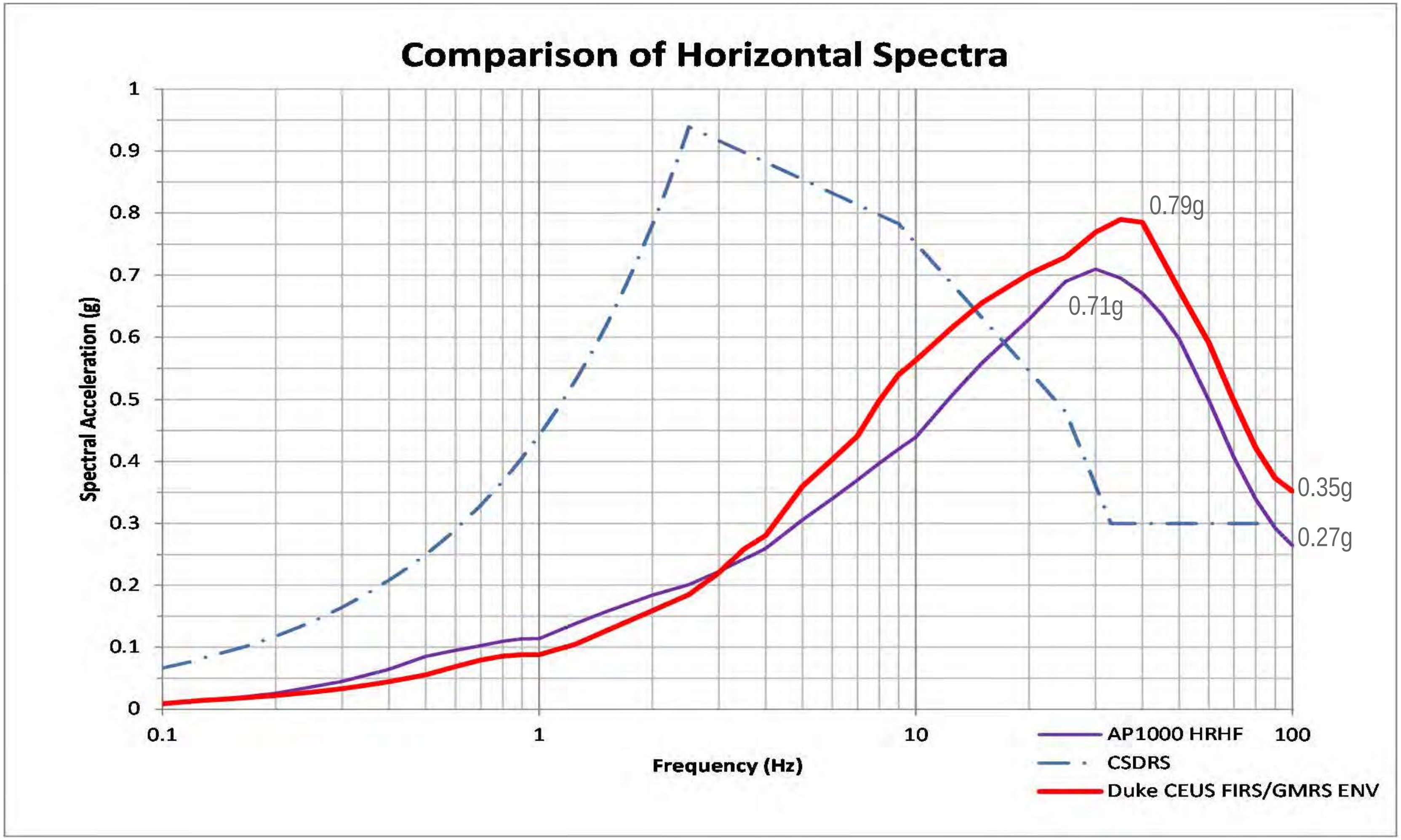
AP1000 Seismic Analysis Introduction

- The **AP1000** plant certification defines two spectra that the COL applicant can compare their site Ground Motion Response Spectra (GMRS):
  - CSDRS – Low Frequency, High Displacement; and
  - HRHF – High Frequency, Low Displacement.
- Design calculations for the majority of the **AP1000** structures, systems and components (SSCs) are based on, or bounded by the CSDRS.
- HRHF evaluation methodology described in Interim Staff Guidance (ISG)-01 and DCD Rev. 19 Appendix 3I was applied to **AP1000** and documented in Technical Report (TR)-115.
- HRHF methodology does not require an evaluation of the total plant, but rather a review of a selected sample of SSCs.
- The seismic design of the selected **AP1000** HRHF-sensitive sample of SSCs in TR-115 was shown to be governed by the CSDRS.

DCD Spectra for Comparison



Lee CEUS NI FIRS Seismic Input – Nuclear Island



Lee Vertical Spectra Comparison is Similar to Horizontal in Both Spectral Shape and Acceleration Magnitude

HRHF Evaluation Methodology Used for Lee

Consistent with ISG-01, DCD Rev. 19 Appendix 3I and TR-115

- Perform incoherent HRHF soil-structure interaction (SSI) analyses and obtain Lee-specific CEUS ISRS.
- Select representative SSCs by screening those that are:
  - Important to safety and function during SSE;
  - Potentially sensitive to high frequency (HF) seismic input ; and
  - In locations where Lee HF ISRS exceedences occurred.
- Obtain and compare Lee site-specific forces and moments for critical building, primary equipment, supports and reactor coolant loop (RCL) nozzles.
- Perform evaluations of selected HF-sensitive equipment and piping systems to demonstrate that **AP1000** CSDRS and/or HRHF bound the Lee site-specific results.
- By screening representative SSCs, the sample is considered sufficient to demonstrate the **AP1000** design is controlled by the CSDRS.

Lee CEUS Seismic SSI Analysis Summary

- Updated Lee HRHF seismic analyses were performed using similar methodology as **AP1000** TR-115, which was reviewed and approved by NRC for seismic analysis of HRHF sites.
- Nuclear Island model refinements were made to enhance the **AP1000** licensing basis NI20r finite element model (FEM) and develop the Lee NI20u FEM.
- The Lee NI20u FEM better represents areas of the Nuclear Island model sensitive to high frequency motion given the increased CEUS spectra.

Lee CEUS Seismic SSI Analysis Summary

- Two separate soil-structure interaction (SSI) analysis models were developed with corresponding dynamic rock profiles to represent the varied conditions beneath the Lee Units 1 and 2 Nuclear Island.
- A comparison of the resulting Lee SSI in-structure response spectra (ISRS) for Units 1 and 2 was made for both dynamic profiles and the responses were similar.
- Coherent and incoherent SSI analyses simulations were evaluated using the Lee Unit 1 dynamic profile.
- Lee site-specific ISRS, forces and moments were obtained for subsequent comparative HRHF evaluations.
- Updated SSI analyses and HRHF evaluations indicate that the Lee HRHF seismic input has a minimal effect on SSCs compared to **AP1000** CSDRS and HRHF.

Lee HRHF Screening Evaluation

*to demonstrate acceptability of the **AP1000** for the Lee CEUS seismic input*

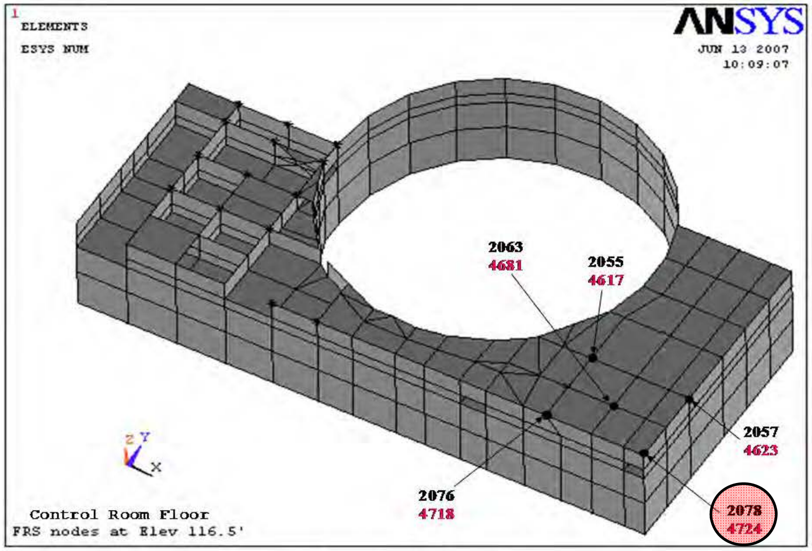
- The Lee SSCs evaluated for HF seismic response were based on a similar TR-115 screening evaluation for the following:
- Building Structures
  - Auxiliary Building;
  - Shield Building; and
  - Containment Internal Structure (CIS).
- Primary Equipment
  - Reactor internals;
  - Primary component supports; and
  - Reactor coolant loop (RCL) primary equipment nozzles.
- Piping Systems – Piping potentially sensitive to HF motion.
- Electro-Mechanical Equipment – Equipment potentially sensitive to HF input.

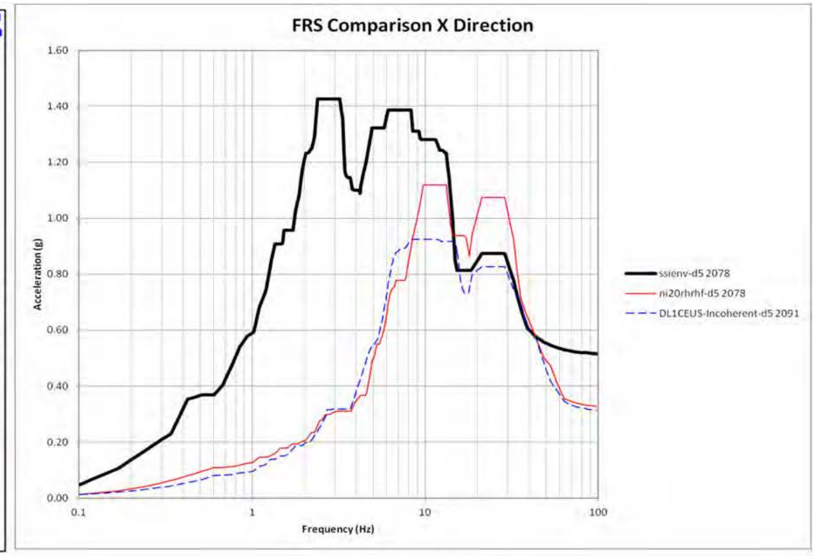
Summary of Results of Lee HRHF Seismic Analysis – Response Spectra

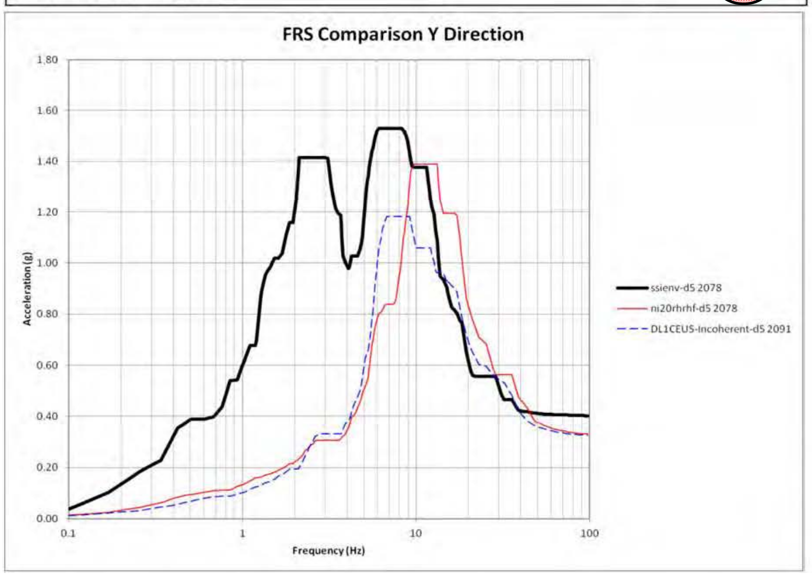
- Comparison of Lee ISRS to the **AP1000** design envelope spectra with incoherency is made for the six key Nuclear Island locations defined in DCD Section 2.5.2.3:
  - Containment internal structures (CISs) at elevation of reactor vessel support – Node 1761
  - Auxiliary building northeast corner at elevation 116'-6" – Node 2078
  - Containment operating floor – Node 2199
  - Shield building at fuel building roof – Node 2675
  - Steel containment vessel (SCV) at polar crane support – Node 2788
  - Shield building roof – Node 3329

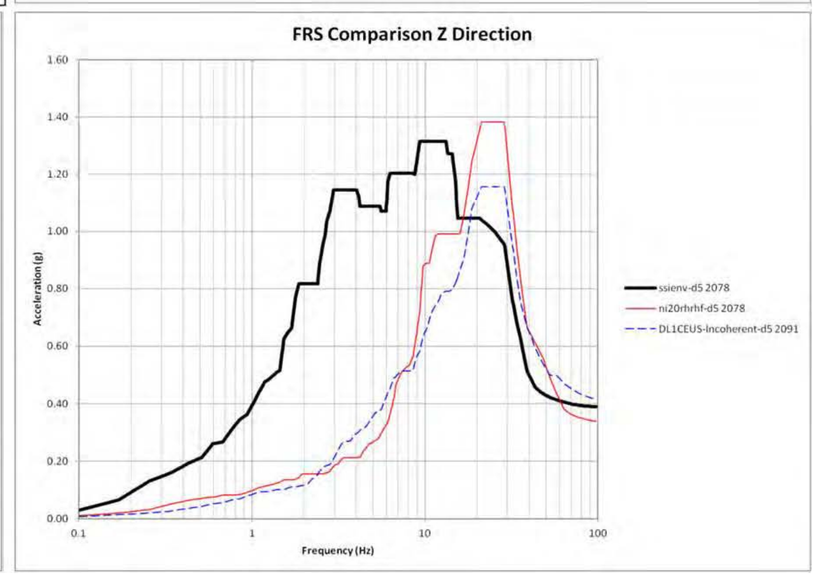
Comparison of Response Spectra: CSDRS, HRHF vs Lee

Auxiliary Building NE Corner at Elevation 116'-6" – Control Room Floor



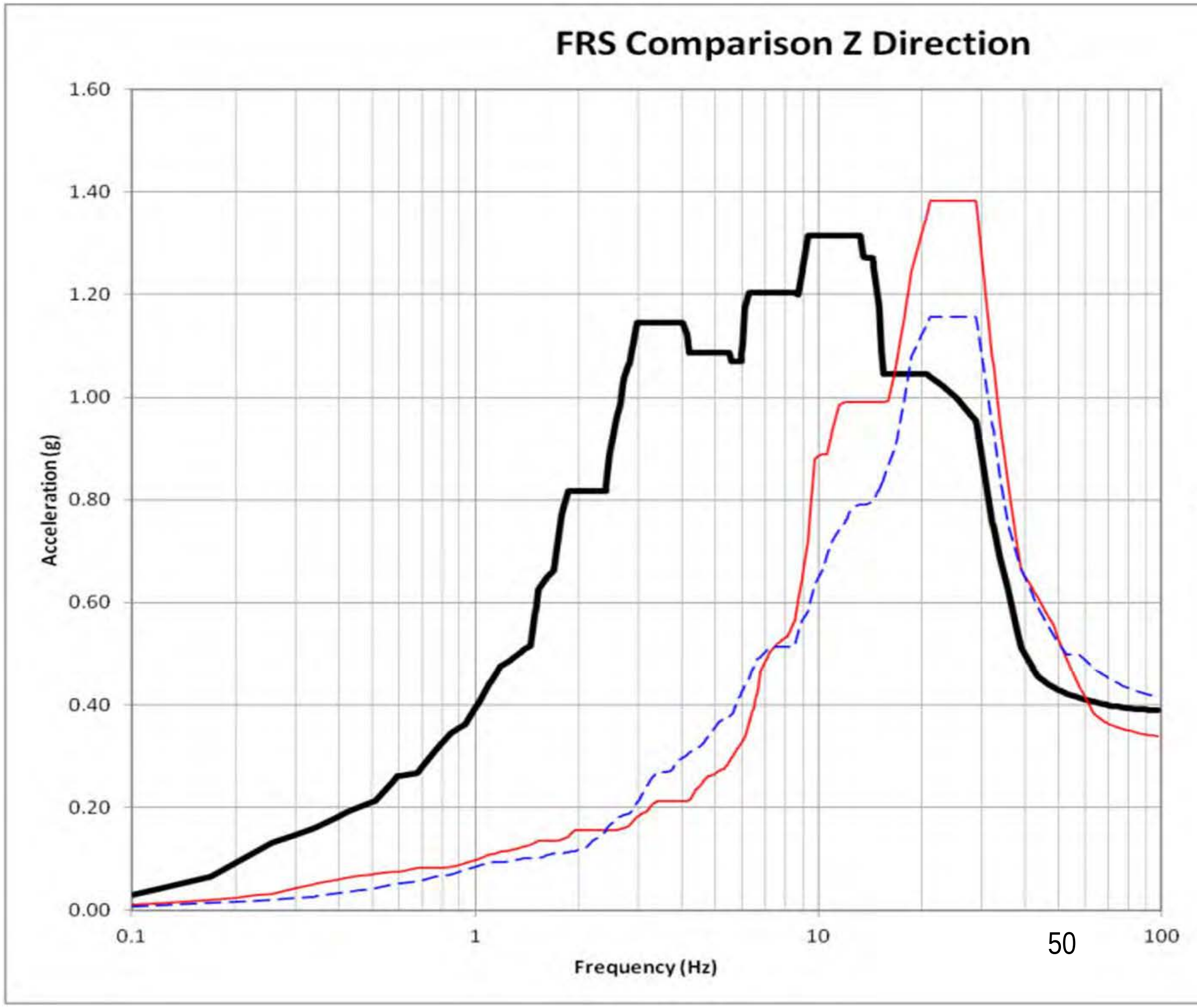






Comparison of Response Spectra: CSDRS, HRHF vs Lee

Auxiliary Building NE Corner at Elevation 116'-6" – Control Room Floor



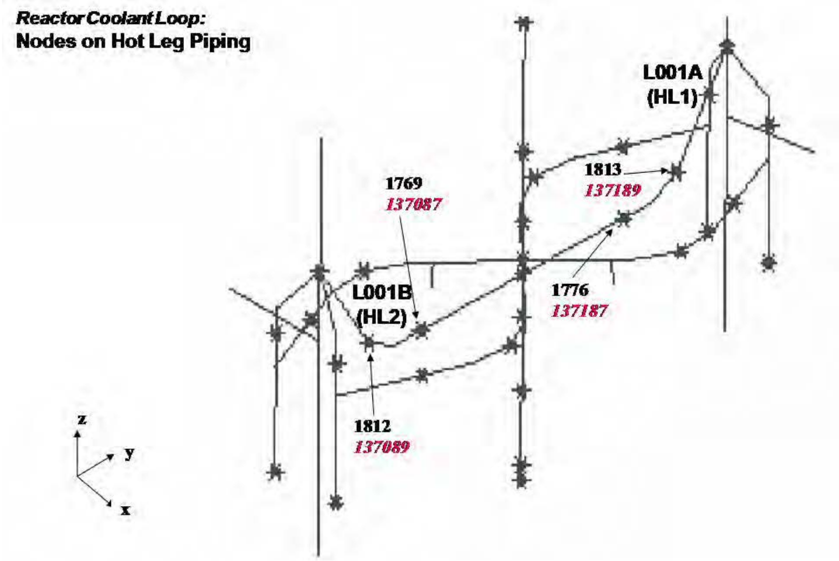
Minor exceedences of CSDRS/HRHF above ~50 Hz

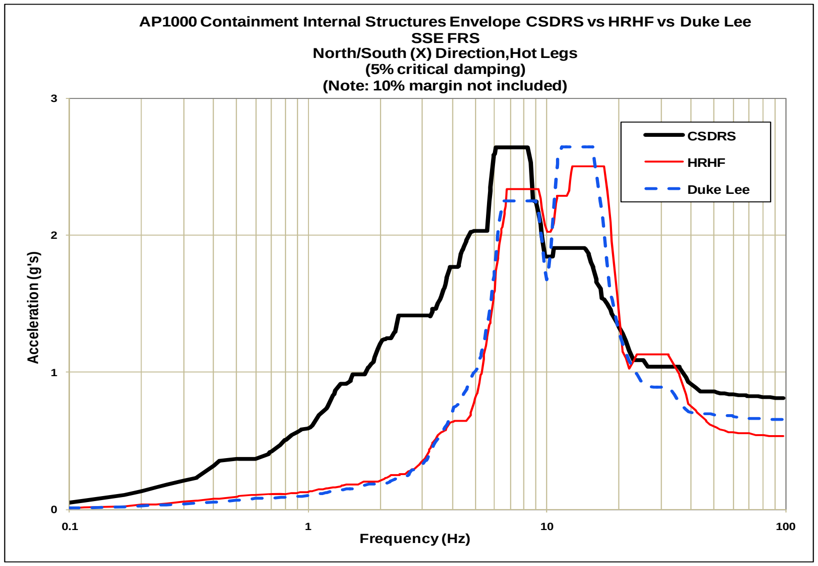
Summary of Results of Lee HRHF Seismic Analysis – Response Spectra

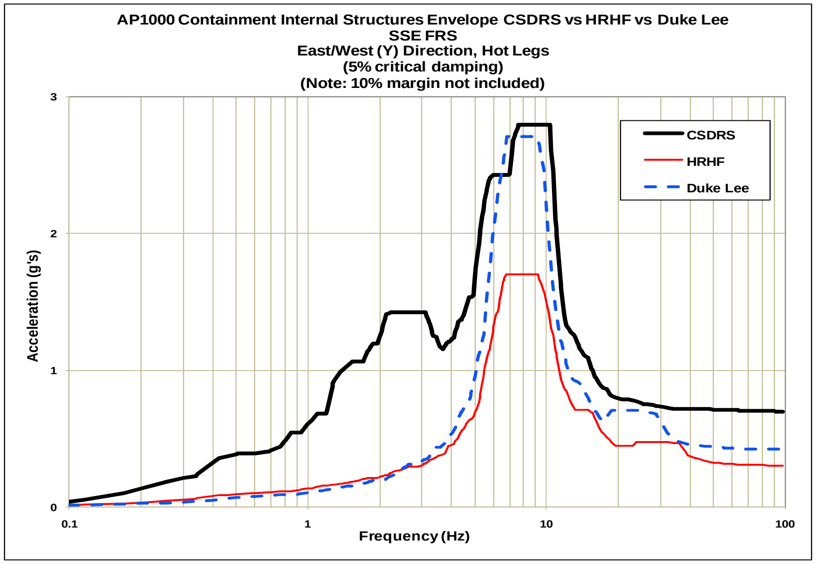
- Lee ISRS with incoherency are also compared to **AP1000** design envelope group spectra for all nodes within node groups of the Nuclear Island including:
  - Auxiliary Shield Building (ASB) El. 99’
  - ASB Main Control Room Floor
  - ASB El. 135’, 160’, 180’, 230’, 267’, 289’ and 327’
  - Containment Internal Structure (CIS) El. 99’
  - CIS El. 134’, 153’ East, 153’ West and 160’
  - RCL Hot Leg Piping and Pressurizer Bottom.

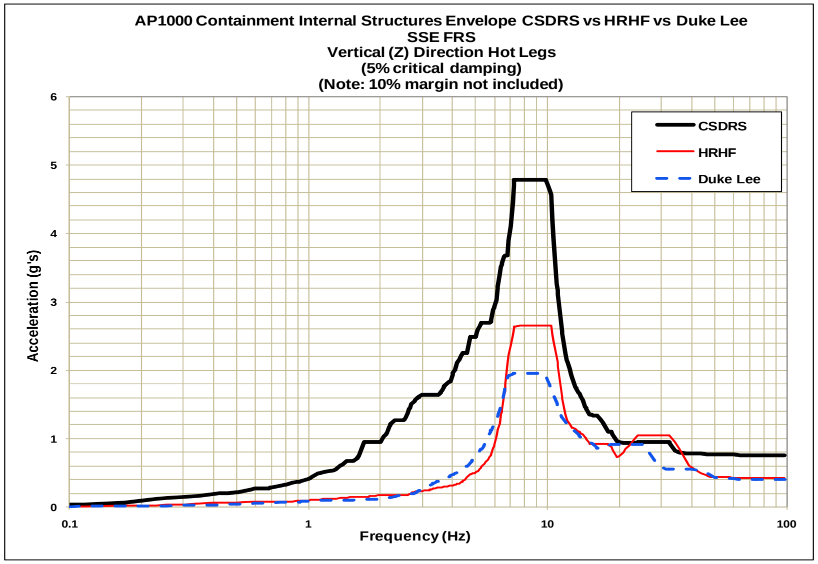
Comparison of Response Spectra: CSDRS/HRHF vs Lee

RCL Hot Leg Piping Group (All Nodes)



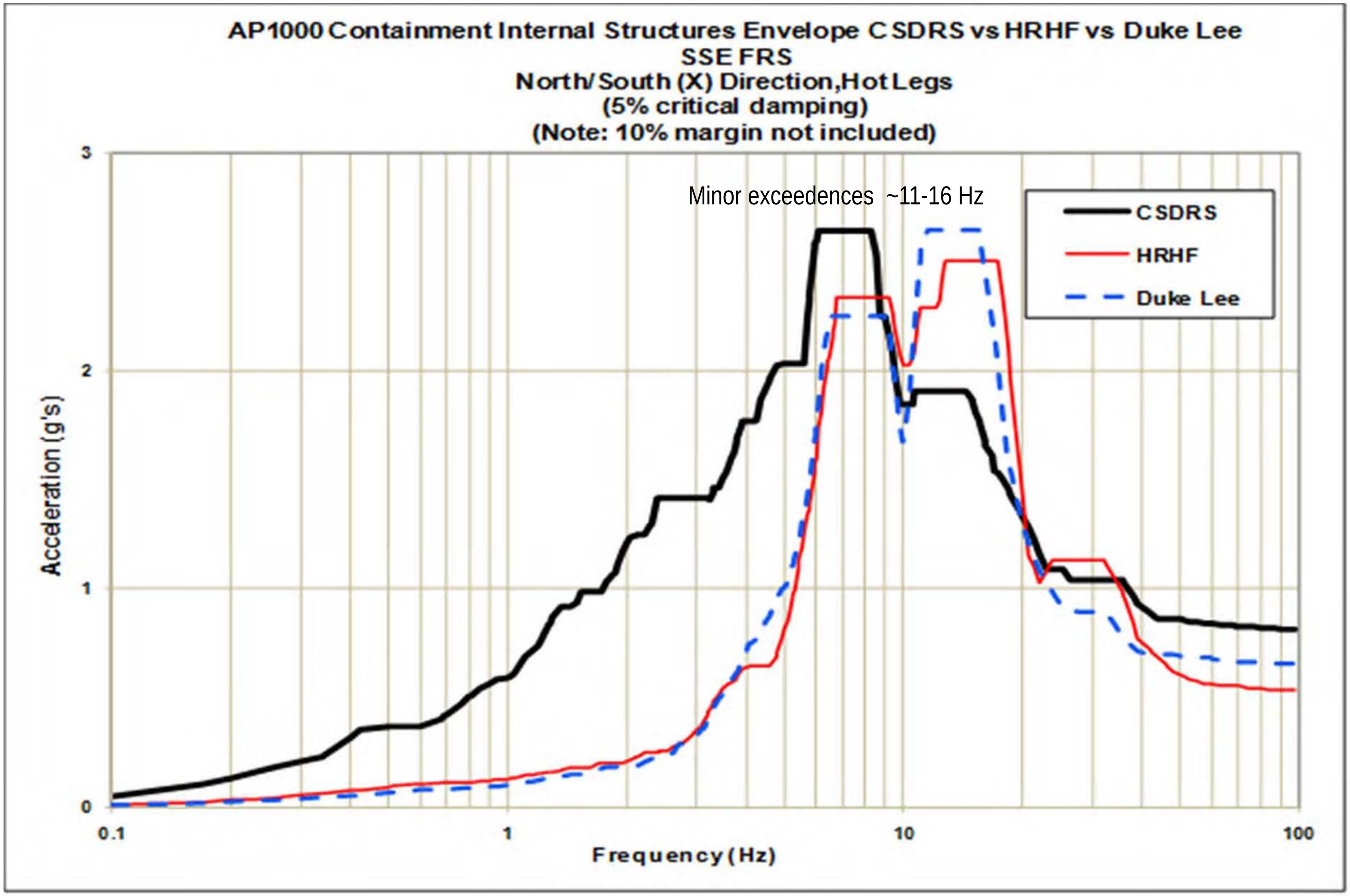






Comparison of Response Spectra: CSDRS/HRHF vs Lee

RCL Hot Leg Piping Group (All Nodes)



Summary of Results of Lee HRHF Seismic Analysis – Response Spectra

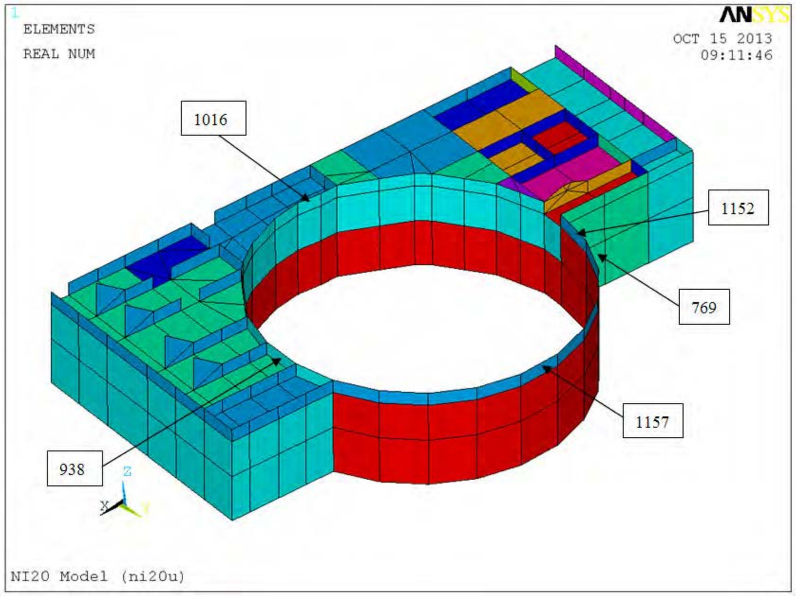
- Lee ISRS for the six key NI locations and all other critical NI group locations are bounded by either CSDRS or HRHF with limited exceptions.
- Some minor ISRS exceedences of the CSDRS/HRHF envelope were observed, mostly above the 15 Hz frequency.
- The limited exceedences of CSDRS/HRHF ISRS are addressed as part of the Lee HRHF screening evaluation to demonstrate that Lee HF seismic input and resulting ISRS are non-damaging.
- No specific design changes are required.

Summary of Results of Lee HRHF Seismic Analysis – Force Comparison

- Lee site-specific forces are compared to **AP1000** CSDRS design forces at select critical locations including:
- Building Structures:
  - Auxiliary Building
  - Shield Building
  - Containment Internal Structure
- Primary Equipment:
  - Major Equipment Supports including:
    - Steam Generator Laterals and Column Supports;
    - Reactor Internals and Reactor Pressure Vessel Support; and,
    - Pressurizer Support;
  - Reactor Coolant Loop (RCL) Nozzles
  - Steel Containment Vessel
  - Pressurizer

Comparison of Forces: CSDRS vs Lee

Shield Building RC/SC connection region



Significant Margin exists between CSDRS and Lee site-specific forces.

Table 6.1-2 Shield Building Time History Member Force Comparison

	William S. Lee Site-Spectra (kips/ft)			CSDRS (kips/ft)		
Element #	**TX**	**TY**	**TXY**	**TX**	**TY**	**TXY**
938	8.3	59.0	54.6	22.3	156.5	125.1
1152	18.8	80.2	55.1	73.2	236.6	117.1
1157	18.6	133.6	55.0	72.6	456.1	196.9
1016	10.8	70.5	25.0	42.4	252.3	59.4

Summary of Results of Lee HRHF Seismic Analysis – Force Comparison

- Maintaining structural integrity of the Nuclear Island structures, primary equipment and supports, and RCL nozzles is important to the safety of the plant.
- Representative portions of the Nuclear Island were selected and evaluated for the effect of HF input and limited ISRS exceedences.
- Lee forces and moments for the TR-115 selected critical structures, primary equipment and supports, and RCL nozzles are all bounded by the corresponding **AP1000** CSDRS design forces.
- No specific design changes are required.

Summary of Results of Lee HRHF Seismic Analysis – Piping Stress and Support Load Comparisons

- Lee ISRS in most locations is enveloped completely by either CSDRS or HRHF envelope spectra.
- The horizontal ISRS for the hot legs and pressurizer bottom have minor exceedences at lower frequencies.
- Thus, two piping packages inside containment were chosen to demonstrate that the CSDRS still governs the **AP1000** design.
- The two piping packages chosen included:
  - Automatic Depressurization System 4th Stage East Compartment ; and,
  - Pressurizer Surge Line.
- A third package in the Auxiliary Building was also reviewed since it is potentially sensitive to high frequency response, which included:
  - SFS (Spent Fuel Cooling System).

Summary of Results of Lee HRHF Seismic Analysis – Piping Stress and Support Load Comparison Summary

- All 3 piping evaluations show that the **AP1000** CSDRS and/or HRHF seismic stresses and support loads are larger than those resulting from the Lee seismic response with margin.
- Standard design practices for **AP1000** have already considered cases enveloping Lee site-specific requirements, i.e.,
- The layout of 40 ASME Class 1, 2 and 3 piping packages were reviewed along with Lee ISRS for susceptibility to HF seismic input.
- The **AP1000** piping is designed to both CSDRS and HRHF spectra;
- In cases when detailed analyses are required as part of as-built reconciliation, the as-built configuration will be qualified for CSDRS, HRHF and Lee site-specific requirements.

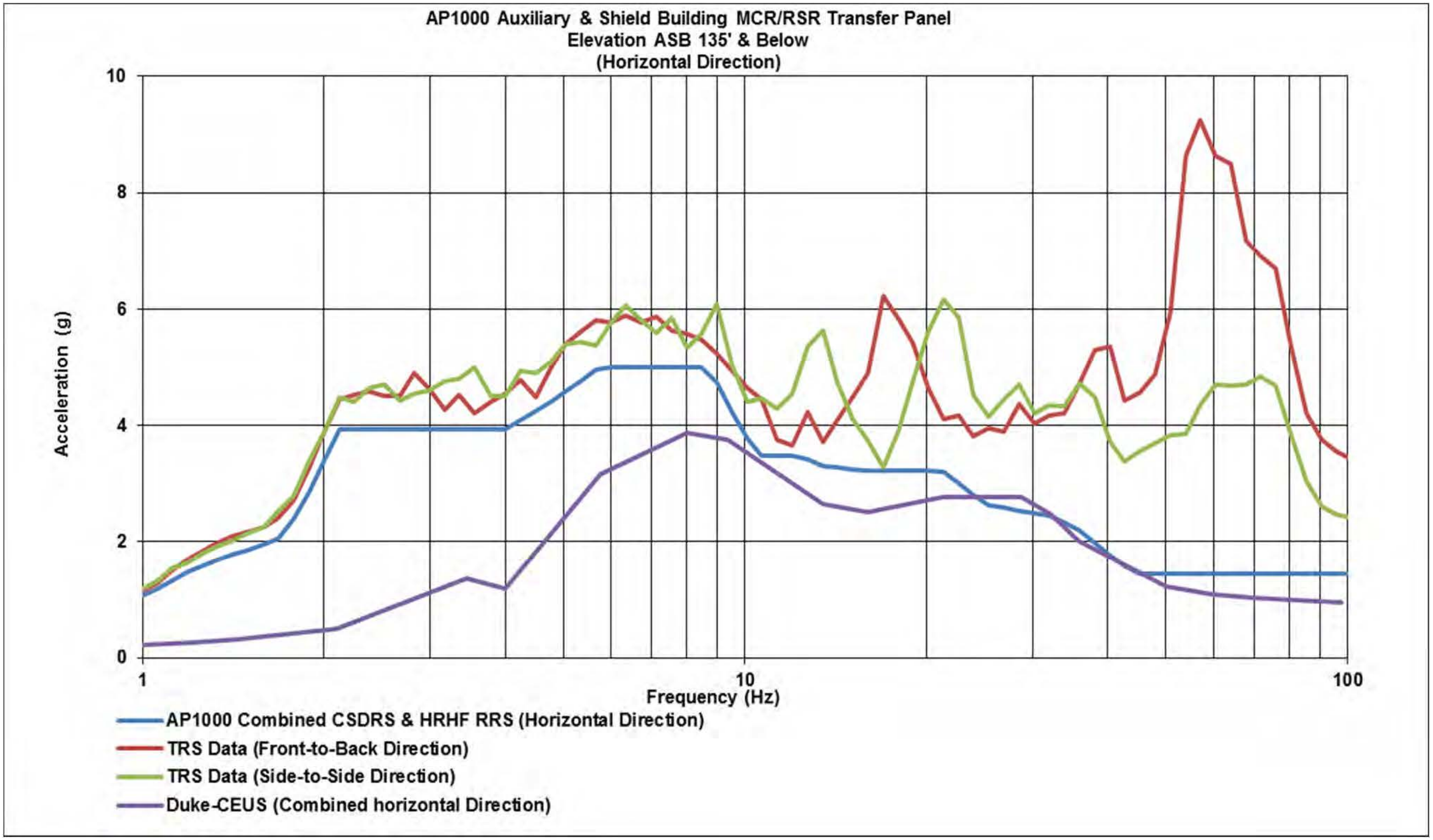
Application of AP1000 Safety-Related Electrical Equipment Testing for Lee

- TR-115 presents the evaluation of **AP1000** safety-related electrical equipment, which concluded that low frequency seismic tests envelope HF input up to 2.0 g spectral acceleration (at 5 percent critical damping);
- No additional seismic testing is required when the HRHF seismic inputs were below this level.
- **AP1000** HF-sensitive equipment are listed in DCD Rev. 19, Appendix 3I and qualified by testing to meet the combined CSDRS and HRHF required response spectra (RRS).
    - The RRS used for the **AP1000** HF-sensitive equipment is an envelop of CSDRS and HRHF with the appropriate margin factors;
- The Lee RRS is compared to **AP1000** RRS and test response spectra (TRS) for selected HF-sensitive equipment.

Lee HRHF Seismic Electrical Equipment Testing Evaluation

- Comparison of the Lee site-specific RRS to the combined CSDRS and HRHF RRS, with the same margin factors, and the **AP1000** TRS was made for the following selected HF-sensitive equipment:
  - Protection and Safety Monitoring System (PMS);
  - Nuclear Instrumentation System (NIS) Source Range (SR) Auxiliary Panel;
  - NIS Intermediate Range (IR) Auxiliary Panel; and
  - Main Control Room (MCR)/Remote Shutdown Room (RSR) Transfer Panel.
- The equipment was selected based on sensitivity to HF and the existence of HF ISRS exceedences;
- The results of the these comparisons show that:
  - The **AP1000** RRS and Lee RRS are similar; and,
  - Demonstrate that the selected HF-sensitive equipment were qualified to a higher TRS than the RRS at Lee with margin.

MCR/RSR Transfer Panel (Horizontal Direction)



Lee HRHF Seismic Electrical Equipment Testing Evaluation

- Supplemental seismic testing of HF-sensitive safety-related equipment is not needed since the Lee RRS was shown to be enveloped by the **AP1000** TRS with significant margin for the selected components evaluated.
- There is high confidence that the TRS for future qualification tests will also envelope the Lee RRS.
- For future testing, in the event there are Lee exceedences of TRS, those specified locations will be evaluated.
- If it is determined that retesting is needed, then additional qualification testing will be performed.
- Duke Energy will ensure that all future TRS are also higher than Lee site-specific RRS.

Seismic Margin Assessment Summary

- Seismic margin is the reserve capacity of SSCs that can bring the plant to a safe shut-down following an earthquake greater than the design level SSE.
- The seismic capacity is defined by High Confidence of Low Probability Failure (HCLPF) value.
- The HCLPF value reflects a 95 percent confidence (probability) of not exceeding a five percent probability of failure.
- The HCLPF values of the SSCs shall be beyond 1.67 times the ground motion acceleration of the **AP1000** CSDRS in accordance with ISG-20, i.e., 1.67 x 0.3g = 0.5g.

Seismic Margin Assessment Summary

- Based on the results of the Lee HRHF ISRS and SSCs force, stress, and testing comparison evaluations:
  - The Lee CEUS seismic input is non-damaging; and,
  - **AP1000** CSDRS seismic response bounds the Lee seismic response, and the **AP1000** CSDRS controls the design.
- Probabilistic Risk Assessment (PRA) insights and Seismic Margin analyses are based on **AP1000** CSDRS seismic response.
- Seismic Margin high confidence low probability of failure (HCLPF) values for the Lee site will be higher than **AP1000** CSDRS-derived HCLPF values.
- Thus, for the Lee site, the Seismic Margin as defined by Chapter 19 NRC regulatory guidance will be equal to or higher than the margins defined using the **AP1000** CSDRS.

Lee SC-II Adjacent Structures Seismic Analyses Summary

- The Lee SC-II Turbine Building 1st Bay and Annex building backfill configuration and backfill properties are uniform and consistent with those evaluated in the **AP1000** DCD.
- The bearing capacity of the Lee SC-II adjacent structures backfill material is greater than the corresponding calculated Lee seismic bearing demand.
- The maximum horizontal seismic relative displacement between the Lee SC-II adjacent structures and the Nuclear Island are much less than the 2-inch foundation and 4-inch top of structure gap clearances provided.
- The Lee horizontal SC-II foundation ISRS are very similar to the **AP1000** SC-II design envelope foundation spectra, which controls the potential for interaction between the SC-II adjacent structures and the Nuclear Island.

Lee SC-II Adjacent Structures Seismic Analyses Summary

- The Lee SC-II Turbine Building 1st Bay and Annex buildings vertical spectra exceeds the corresponding **AP1000** SC-II DCD envelopes.
- Vertical spectra, however, contributes less to potential Nuclear Island and SC-II adjacent structures interactions, as evidence by the low relative displacements.
- Performance criteria for SC-II buildings have been identified and committed to by Duke Energy.
- Duke Energy will complete confirmatory analysis to demonstrate applicability of the **AP1000** SC-II design, and SC-II design updates, if any, before start of SC-II construction.

Lee CEUS HRHF Seismic Analyses Final Conclusions

- After relocation of the plant, Lee Nuclear Station is a uniform hard-rock site with configuration just as described in the AP1000 DCD.
- Site-specific seismic inputs based on CEUS SSC (NUREG-2115) result in a site characteristic GMRS and Unit 1 FIRS that are higher than the DCD CSDRS spectrum (WLS DEP 2.0-1). Site spectra are also higher than DCD HRHF spectrum.
- Site-specific analyses were required for the Nuclear Island and for the adjacent SC-II buildings to demonstrate design adequacy.

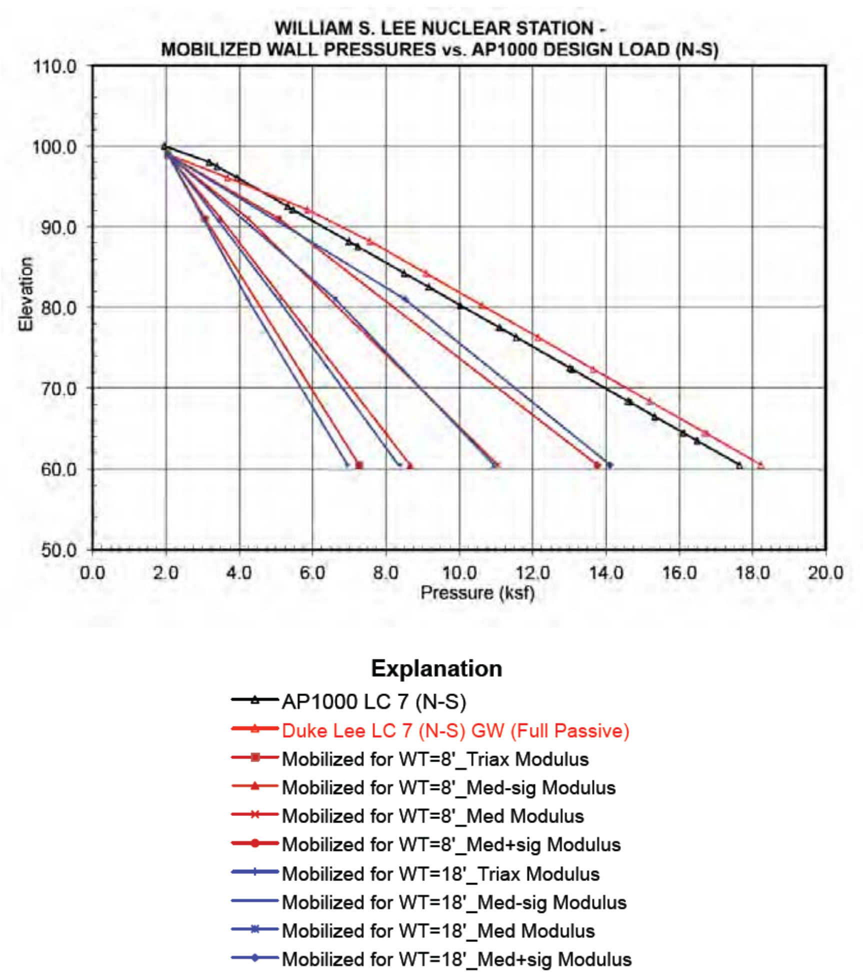
Lee CEUS HRHF Seismic Analyses Final Conclusions

- For the Nuclear Island, site-specific in-structure response spectra show minor exceedences over corresponding **AP1000** CSDRS/HRHF envelope spectra.
- Review of representative sample of structures, primary equipment and piping demonstrate that the **AP1000** CSDRS controls design forces, moments and stresses.
- Review of equipment qualification practices shows that exceedences do not affect equipment qualification, since in all completed tests, the Test Response Spectrum (TRS) is higher than the Lee site-specific Required Response Spectrum (RRS).
- Duke Energy will ensure that all future TRS are also higher than Lee site-specific RRS.

Lee CEUS HRHF Seismic Analyses Final Conclusions

- For SC-II Turbine Building 1st Bay and Annex Building adjacent structures, horizontal base spectra are very similar to **AP1000** SC-II envelope spectra, but vertical spectra are higher.
- Relative displacements between the Nuclear Island and SC-II adjacent structures are much less than space provided, therefore, there is no interaction between the structures.
- High confidence exists that the **AP1000** standard design lateral force resisting system is adequate.
- Vertical spectrum exceedences may affect details of floors and roof.
- SC-II performance criteria are identified, and confirmatory analysis and design updates, if any, will be completed before start of SC-II construction.

Lateral Earth Pressures (DEP 3.8-1)



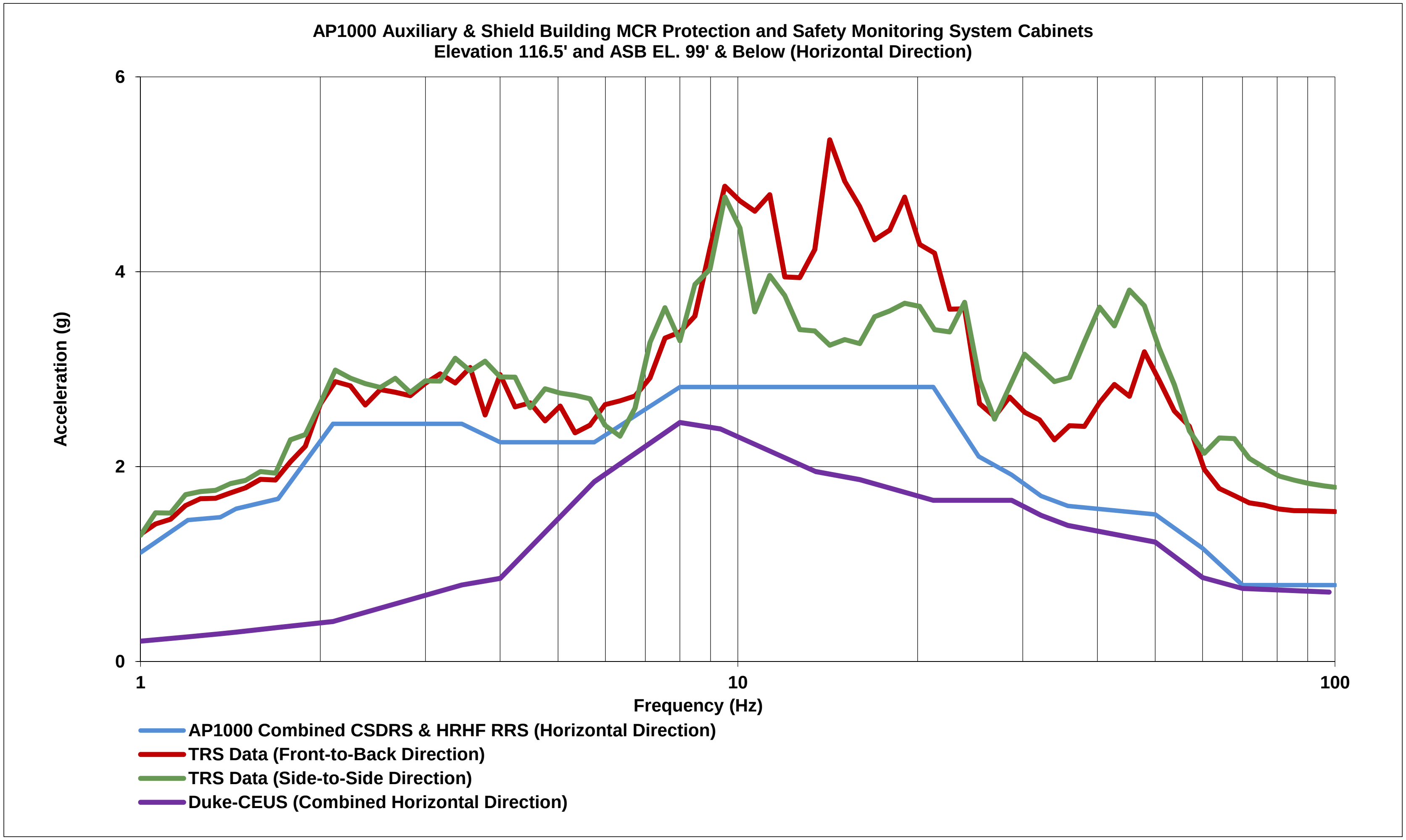
FSAR Figure 3.8-204

- Design groundwater level is 6 feet lower than DCD level
- Results in 6 feet of non-buoyant soil, heavier than considered in DCD
- Theoretical full passive pressure is higher for this heavier soil
- One load combination (LC 7) with full passive pressure is higher than AP1000
- Passive pressure <u>not</u> relied on for stability of nuclear island
- Site-specific seismic displacements (<0.2”) are too small to mobilize theoretical full passive earth pressure
- Actual site-specific lateral earth pressures are <u>less</u> than considered in AP1000 design

Backup Slides

Testing Comparison - CSDRS, HRHF and Duke Lee Electrical Equipment

PMS Cabinet (Horizontal Direction)



Staff Presentation to ACRS Subcommittee

William States Lee III (WLS) Nuclear Station Units 1 and 2 COL Application

Overview of Advanced Safety Evaluation (ASE) and ASE Chapter 1 Introduction and Interfaces

October 21, 2015

Staff Review Team

- Technical Staff
  - Sheila Ray, NRR
  - John Frost, NSIR
  - Al Tardiff, NSIR
  - Kevin Quinlin, NRO
  - Z. Gran, NRO
  - J. Giacinto, NRO
  - Robert Roche, NRO
  - Tanya Hood, NRO
  - Alexander Tsirigotis, NRO
  - P Y Chen, NRO
  - Judith McLellan, LA, NRO
  - Bret Tegeler, NRO
  - Pravin Patel, NRO

- Project Management
  - Brian Hughes

Overview

- Staff's philosophy for presentations
  - The staff does not intend to brief the ACRS subcommittee on Certified Design or standard content material
  - Emerging issues generic to the Certified Design will be presented to the ACRS on the Levy County docket

- The staff intends to provide a high-level description of the site-specific content on a chapter by chapter basis
  - The staff does not intend to brief every site-specific item, rather it intends to brief the ACRS on a subset of those issues, as appropriate

Overview Continued

- Chapters that will not be presented include the following:
  - Chapter 4, “Reactor”
  - Chapter 5, “Reactor Coolant System and Connected Systems”
  - Chapter 7, “Instrumentation and Control”
  - Chapter 10, “Steam and Power Conversion System”
  - Chapter 11, “Radioactive Waste Management”
  - Chapter 14, “Initial Test Programs”
  - Chapter 15, “Transient and Accident Analyses”
  - Chapter 16, “Technical Specifications”
  - Chapter 17, “Quality Assurance”
  - Chapter 18, “Human Factors Engineering”
  - Chapter 19, “Probabilistic Risk Assessment”

WLS COL Application

- WLS Application consists of:
  - Material incorporated by reference (IBR) from the AP1000 Design Control Document (DCD)
    - o Staff's safety evaluation for the AP1000 design certification reflected in NUREG-1793 and its supplement
    - o Staff's safety evaluation of AP1000 DC amendment was completed and presented to the committee

WLS COL Application Continued

- Standard content material (applicable to all AP1000 COL applicant)
  - The WLS safety evaluation for standard content references Vogtle's advanced safety evaluation report
    - o Standard content evaluation material is double indented and italicized
    - o Standard content evaluation contains some language from the Bellefonte safety evaluation report with open items to capture evaluations that were performed when Bellefonte was the reference COL
- WLS plant specific information

WLS COL Overview

Part Number	Description	Evaluation
1	General and Administration Information	Section 1.5.1
2	Final Safety Analysis Report	In Appropriate SER Chapters
3	Environmental Report	Final Environmental Impact Statement
4	Technical Specifications	Chapter 16
5	Emergency Plan	Section 13.3
6	Limited Work Authorization Request	Not Applicable
7	Departures and Exemption Requests	In Appropriate SER Chapters
8	Safeguards / Security Plans	Section 13.6
9	Withheld Information	In Appropriate SER Chapters
10	Proposed Combined License Conditions (Including ITAAC)	In Appropriate SER Chapters
11	Enclosures (Cyber Security, QA, LOLA)	Sections 13.8, 17 and, 19A

Overview of WLS COL FSAR Chapter 1

FSAR Section	Summary of Departures/ Supplements
1.1 Introduction	Incorporated By Reference (IBR) with Standard and Site-Specific Supplements
1.2 General Plant Description	IBR with Site-Specific Supplements
1.3 Comparison with Similar Facility Designs	IBR
1.4 Identification of Agents and Contractors	IBR with Site-Specific Supplements
1.5 Requirements for Further Technical Information	IBR
1.6 Material Referenced	IBR with Standard and Site-Specific Supplements
1.7 Drawings and Other Detailed Information	IBR with Site-Specific Supplements
1.8 Interface for Standard Designs	IBR with Site-Specific Supplements
1.9 Compliance with Regulatory Criteria	IBR with Site-Specific Supplements
1.10 Nuclear Power Plants to be Operated on Multi-Unit Sites	Standard and Site-Specific Supplements

Departures and Exemptions

Departures

- COL application organization and numbering (Section 1.5.4)
- Class 1E voltage regulating transformer current limiting features (Section 8.3.2)

Exemptions

- COL application organization and numbering (Sections
- 1.5.4 and 2.0)
- Exemption from 10 CFR 52.93(a)(1)
- From requirements of 10 CFR 70.22(b), 70.32(c), and 10 CFR 74.31, 74.41 and 74.51(Section 1.5.4)

Staff Presentation to ACRS Subcommittee

William States Lee III (WLS) Nuclear Station
Units 1 and 2 COL Application

FSER Chapter 2, Site Characteristics
Section 2.1 – Geography and Demography
Section 2.2 – Nearby Industrial, Transportation, and Military Facilities

October 21, 2015

2.1 Geography and Demography

Site Location and Description

- Coordinates, site boundaries, orientation of principal plant structures, location of highways, railroads, waterways that traverse the exclusion area

Exclusion Area Authority and Control

- Legal authority, control of activities unrelated to plant operation, arrangements for traffic control

Population Distribution

- Current and future population projections, characteristics of the Low Population Zone (LPZ), population center distance, and population density

Staff reviewed the applicant addressed above information and also staff independently verified. Based the review and confirmatory evaluation, staff found the applicant’s information to be acceptable as it meets the requirements of 10 CFR 100.20, and guidance provided in NUREG-800.

2.2 Nearby Industrial, Transportation, and Military Facilities

Identification of Potential Hazards in Site Vicinity

- Maps of site and nearby significant facilities and transportation routes
- Description of facilities, products, materials, and number of people employed
- Description of pipelines, highways, waterways, railroads and airport
- Projections of industrial growth

Staff reviewed the applicant addressed information pertaining to the location and description of Nearby Industrial, Transportation and Military Facilities for the evaluation of potential hazards for the safe operation of the proposed plant. Staff independently verified the locations and descriptions of the facilities, including transportation routes and pipelines from the data available in public domain, and found it to be acceptable as the information meets the guidance provided in NUREG-0800 Section 2.2.1-2.2.2.

2.2 Nearby Industrial, Transportation, and Military Facilities

Evaluation of Potential Accidents

Explosions and Flammable Vapor Clouds

- Truck Traffic, Pipelines, Mining Facilities, Waterway Traffic, Railroad traffic

Release of Hazardous Chemicals

- Transportation Accidents, Major Depots, Storage Areas, Onsite Storage tanks

Fires

- Transportation Accidents, Industrial Storage Facilities, Onsite Storage

Staff reviewed the applicant addressed site specific Evaluations of Potential Accidents. Staff also Performed independent confirmatory calculations in confirming the applicant’s conclusions. Based on the review of the applicant provided information, responses to the RAIs, staff evaluations and staff’s independent confirmatory analyses, the staff found the applicant’s conclusions to be acceptable as the evaluations are in accordance with the guidance provided in NUREG-0800 Section 2.2.3.

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Staff Presentation to ACRS Subcommittee

William States Lee III (WLS) Nuclear Station Units 1 and 2 COL Application

FSER Chapter 2, Site Characteristics Section 2.3 - Meteorology

October 21, 2015

Contents of Section 2.3 - Meteorology

- FSAR Chapter 2.3 incorporates Section 2.3 of the AP1000 DCD.

- COL items and Supplemental Information
  - WLS SUP 2.0-1 – Comparison Table of Site Parameters and Site Characteristics
  - WLS COL 2.3-1 – Regional Climatology
  - WLS COL 2.3-2 – Local Meteorology
  - WLS COL 2.3-3 – Onsite Meteorological Measurements Program
  - WLS COL 2.3-4 – Short-Term Diffusion Estimates
  - WLS COL 2.3-5 – Long-Term Diffusion Estimates

Section 2.3 – Meteorology Technical Topics of Interest

- **2.3.1 Regional Climatology**

  Compared AP1000 climatic site parameters with WLS climatic site characteristics
  - 50-year/100-year Wind Speed (3-second gust)
  - Maximum Tornado Wind Speed
  - Maximum Roof Load (Winter Precipitation)
  - 0% Exceedence and 100-year Return Period Air Temperatures

- **2.3.2 Local Meteorology**
  - Addressed the Cooling Tower-Induced Effects on Temperature, Moisture, and Salt Deposition
  - Provided detailed information showing that the WLS meteorological data are representative of the site area

Section 2.3 – Meteorology Technical Topics of Interest

- **2.3.3 Onsite Meteorological Measurements Program**
  - COL applicant described the onsite meteorological measurements program and provided a copy of the resulting meteorological data
  - Applicant met RG 1.23, Revision 1 criteria for siting of the tower in relation to Units 1 & 2

Section 2.3 – Meteorology Technical Topics of Interest

- **2.3.4 Short-Term (Accident) Diffusion Estimates**
  - Compared AP1000 atmospheric dispersion site parameters with WLS atmospheric dispersion site characteristics
  - COL FSAR presented offsite (EAB & LPZ) and onsite (CR) χ/Q values

- **2.3.5 Long-Term (Routine) Diffusion Estimates**
  - Compared AP1000 atmospheric dispersion site parameters with WLS atmospheric dispersion site characteristics
  - COL FSAR 2.3-5 verified release points and receptor locations

Staff Conclusions for Section 2.3 - Meteorology

- All regulatory requirements for Section 2.3 have been satisfied
- No open items
- No confirmatory items
- No exemptions or departures

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Staff Presentation to ACRS Subcommittee

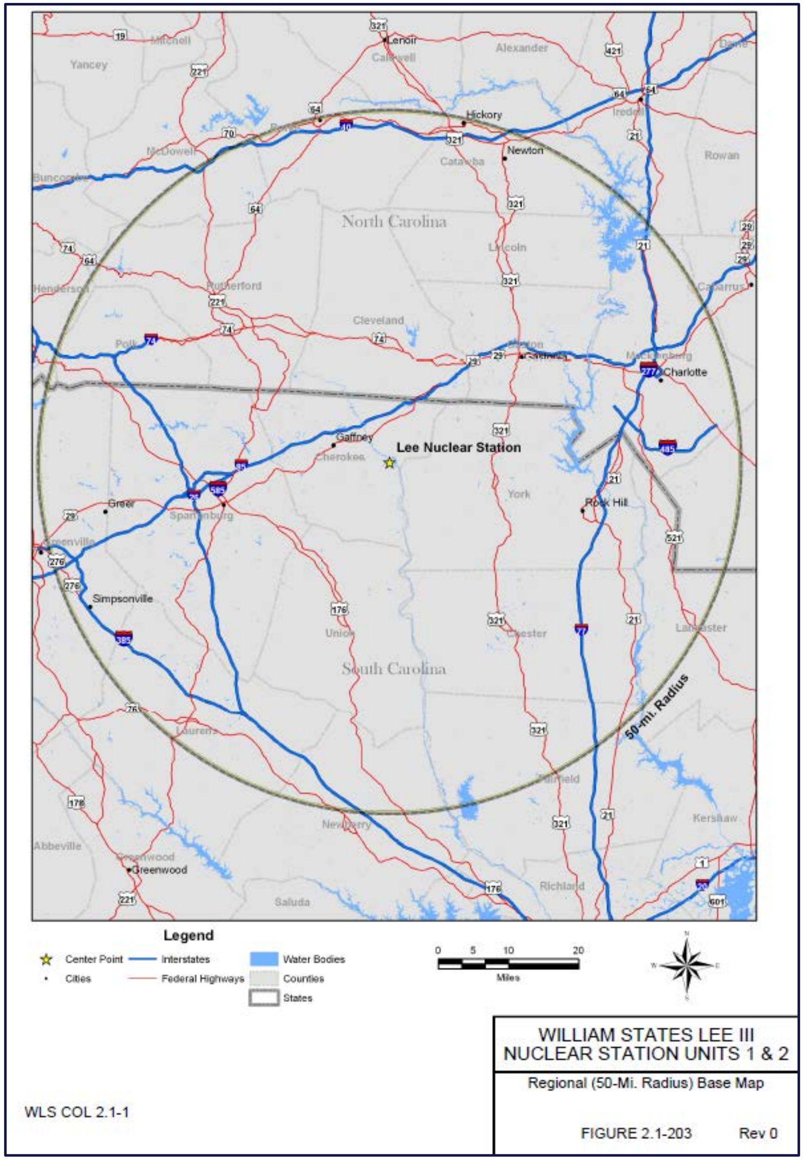
William States Lee III (WLS) Nuclear Station Units 1 and 2 COL Application

FSER Chapter 2, Site Characteristics Section 2.4 – Hydrologic Engineering

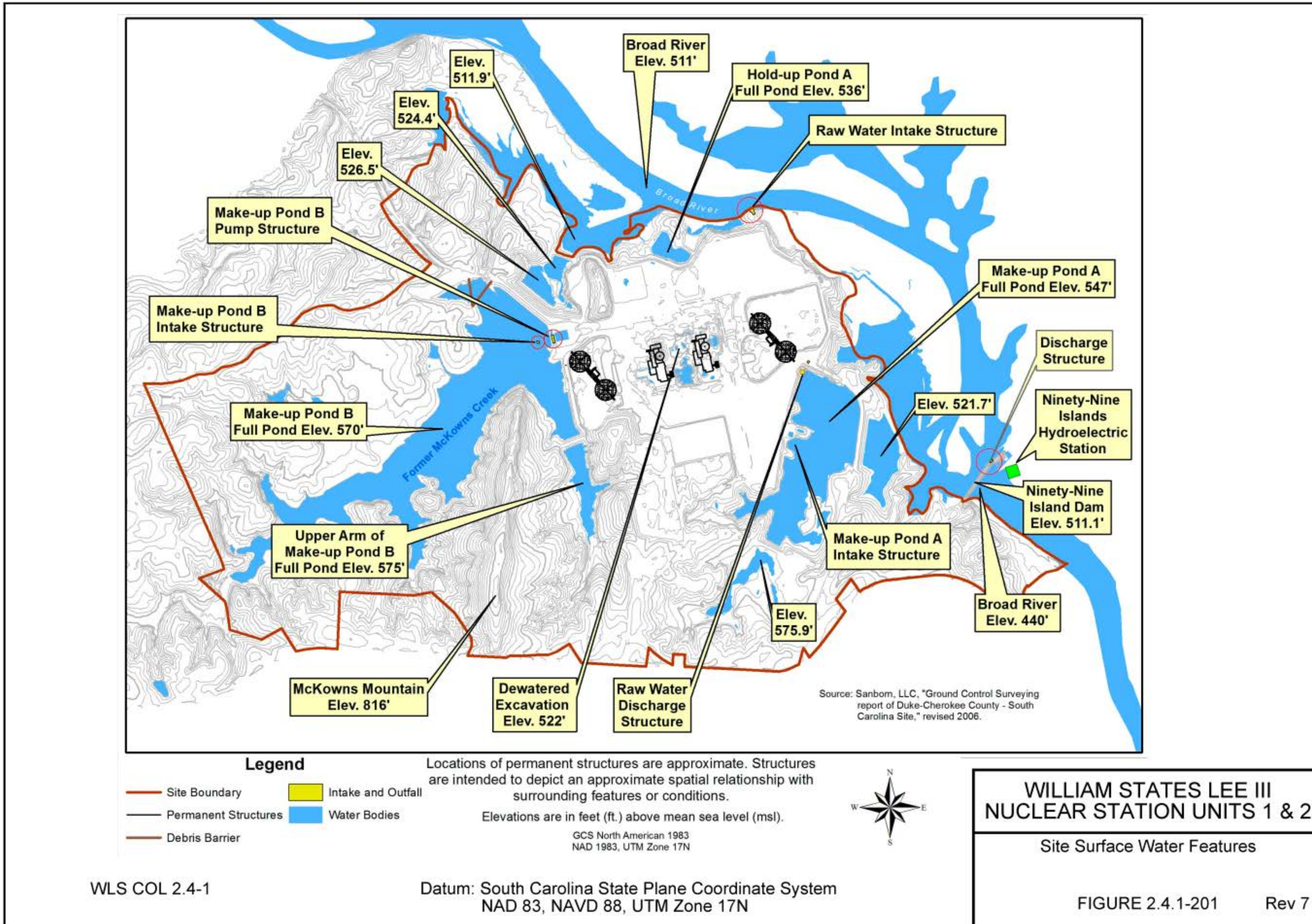
October 21, 2015

Section 2.4 – Hydrologic Engineering Staff Presentation Topics

- WLS Site Overview
- Flooding
  - Local Intense Precipitation
  - Probable Maximum Flood
- Potential Dam Failures
- Groundwater
- Conclusions



WLS Site



Broad River
Elev. 511'
Elev.
511.9'
Hold-up Pond A
Full Pond Elev. 536'
Elev.
524.4'
Raw Water Intake Structure
Elev.
526.5'
Broad River
Make-up Pond B
Pump Structure
Make-up Pond A
Full Pond Elev. 547'
Make-up Pond B
Intake Structure
Discharge
Structure
Elev. 521.7'
Ninety-Nine
Islands
Hydroelectric
Station
Make-up Pond B
Full Pond Elev. 570'
Former McKowns Creek
Ninety-Nine
Island Dam
Elev. 511.1'
Upper Arm of
Make-up Pond B
Full Pond Elev. 575'
Make-up Pond A
Intake Structure
Broad River
Elev. 440'
Elev.
575.9'
McKowns Mountain
Elev. 816'
Dewatered
Excavation
Elev. 522'
Raw Water
Discharge
Structure
Source: Sanborn, LLC, "Ground Control Surveying report of Duke-Cherokee County - South Carolina Site," revised 2006.
Legend
Site Boundary
Permanent Structures
Debris Barrier
Intake and Outfall
Water Bodies
Locations of permanent structures are approximate. Structures are intended to depict an approximate spatial relationship with surrounding features or conditions.
Elevations are in feet (ft.) above mean sea level (msl).
GCS North American 1983
NAD 1983, UTM Zone 17N
N
W
E
S
WILLIAM STATES LEE III
NUCLEAR STATION UNITS 1 & 2
Site Surface Water Features
WLS COL 2.4-1
Datum: South Carolina State Plane Coordinate System
NAD 83, NAVD 88, UTM Zone 17N
FIGURE 2.4.1-201
Rev 7

Flooding
Local Intense Precipitation (LIP)

- Safety-related SSCs 593 ft msl and above
- Applicant analysis
  - Assumed all site drainage features blocked
  - Site runoff and runoff depth maximized
  - Localized flooding result of 592.6 ft msl
- Independent staff analysis
  - Results consistent with the applicant's
  - Applicant's analysis/methods were adequately conservative

Flooding
Probable Maximum Flood (PMF)

- Shoreline Management Program (SMP)
  - Annual inspection of Make-Up Pond B shoreline to remove fallen and weak trees
  - Inspection of Make-Up Pond B spillway for debris after rainfall events exceeding 3 in/hr
  - Installation of a debris barrier system for spillway
- Staff concluded SMP would prevent blockage of Make-Up Pond B spillway
- Staff considers the SMP and the installation of debris barrier system commitments
- Highest PMF level of 589.1 ft msl results from Make-Up Pond B and includes wind wave effects

Potential Dam Failures

- Proposed Cleveland County Water dam
  - Not included in the applicant's analysis
    - 47,500 ac-ft of storage, 80 ft high, 1 mi north of Lawndale, NC
- Staff performed an independent analysis including a hypothetical failure of the proposed dam
  - Staff estimated peak dam breach discharge: 230,403 cfs
  - Other dams were assumed to fail in a manner identical to the applicant's
  - Staff used the applicant-provided HEC-RAS model to simulate flood water-surface elevation of 580.3 ft above MSL, about 3.8 ft higher than the applicant's estimate
  - Accounting for coincident wind-wave activity, staff-estimated flood water-surface elevation was 585.5 ft above MSL, 7.5 ft lower than the site grade

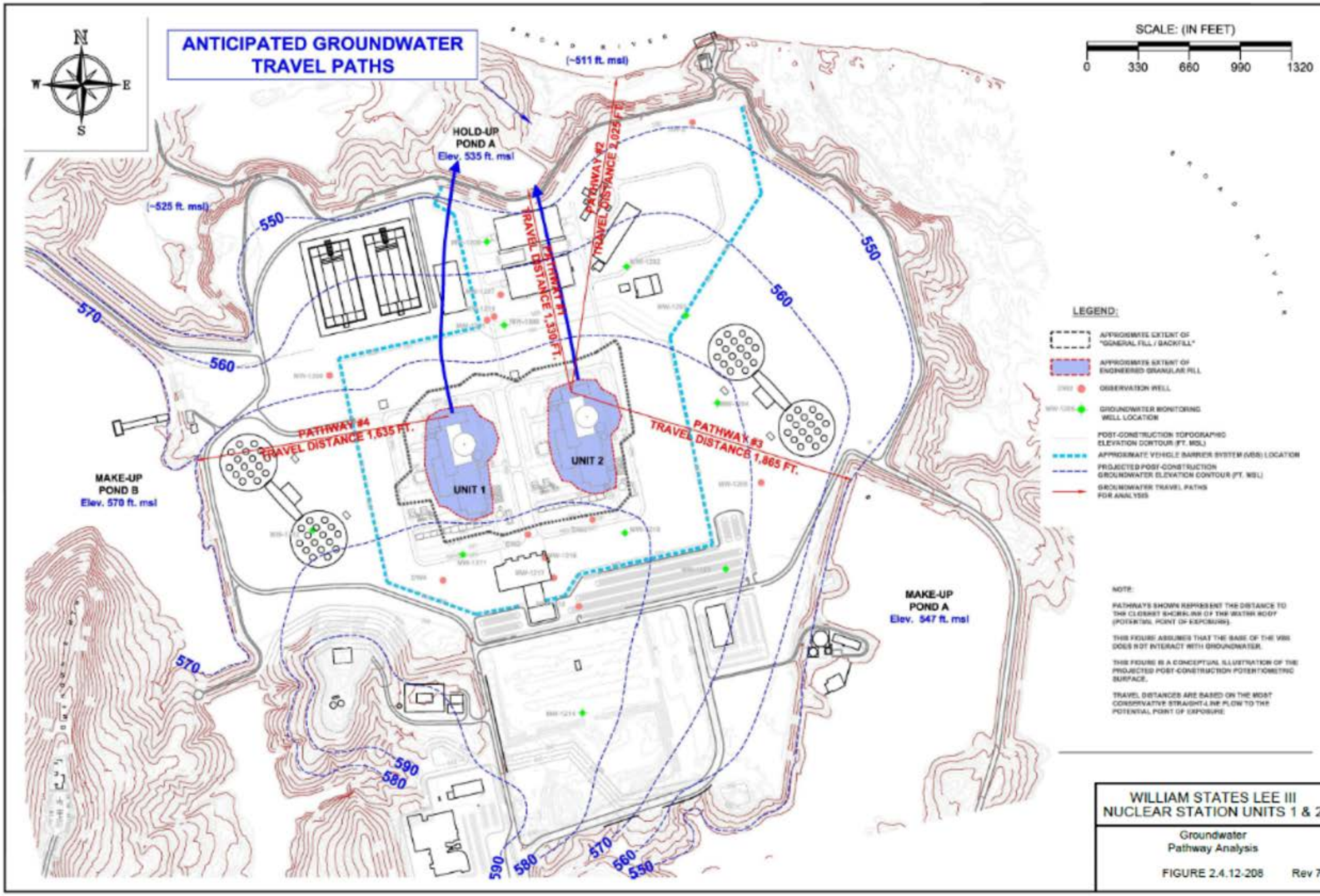
Groundwater

- General hydrogeological condition
  - Unconfined Piedmont surficial aquifer include fill material from 1970s construction of Cherokee Site
  - Groundwater flows generally from the south to the Lee Nuclear Site then west, north, and east
- Focus of staff's review
  - Maximum groundwater level cannot exceed the DCD-based local elevation of 591 ft
  - Direction and velocity of potential radionuclide movement in groundwater
- The applicant
  - Investigated hydrogeology and developed a conceptual model
  - Determined hydrologic properties of aquifer
  - Developed groundwater model to estimate maximum level

Groundwater (continued)

- Staff's confirmatory analysis and review conclusions
  - Applicant developed an appropriate conceptual model of groundwater and adequately addressed groundwater level and pathway issues
  - Model assumptions were conservative
  - Maximum groundwater level will remain below the DCD-based elevation 591 ft
  - Groundwater pathways are adequately conservative
- Staff identified a subsurface drainage pipe from former site construction that may become a preferential pathway if groundwater rose to the maximum level; necessitated license condition 15
  - Proposed License Condition 15
    - "*Prior to fuel load, the licensee shall confirm that a single legacy Cherokee project stormwater drain line (designed to transfer stormwater from the Cherokee power block area to Hold-Up Pond A) and any associated bedding material representing a potential preferential groundwater pathway have been removed and the excavation has been backfilled with compacted native soils.*"

Groundwater - Resulting Flow Paths



Water Levels at the WLS Site

Staff Conclusions for Section 2.4 - Hydrologic Engineering

- The applicant:
  - Demonstrated that the site is suitable by satisfying the applicable regulatory requirements
  - Addressed the COL-specific information items identified in the respective sections of the AP1000 DCD
  - Performed the necessary hydrological analyses and determined the design basis flood as required with acceptable level of conservatism
- There are no post-combined license activities

Backup Slides

Section 2.4.2 – Floods

- RAI 2679, Question 02.04.02-3
  - Issued June 8, 2009
  - Responses received July 17, 2009 and May 2, 2013
  - Selection of appropriate Manning's roughness coefficient
    - Applicant performed a reevaluation using increased value of Manning's roughness coefficient
    - Slight increase in estimated maximum water-surface elevation
  - Reanalysis of local flooding after relocation of the units and increase in plant grade and yard elevation

Section 2.4.5 – Probable Maximum Surge and Seiche Flooding

- RAI 823, Question 02.04.05-2
  - Issued September 22, 2008
  - Response received October 27, 2008
  - Characterization of meteorologically and seismically induced seiches in Make-Up Ponds A and B
    - The natural fundamental periods of oscillation of Make-Up Ponds A and B are much shorter than those that can be induced by meteorological forcings
    - Absence of capable tectonic sources within a 25-mi radius of the site

Section 2.4.6 – Probable Maximum Tsunami Hazards

- RAI 824, Question 02.04.06-2
  - Issued September 22, 2008
  - Response received October 27, 2008
  - Characterization of landslide and slope-failure induced tsunami-like waves in Make-Up Ponds A and B
    - No irregular weathering or natural landslides were identified during field investigations by the applicant
    - Staff determined no active or passive volcanoes are located near the WLS site, so pyroclastic flow-induced tsunami-like waves are not plausible

Section 2.4.13 – Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters

- RAIs 721, 722, 828, 2682; 29 Questions; 9/19/08 to 6/30/09
- Postulated accidental release from the liquid waste mgmt system and its potential effects on groundwater and surface water
- The applicant assumed:
  - Failure of an effluent holdup tank on the bottom floor of either auxiliary building
  - 80% of tank volume released (84,973 L [22,400 gal]) directly to the surficial aquifer
  - Four plausible transport pathways
- The applicant evaluated the ability of the groundwater and surface water environment to delay, disperse, dilute, or concentrate liquid effluent
- Applicant described the effects of postulated releases on known and likely future uses of water resources

Section 2.4.13 – Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters (cont.)

- The staff independently reviewed the applicant's analysis, based on information in the FSAR and RAI responses, including:
  - Accidental release scenario and radionuclide transport pathways.
  - Conservatism of assumptions and parameters used in transport analysis.
  - Calculation methods for transport analysis.
- The staff concluded that:
  - Direct release to the local aquifer (no transit time through containment building) is conservative
  - Parameter values used in the applicant's sensitivity analysis were appropriately conservative.
  - Maximum radionuclide concentrations were below limits
  - Total sum of fractions was less than 1 (4×10^{-5} in the Broad River)
  - The nearest potable water supply is 34 km (21 mi) downstream
  - The release scenario and pathway analysis are acceptable

United States Nuclear Regulatory Commission
Protecting People and the Environment

Staff Presentation to ACRS Subcommittee

William States Lee III (WLS) Nuclear Station Units 1 and 2 COL Application

FSER Chapter 2, Site Characteristics Section 2.5 - Geology, Seismology, and Geotechnical Engineering

October 21, 2015

Review Team - FSER Chapter 2, Section 2.5
(Geology, Seismology, and Geotechnical Engineering)

- Technical Staff (Geoscience and Geotechnical Engineering Branches 1 & 2)
  - Gerry L. Stirewalt, Ph.D., P.G., C.E.G. (Sections 2.5.1 & 2.5.3)
  - Meralis Plaza-Toledo, M.S. (Sections 2.5.1 & 2.5.3)
  - Stephanie Devlin-Gill, Ph.D. (Section 2.5.2)
  - Vladimir Graizer, Ph.D. (Section 2.5.2)
  - Weijun Wang, Ph.D., P.E. (Sections 2.5.4 & 2.5.5)
  - Wayne Bieganousky, M.S., P.E. (Sections 2.5.4 & 2.5.5)

- Project Manager
  - Brian Hughes, AP1000 COL

Focus of Staff Presentations

- Presentations focus on key technical issues for each of the three technical disciplines rather than providing a comprehensive assessment of all information reviewed and evaluated by staff for Lee Units 1 and 2.

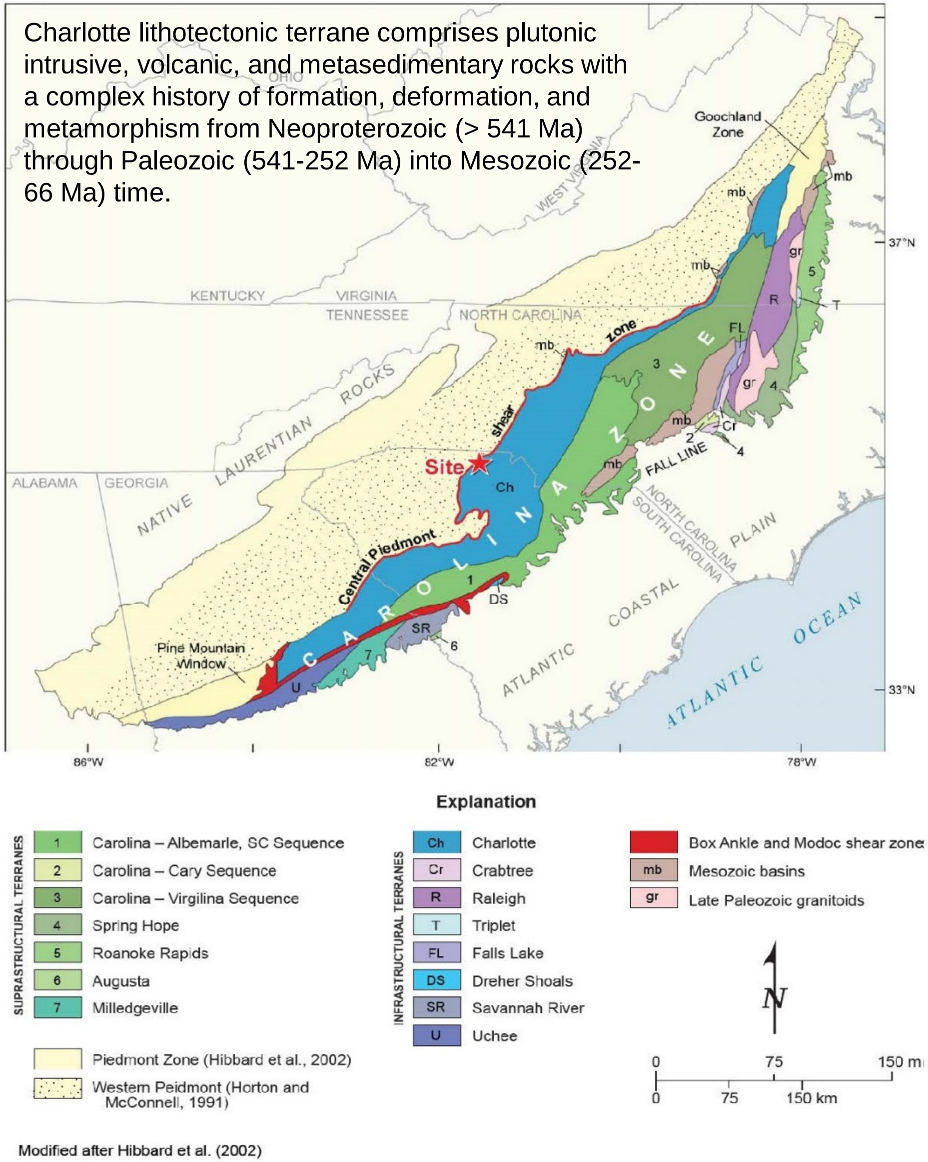
- Key technical issues were defined based on their safety significance and relationship to important site features or characteristics associated with each of the technical disciplines.

Section 2.5.1 - Basic Geologic and Seismic Information

Section 2.5.3 - Surface Faulting

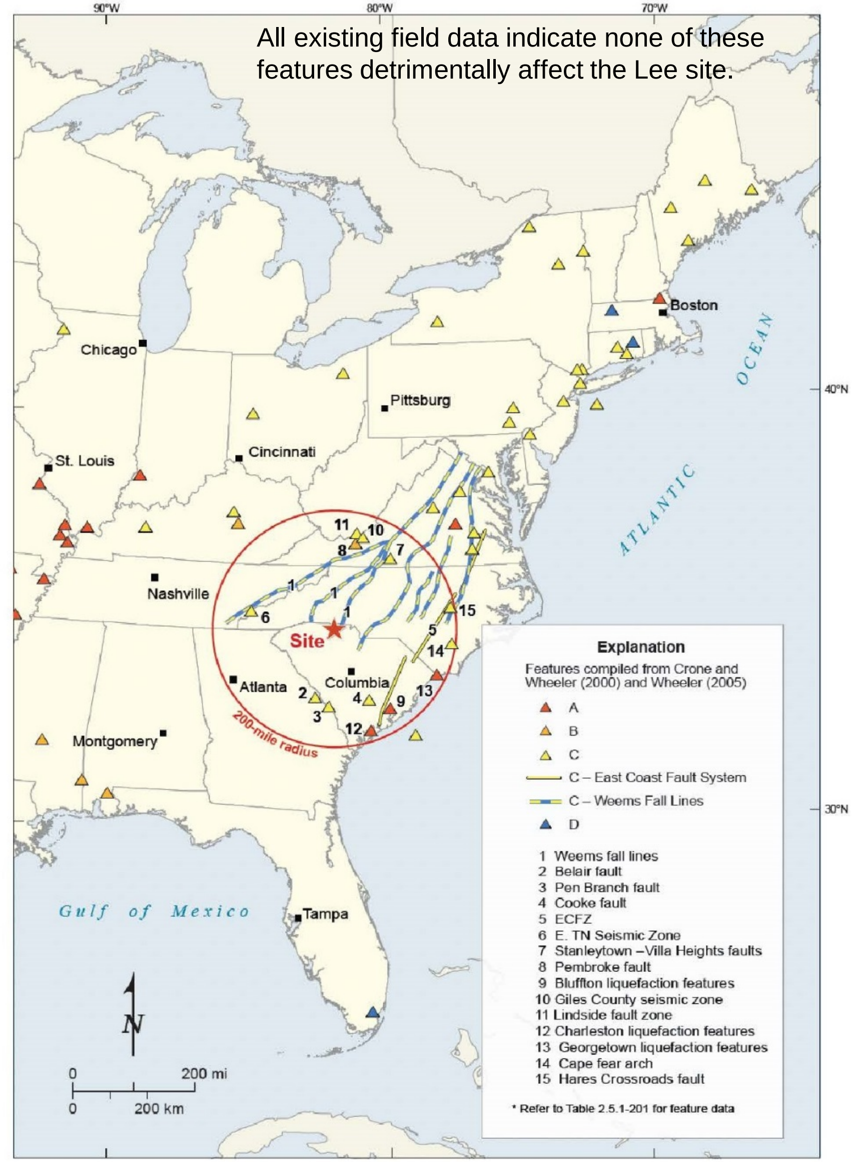
Regional Tectonic Setting

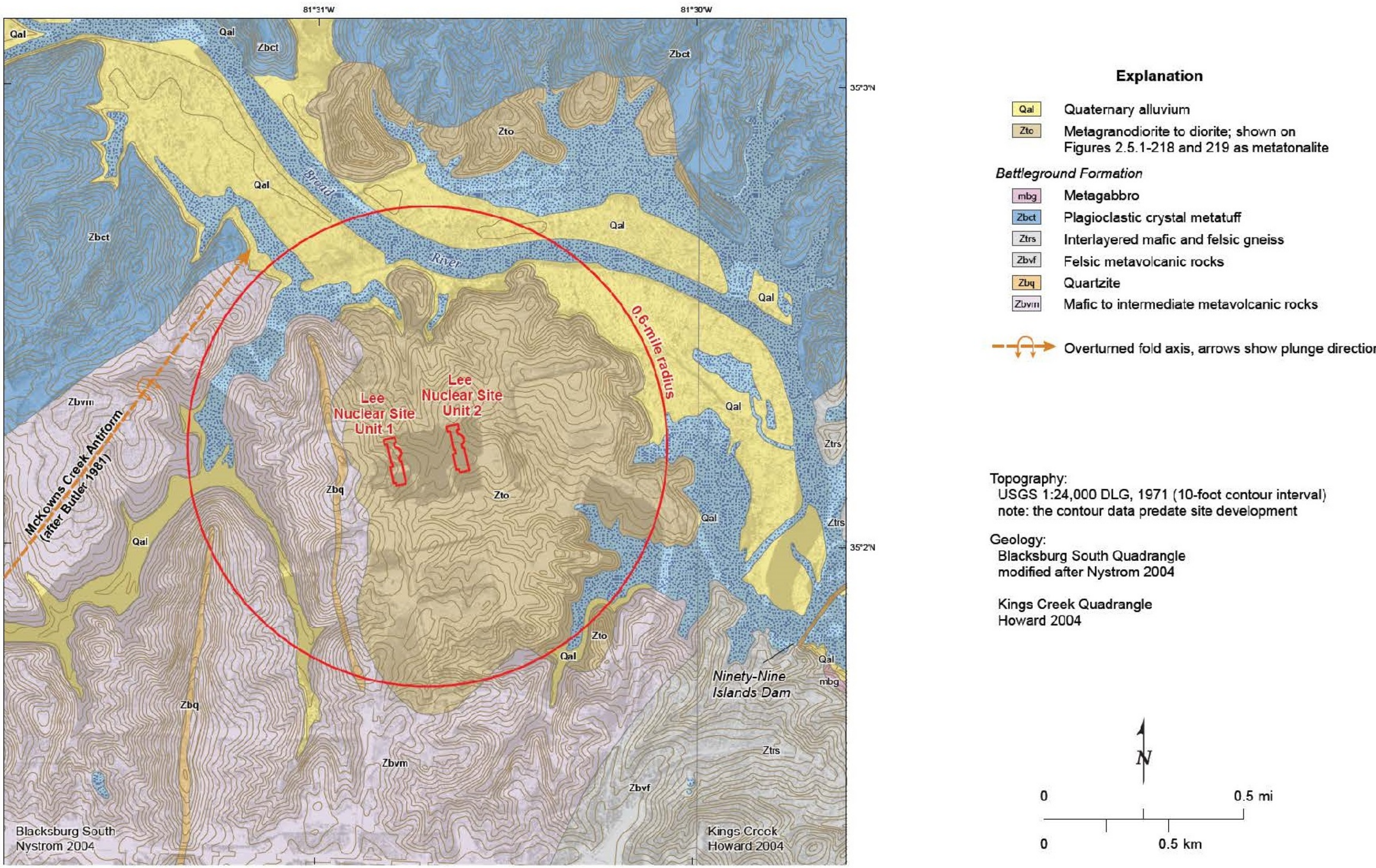
Charlotte lithotectonic terrane comprises plutonic intrusive, volcanic, and metasedimentary rocks with a complex history of formation, deformation, and metamorphism from Neoproterozoic (> 541 Ma) through Paleozoic (541-252 Ma) into Mesozoic (252-66 Ma) time.



Potential Quaternary Tectonic Features in the Site Region (15)

All existing field data indicate none of these features detrimentally affect the Lee site.





Foundation bedrock (Zto) comprises deformed and metamorphosed intrusive igneous rocks, mainly a granodiorite pluton > 300 Ma in age and diorite dikes

N45W-striking shear zone at southern edge of CNS Unit 1 concrete that trends beneath the concrete and into Lee Unit 1 foundation grade level bedrock.

Staff audited information on tectonic features and lithologies at CNS/Lee Unit 1, including digitized detailed geologic maps compiled from original field maps prepared for CNS Unit 1.

Staff audited data documenting age of shearing as older than middle Mesozoic (>145.5 Ma) based on geologic field relationships and radiometric age dates on undeformed minerals collected from the shear zones.

Based on audits and field observations, staff confirmed no shear zones younger than Mesozoic exist at Lee Units 1 or 2.

Field confirmation of geologic characteristics of foundation bedrock at Lee Units 1 and 2 by NRC staff

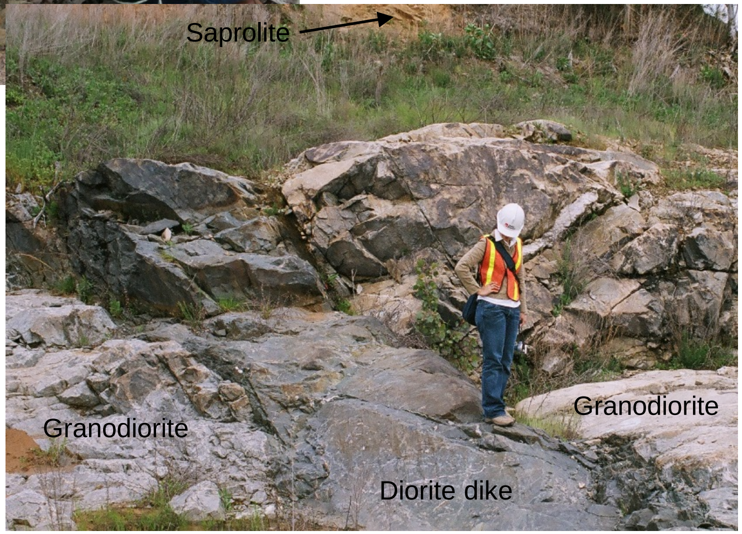
NRC field confirmation of tectonic structures and lithologic units at CNS/Lee Unit 1 and Lee Unit 2 and in the site area and site vicinity

- Staff and USGS geologists examined tectonic features and lithologies in the existing excavation for Lee Unit 2 and in outcrops adjacent to concrete at Lee Unit 1, as well as in exposures between Lee Units 1 and 2 and the site area and site vicinity.

- Staff confirmed that tectonic features and lithologic units at CNS/Lee Unit 1 match those in the Lee Unit 2 excavation and in the site area and site vicinity.

USGS geologist Dr. Tony Crone examining tectonic structures and lithologies in the Lee site area with Dr. Gerry Stirewalt

Ms. Meralis Plaza-Toledo examining tectonic structures and lithologies at the Lee site



Lee Unit 2 Geologic Mapping License Condition

- SRP Section 2.5.3 specifies the importance of a Geologic Mapping License Condition for COLs that have not completed this activity prior to license issuance.

- Staff considers detailed geologic mapping for Lee Unit 1 to be complete based on information documented by the applicant related to results of the geologic mapping for CNS Unit 1.

- Applicant plans detailed geologic mapping of excavations for safety-related engineered structures at Lee Unit 2 to assure no tectonic or non-tectonic features exist that may result in surface deformation.

  License Condition 2.5.3-1: “The licensee shall perform detailed geologic mapping of the excavation for Lee Nuclear Site Unit 2 nuclear island structures; examine and evaluate geologic features discovered in excavations for safety-related structures other than those for the Unit 2 nuclear island; and notify the Director of the Office on New Reactors, or the Director’s designee, once excavations for Unit 2 safety-related structures are open for examination by NRC staff.”

Section 2.5.2 - Vibratory Ground Motion

Change in Seismic Source Models

- Original COLA FSAR, submitted in 2007, used the EPRI-SOG seismic source models
- January 2012 – New seismic source models were published in NUREG-2115 (CEUS-SSC model)
- Consistent with guidance in RG 1.208, the staff asked an RAI regarding the new model
- In response, the applicant changed its seismic source models from the EPRI-SOG models to the newly published CEUS-SSC model
- Complete reanalysis and revision of COLA FSAR Section 2.5.2

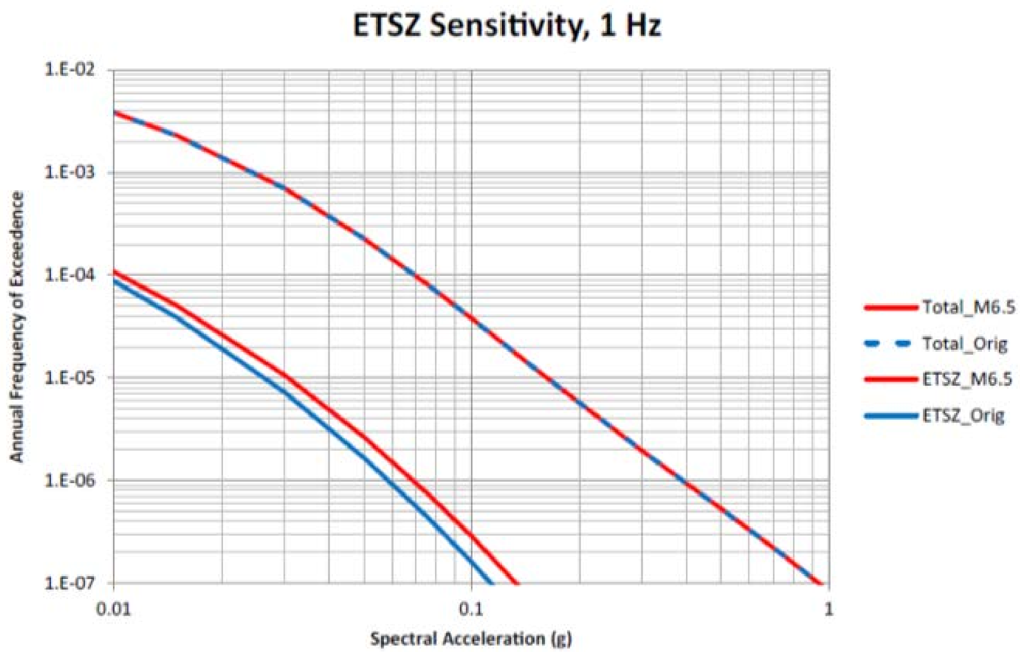
Reservoir-Induced Seismicity & Controlling Earthquakes

- The applicant evaluated the potential for reservoir-induced seismicity (RIS) associated with the construction and operation of Make-Up Pond C
- The staff reviewed the applicant’s assessment and concludes :
  - the local earthquakes that control the short period hazard at the site are larger than potential RIS (**M** < 5)
  - it is unlikely that seismicity induced from the impoundment of Make-Up Pond C at the WLS site would exceed the **M** of the short-period controlling earthquakes and the potential for RIS associated with the Make-Up Pond C impoundment is low with a negligible risk to safe operations at the WLS site

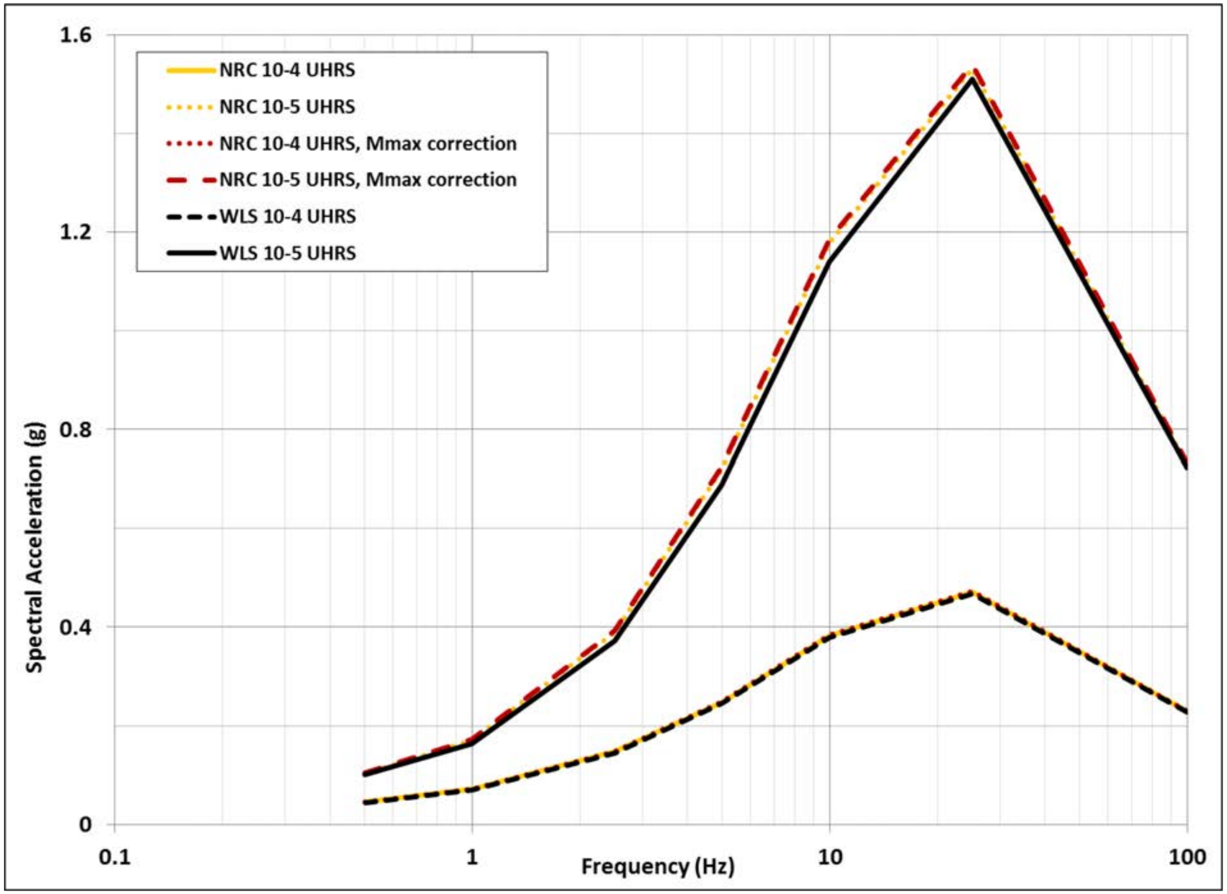
1	Mean 10^{-4}	Mean 10^{-5}	Mean 10^{-6}
Low Frequency **M** (R>100 km)	7.2	7.3	7.4
Low Frequency R (R>100 km)	250 km	230 km	190 km
High Frequency **M**	6.1	6.0	6.2
High Frequency R	35 km	16 km	12 km

Geologic Investigations of the Eastern Tennessee Seismic Zone

- **Issue:** The staff asked the applicant to evaluate the potential significance of a recent geologic study of the Eastern Tennessee Seismic Zone (ETSZ) on the site-specific seismic hazard analysis.
- **Resolution:** Staff reviewed the applicant's sensitivity studies, which indicated that incorporating a large earthquake of **M**6.5 into the ETSZ magnitude distribution resulted in insignificant increases in total hazard at the WLS site.



PSHA - Staff Confirmatory Calculations



Staff (yellow and red) and applicant's (black) Uniform Hazard Response Spectra (UHRS) results are in good agreement at the annual frequency of exceedances of 10^{-4} and 10^{-5}.

Site Response

- WLS Site is a hard rock site with the majority of shear wave velocity measurements exceeding 2.8 km/s (9,200 fps).
- The staff concluded that the ground motion prediction equations are appropriate for direct use, such that, the UHRS reflects this hard rock condition.
- The staff considered the presence of the pre-existing CNS concrete in its FIRS site response confirmatory calculations, which is covered in Section 3.7.1 to be presented to this ACRS Subcommittee later today.

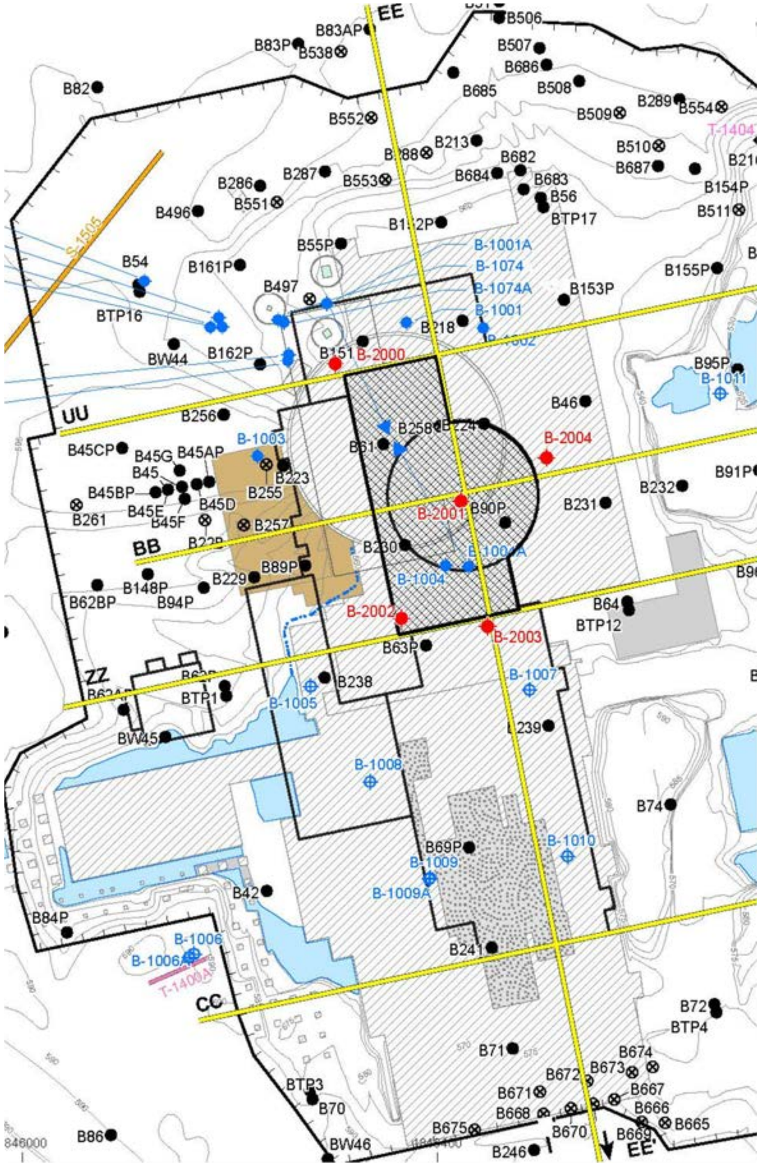
Section 2.5.4 - Stability of Subsurface Materials and Foundations

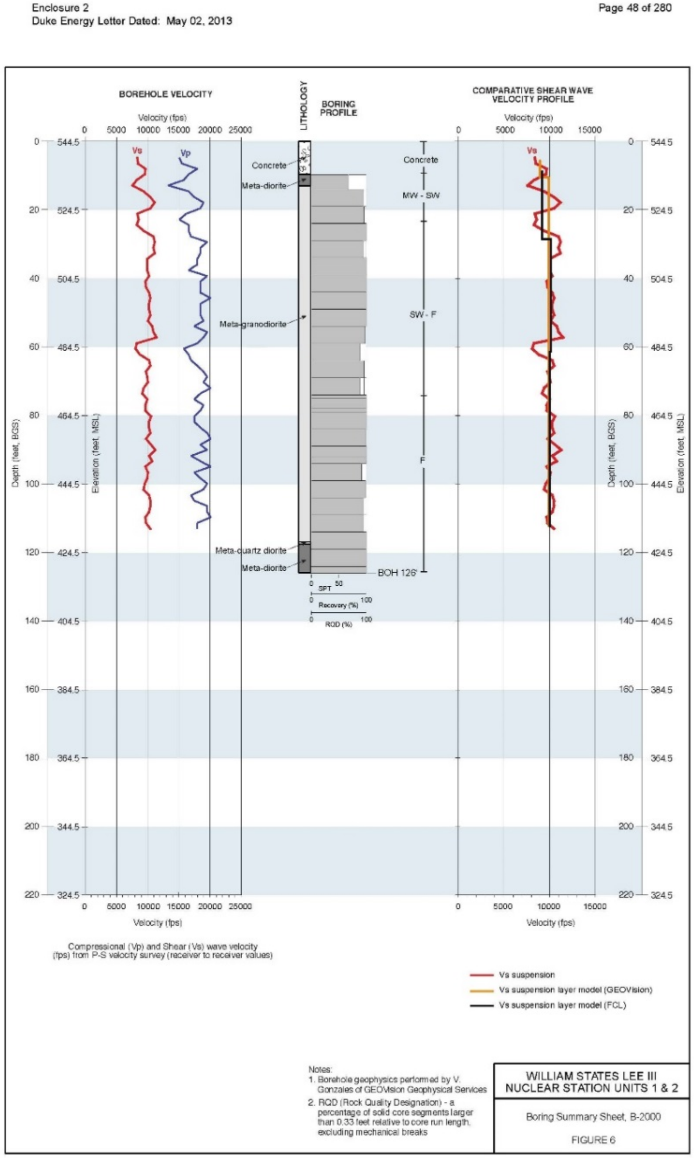
Section 2.5.5 - Stability of Slopes

CNS foundation concrete underneath the Lee Unit 1 foundation

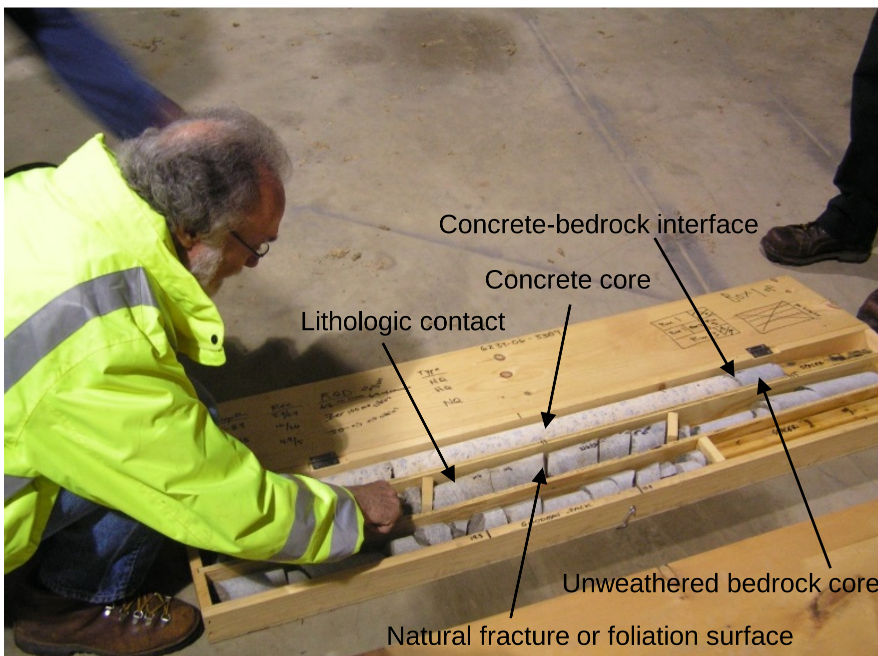
- CNS Unit 1 foundation concrete was placed on continuous rock or on leveling pad fill concrete above continuous rock.
- CNS Unit 1 concrete condition was examined during COL site investigations.
  - 14 core borings penetrated CNS Unit 1 concrete.
- CNS Unit 1 foundation concrete is about 15 ft thick on average with shear wave velocity (Vs) of 7,500 ft/s.
  - New concrete fill is designed to have similar properties.
- Applicant will use the guidance in ACI 349 when placing new concrete over old concrete.
  - QA/QC is specified.

CNS/Lee Unit 1 Borehole Locations and Borehole B-2000 Log

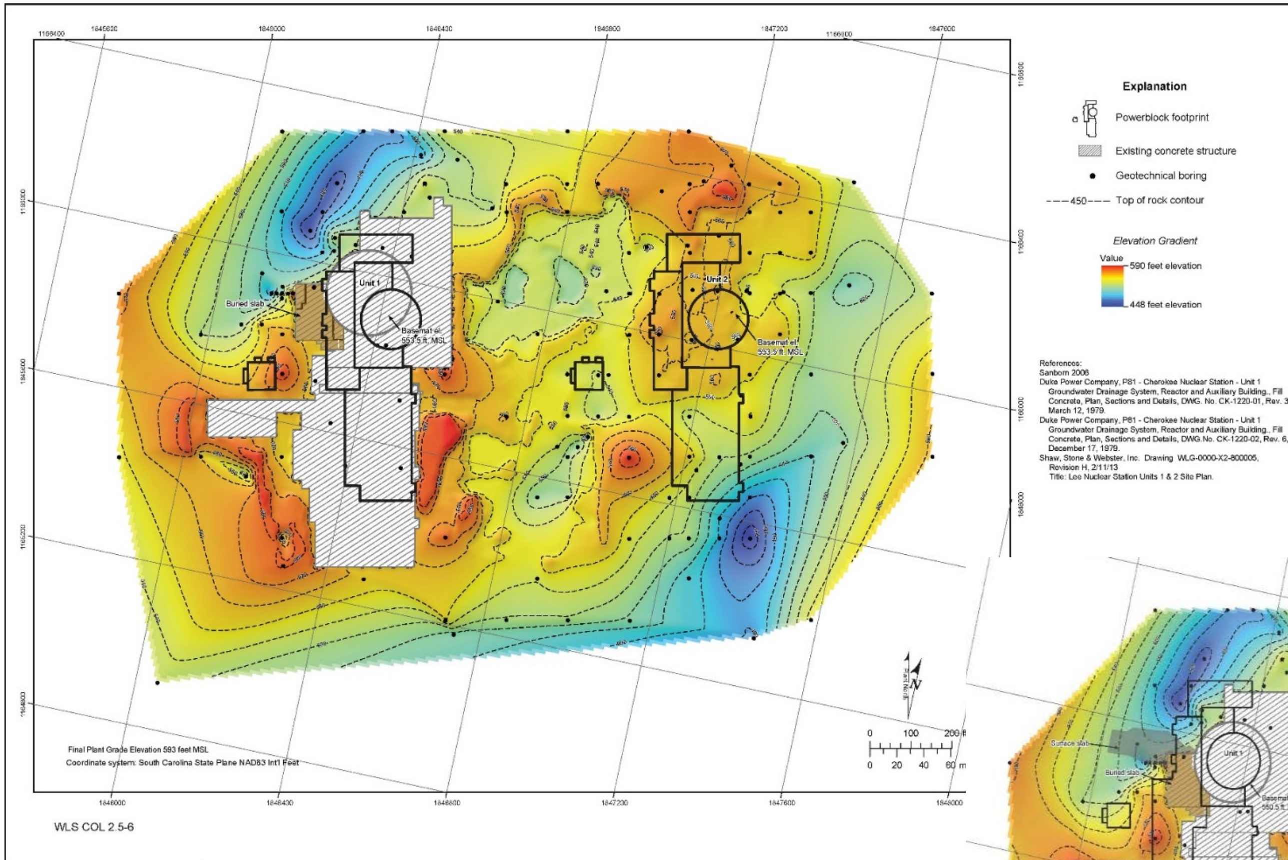




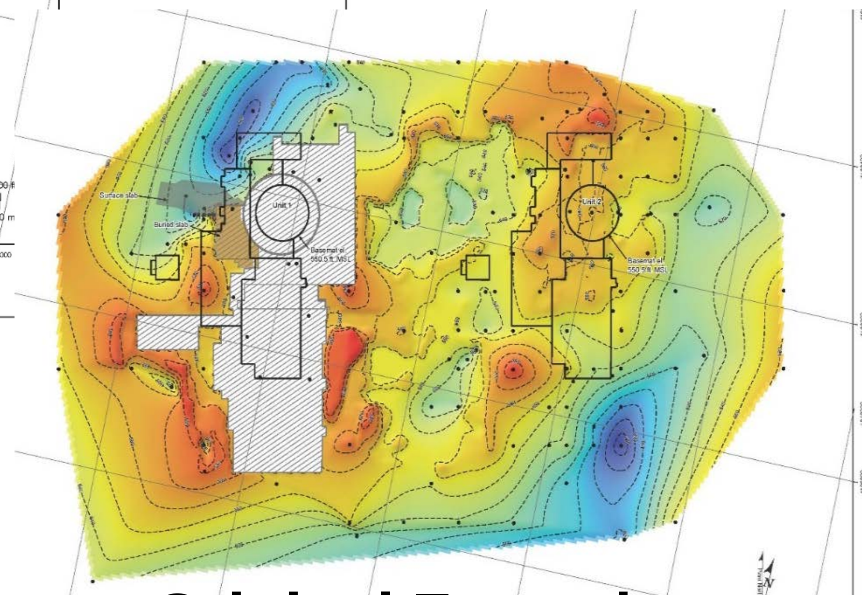
Examination of concrete and foundation bedrock core from CNS/Lee Unit 1 by NRC staff



Examination of saprolite samples from the location of CNS/Lee Unit 1 by NRC staff



Relocated Footprint



Original Footprint

Lateral Earth Pressure Evaluation

- Lateral earth pressure analysis found exceedance under one loading condition.
- This exceedance is mainly attributed to the assumption of full passive lateral earth pressure with lower groundwater level. However, full development of passive earth pressure requires large lateral displacement at the base of the nuclear island.
- Applicant performed a sensitivity study and the results showed that no full passive earth pressure will be developed.
- The detailed evaluation of this issue is presented in Section 3.8.
- This was Confirmatory Item CI 02.05.04-1 and is now closed.

Section 2.5.5

- Addressed WLS COL 2.5-14 regarding stability of all earth and rock slopes.
- No RAIs or Open Items.
- No significant technical issues.

Staff Conclusions for Section 2.5

- No tectonic or non-tectonic features occur in the site region, site vicinity, site area, or at the site location with the potential for adversely affecting suitability or safety of the site.
- No faults or shear zones younger than Middle Mesozoic (145.5 Ma) are observed so negligible potential exists for tectonic surface deformation at the site.
- GMRS adequately represents the seismic hazard at the site and accurately includes the effects of the local site subsurface properties.
- Applicant properly characterized subsurface material properties and profiles underlying the WLS site.
- Applicant used adequate analytical methods with conservative input values to evaluate stability of foundation and structures.
- Design criteria specified in the AP1000 DCD and applicable regulatory requirements are met.

Staff Presentation to ACRS Subcommittee

William States Lee III (WLS) Nuclear Station
Units 1 and 2 COL Application

FSER Chapter 3, Design of Structures, Components, Equipment, and Systems
Section 3.5 – Missile Protection

October 21, 2015

Section 3.5 – Missile Protection

Summary of FSAR Section :

- **AP1000 DCD Incorporated By Reference**
  - Standard supplemental information (STD SUP 3.5-1 and 3.5-2)

- **Site Specific Information Addressed**
  - Site-Specific Missile sources (site Proximity Missiles), 3.5.1.5 (COL Information Item 3.5-1)
  - Site-Specific Aircraft Analysis (Aircraft Hazards), 3.5.1.6 (COL Information Item 3.5-1)

Staff’s Review of COL Information Item 3.5-1

- COL Information Item 3.5-1: Address of Site-Specific Missile Sources (Site Proximity Missiles), 3.5.1.5

- Staff reviewed the applicant addressed information pertaining to site-specific sources and found to be acceptable as it satisfies the guidance and GDC 4 Criteria.

Staff's Review of COL Information Item 3.5-1

- COL Information Item 3.5-1: Address of Site-Specific Aircraft Analysis (Aircraft Hazards), 3.5.1.6

- Staff reviewed the applicant addressed information pertaining to site-specific aircraft analysis (aircraft hazards) and found the calculated aircraft crash probability less than 1.8×10^{-7} per year meeting the acceptable criterion of on the order of magnitude of 1×10^{-7} per year. The staff performed independent calculation using the actual Federal Aviation Administration (FAA) data covering 5-year period from 2004-2008 resulted in also the same probability of 1.8×10^{-7} per year. Therefore, it is concluded that the potential aircraft crash does not pose any undue risk to the safe operation of the proposed nuclear units.