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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ATOMIC SAFETY AND LICENSING BOARD PANEL

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HEARING

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In the Matter of: : Docket No.
SOUTHERN NUCLEAR OPERATING : 52-011-ESP
COMPANY : ASLBP No.
(Early Site Permit for : 07-850-01-ESP-BD01
Vogtle ESP Site) :

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Wednesday, March 25, 2009

Augusta Technical College
Waynesboro/Burke Campus Auditorium
216 Highway 24 South
Waynesboro, Georgia

BEFORE:

G. PAUL BOLLWERK, Chair, Administrative Judge
NICHOLAS G. TRIKOUROS, Administrative Judge
DR. JAMES F. JACKSON, Administrative Judge

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

(8:29:52 a.m.)

JUDGE BOLLWERK: All right. Let's go on the record, please. Good morning, everyone. We're here for the third and what will, in all likelihood, be the concluding day of the mandatory hearing for the Early Site Permit for the Vogtle 3 and 4, the proposed Vogtle 3 and 4 units.

We're going to hear this morning testimony relating to a presentation on seismic. Also, we have scheduled for this morning, or today, additional presentations on Severe Accident Mitigation Design Alternatives, and also the AP-1000 Design Certification revisions.

At this point, I think there's one administrative matter I know of we need to take care of, which is with respect to Exhibit SNC00001p.

MR. BLANTON: Yes, Your Honor, thank you. I think we need to offer it to be marked for identification first. And this is Chapter 9 of the Environmental Report, as we've discussed yesterday.

JUDGE BOLLWERK: All right. Then the record should reflect that Exhibit SNC00001p is marked for identification.

(WHEREUPON, THE DOCUMENT

REFERRED TO WAS MARKED AS EXHIBIT SNC00001p-MA-BD01 FOR IDENTIFICATION.)

MR. BLANTON: We move to admit it.

JUDGE BOLLWERK: Any objection? Hearing none, then Exhibit SNC00001p is admitted into evidence. I think I got the right number of zeroes in there, but we'll correct that if we need to.

(WHEREUPON, THE DOCUMENT REFERRED TO, PREVIOUSLY MARKED EXHIBIT SNC00001p-MA-BD01 FOR IDENTIFICATION, WAS RECEIVED IN EVIDENCE.)

JUDGE BOLLWERK: All right. And then I believe that -- anything else the parties have administratively we need to take care of at this point?

All right. Then let's move on then to our witnesses on seismic, and we have a considerable panel here. I guess I did get the right number of chairs. I guess we did count right. Why don't we go ahead and have the Applicant introduce their witness. We'll get him sworn in, and then we'll move -- deal with the exhibits, and then go to the Staff.

MR. BLANTON: Thank you, Your Honor.

Southern Nuclear's witness on the seismic evaluation issue is Mr. Donald P. Moore.

JUDGE BOLLWERK: All right. If you could raise your right hand, please, and respond orally to the question I'm going to ask you.

Do you swear or affirm that the testimony you will give in this proceeding will be the truth, the whole truth, and nothing but the truth?

MR. MOORE: I do.

JUDGE BOLLWERK: Thank you, sir.

MR. BLANTON: Your Honor, Mr. Moore has three exhibits, I think, that have not yet been introduced. First is, SNC000091, which is the Presentation.

JUDGE BOLLWERK: All right. Let the record reflect that Exhibit SNC000091 is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT SNC000091-MA-BD01 FOR IDENTIFICATION.)

MR. BLANTON: SNC000092 is Mr. Moore's CV.

JUDGE BOLLWERK: All right. The record should reflect that SNC000092, as identified by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT SNC000092-MA-BD01 FOR IDENTIFICATION.)

MR. BLANTON: SNC000093 is Chapter 2.1 of the Vogtle Early Site Permit Application Safety Analysis Report.

JUDGE BOLLWERK: The record should reflect that Exhibit SNC000093, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT SNC000093-MA-BD01 FOR IDENTIFICATION.)

MR. BLANTON: And SNC000094 is a site layout from Part 2 of the Site Safety Analysis Report.

JUDGE BOLLWERK: All right. Then the record should reflect that Exhibit SNC000094, as described by counsel, is marked for identification.

MR. BLANTON: And we would move to admit those exhibits at this time.

JUDGE BOLLWERK: Any objections? Hearing none, then Exhibits SNC000091, 92, 93, and 94 are admitted into evidence.

(WHEREUPON, THE DOCUMENTS

REFERRED TO, PREVIOUSLY MARKED
EXHIBITS SNC000091-MA-BD01
THROUGH SNC000094-MA-BD01 FOR
IDENTIFICATION, WERE RECEIVED
IN EVIDENCE.)

JUDGE BOLLWERK: All right. Then let's turn to the Staff panel, and we have a host of thousands here. No, a large panel. Why don't we go ahead and let you introduce the witnesses so the court reporter can try to figure out who's who here.

MS. PRICE: Good morning, Your Honor.

JUDGE BOLLWERK: Make sure you tap and get close.

MS. PRICE: Okay. Good morning, Your Honor. Starting on the far left, we have Mr. Mark Notich, who is not currently on the witness list, but we did want to have him up there, because there are some environmental slides in the presentation.

JUDGE BOLLWERK: All right. Any objection from the Applicant? All right. Thank you.

MS. PRICE: Next to Mr. Notich is Mr. Christian Araguas, with Mr. Bret Tegeler, Dr. John Ma, Dr. Weijun Wang, Dr. Carl Costantino, Ms. Sarah Gonzalez, Ms. Laurel Bauer, and Dr. Gerry Stirewalt.

JUDGE BOLLWERK: All right. Thank you.

All right. I believe that -- let's see. Mr. Notich, you've already been sworn. Mr. Araguas, you've already been sworn. I think, are all the rest of the members of the panel new witnesses?

MS. PRICE: Yes, Your Honor.

JUDGE BOLLWERK: All right. Very good. Then I need all of you to raise your right hand, and respond orally to the question I'm going to ask you. And when you do respond, let's start at this end, and just move one after another right down the line.

Do you swear or affirm the testimony you will give in this proceeding will be the truth, the whole truth, and nothing but the truth? Make sure you've got it in front of a mic so that the court reporter can pick it up.

MR. TEGELER: Yes, Your Honor.

DR. MA: Yes, I do.

DR. WANG: I do.

DR. COSTANTINO: Yes.

MS. GONZALEZ: I do.

MS. BAUER: I do.

DR. STIREWALT: I do.

JUDGE BOLLWERK: All right. Thank you very much. We're going to have to work out the logistics of the mics here as we go along, but bear with us. We'll kind of pass it around and make sure everybody gets an opportunity to say what they need to.

All right. Then I think with respect to the Staff, we have some exhibits to take care of, as well.

MS. PRICE: We do. I'd like to start with NRC00065, which is Staff Presentation 7, the Seismic Evaluation.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000065, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000065-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: And then NRC000081, which is the CV for Laurel Bauer.

JUDGE BOLLWERK: And the record should reflect that Exhibit NRC000081, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000081-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: NRC000082, the CV for Sarah Gonzalez.

JUDGE BOLLWERK: The record should reflect that the Exhibit NRC000082, as identified by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000082-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: NRC000083, the CV for Gerry Stirewalt.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000083, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000083-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: NRC000084, the CV for Weijun Wang.

JUDGE BOLLWERK: And the record should reflect that Exhibit NRC000084, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS

EXHIBIT NRC000084-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: NRC000085, the CV for Carl Costantino.

JUDGE BOLLWERK: And the record should reflect that Exhibit NRC000085, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000085-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: And NRC000086, the CV for John Ma.

JUDGE BOLLWERK: The record should reflect that Exhibit NRC000086, as described by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000086-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: At this time, I'd move to admit these exhibits into the record.

JUDGE BOLLWERK: Is there an 87?

MS. PRICE: Oh, yes. Sorry about that. We also have NRC000087.

JUDGE BOLLWERK: And that is the?

MS. PRICE: That is the CV for Bret Tegeler.

JUDGE BOLLWERK: Thank you. Exhibit NRC000087, as identified by counsel, is marked for identification.

(WHEREUPON, THE DOCUMENT REFERRED TO WAS MARKED AS EXHIBIT NRC000087-MA-BD01 FOR IDENTIFICATION.)

MS. PRICE: Again, at this time, we'd move to have those exhibits admitted into the record.

JUDGE BOLLWERK: All right. Any objections? Hearing none, then NRC Exhibits NRC000065, NRC000081, 82, 83, 84, 85, 86, and 87 are admitted into evidence.

(WHEREUPON, THE DOCUMENTS REFERRED TO, PREVIOUSLY MARKED EXHIBITS NRC000065-MA-BD01, NRC000081-87-MA-BD01 FOR IDENTIFICATION, WERE RECEIVED IN EVIDENCE.)

MS. PRICE: We have just one administrative matter. Apparently, Mr. Ma is having difficulty speaking, and I'm concerned that he might lose his voice.

JUDGE BOLLWERK: All right.

MS. PRICE: I wondered if it would be okay if Mr. Tegeler read Mr. Ma's slides for him, and then let Mr. Ma answer any questions that you have.

JUDGE BOLLWERK: Okay. Just let us know, and we'll work around that. Thank you.

MS. PRICE: Thank you.

JUDGE BOLLWERK: Okay. I believe at this point we're ready then to turn back to the Applicant's witness, and begin his presentation. And we're dealing with Exhibit SNC000091.

MR. MOORE: Good morning. It's an honor to present to you this morning the information on the geology, seismology, and geotechnical aspects of the Vogtle ESP LWA application.

My name is Don Moore. I'm with Southern Nuclear Operating Company, and my title is Consulting Engineer. My responsibilities for the ESP LWA application is to provide Southern Nuclear overall technical oversight of Section 2.5, which is geology, seismology, and geotechnical portions of the application. As such, I represented Southern Nuclear in the technical decision making process required of this multi-disciplined effort.

I will provide this morning a high-level overview of Section 2.5, hopefully, addressing the Board's request in regard to this section, and focusing on the key areas that form the basis of 2.5. Could I have Slide Two, please.

Please note at the bottom of these slides, certain slides have an exhibit number, which it means that information has been submitted for this hearing that supports the slide information.

Briefly, I would like to let the ASLB panel know something about my professional experience and qualifications. I have 40 years of experience in commercial nuclear power plant industry in the area of civil, structural, seismic analysis and design, solar dynamic behavior, and seismic qualification of structures, systems, and components. I'm a registered Professional Engineer, and I have a Master's degree in Engineering Science relating mainly to structural engineering. Again, my position at Southern Nuclear is Consulting Engineer, which is the highest engineering technical classification at Southern. Slide Three, please.

I have been a member of various national standard and code committees on site analysis and design of nuclear facilities, and seismic qualification of electrical and mechanical equipment, as shown here. Note that ASCE Standard 43 is listed, which will be mentioned later, as providing the methodology for developing the Vogtle Site Pacific Ground Motion Response. Also, at the bottom, I note that I'm a member of various nuclear power industry committees working on resolving generic seismic issues.

I would like to conclude, though, that even though I have provided technical oversight, and have an in-depth knowledge of the development of 2.5, I do not profess to have all the technical expertise that was required of the many disciplines required to develop 2.5. Next slide, Slide Four, please.

The ESP Solar sections are outlined here in this slide. As I said earlier, my presentation will provide a high-level overview. The main focus of this presentation will be on those sections with a checkmark to the right. To support the LWA request, additional information was required in the ESP application. Those sections that were significantly modified or added to support the LWA are shown with a red checkmark. Slide Five, please.

I think it's important just to point out the seismic organization that was put together to develop Section 2.5. This slide provides the program organization at the top. Of course, Southern Nuclear has the overall management of this task. My responsibility, as part of Southern Nuclear, was to provide overall technical oversight.

Bechtel managed and performed the tasks required of 2.5. Due to the multi-disciplined expertise required, other organizations were involved. And, as shown here, we have William Lettis and Associates. They did the geology and seismical test. We had Risk Engineering do the site-specific Probabilistic Seismic Hazard Analysis, PSHA, and development of the SSE. We also have Bechtel San Francisco do the slight response, and also worked on some of the seismological tasks, and also involved in the development of the site-specific SSE, the GMRS which is the Ground Motion Response Spectra.

Due to the technical complexity of 2.5, Southern Nuclear formed a Review and Advisory Panel of outside experts to review the work at key steps, key stages in the site investigation to provide comments and recommendations, and I'd like to point out who these members were. First, we had Dr. Martin Chapman, Professor at Virginia Tech. He's an expert in southeast seismology. We have Dr. Robert Kennedy, a renowned seismic structural expert, and was a key contributor to the performance-based method used to develop the GMRS, that is ASCE 43-05. We had Dr. Carl Stepp, who's a former member of the NRC, and later manager of the EPRI seismic program that developed the PSHA that was used as a starting point for the Vogtle site-specific PSHA. And, finally, we had Dr. Robert Youngs of Geometrics, who's an expert in seismic hazard and side amplification. Slide Six, please.

To help get us oriented, I have a site plan here showing the location of the two new units, 3 and 4, to the location of the existing Vogtle Units 1 and 2. I have several plans, views shown here. In all of these, plant north is up, and so that will help us keep ourselves oriented. I want to note that Unit 3, the union at 3 is only about 1,700 feet west of the existing Unit 2. The geology and geotechnical soil conditions are basically the same for all four units. Therefore, there's basically nothing new in regard to site soil conditions. We have successfully addressed soil conditions at the site, and have built two units that have been operating for about 20 years. Slide Seven, please.

Here we have an aerial view of the Vogtle site, with the layout of the two new units, 3 and 4, overlaid. Here, again, we have Unit 1 and 2, and to the west we have Unit 3 and 4. In the upper right corner, we have the Savannah River, which, of course, is the boundary between Georgia to the left, and South Carolina to the upper right.

On the South Carolina side is the DOE Savannah River site. The Savannah River site have similar geological features as the Vogtle site. There has been a significant amount of geological, seismological, and geotechnical studies performed at the Savannah River site, including multiple deep borings, and fault identification studies.

As part of the Vogtle ESP site investigation, Savannah River site shared much of their site information that proved to be very useful in supporting the Vogtle site investigation for the ESP. For example, this included several site visits by William Lettis and Associates to investigate site features, evaluate data, and perform independent studies, like geomorphic mapping of a river terrace overlying the Pen Branch Fault to provide additional data to conclude that the Pen Branch Fault is not a tectonic source. We'll discuss that a little bit later in the presentation. Slide Eight, please.

I will provide an overview from different sections in 2.5, as previously identified, but the order that I present it will not, necessarily, be in numerical order. Instead, I want to follow how the data was assembled to obtain the final results and conclusions provided in 2.5.

Here, we start off at 2.5-1. This slide provides the basic geologic and seismic information. For example, this slide here provides the different types of studies performed for the Vogtle ESP to evaluate the tectonic features. Studies, of course, were also made of non-tectonic features to assess site acceptability. Slide Nine, please.

Now, here's an example, one of the most significant investigations performed for the Vogtle ESP. It is the seismic reflection survey performed at the Vogtle ESP site in order to locate the Pen Branch Fault. The Pen Branch Fault was identified beneath the Savannah River site. The Pen Branch Fault is neither exposed, nor expressed at the surface of the Savannah River site. Previous studies have determined that the Pen Branch Fault is not a capable tectonic source. It's not a source for motion at the site.

The ESP site investigations, though, indicated that the Pen Branch Fault may actually cross under the Vogtle site. It was decided to perform a seismic reflection survey to determine if, indeed, this was the case for the following reasons. One, of course, is the completeness of our site investigation. And most importantly, we need to identify the potentially different rock formations directly below the site. The Pen Branch Fault is associated with the boundary between the Triassic Dunbarton Basin rock and the harder crystalline rock.

I'm going to describe this figure for you. On the right is southeast, on the left is northwest, and there is -- if you can see here, this is a seismic reflection survey, and you can see a dipping reflector right here. This actually is the Pen Branch Fault. And to the southeast is the Triassic basin rock, and to the northwest is the crystalline basement rock. We have a horizontal reflector shown here, and this is the bottom of the coastal plain sediments. And there is a pull, or uplift shown here, and that is caused by the reverse fault displacement of the coastal plain sediments by the Pen Branch Fault.

JUDGE BOLLWERK: So what you're referring to, if you look at the photograph, is that the fault comes -- basically, there's a horizontal line running across the center. The fault then comes down from the center toward the right-hand side of the photograph.

MR. MOORE: Right. Correct.

JUDGE BOLLWERK: And then you mentioned a
-

MR. MOORE: There is a -- this particular rock, there's a reverse fault movement up.

JUDGE BOLLWERK: That's in the center of the photograph, that's part of the horizontal line.

MR. MOORE: Right.

JUDGE BOLLWERK: Right.

MR. MOORE: And what is showing here, too, is these horizontal lines, and there is a warp or distortion here, which is basically distortion of the lower sand sediments due to the fault displacement.

JUDGE BOLLWERK: All right. Thank you.

JUDGE JACKSON: You said that it had been determined that this fault was not capable, is that the term of art, which means -

MR. MOORE: That's correct.

JUDGE JACKSON: -- that it is not considered a source for earthquake?

MR. MOORE: That is correct.

JUDGE JACKSON: Is that -

MR. MOORE: It is not considered to be capable source for generating ground motion.

JUDGE JACKSON: Is that related primarily to its depth, because it's not expressed on the surface, or are there other features?

MR. MOORE: It is based on studies done to determine the age when it was last active. And we will discuss that in just a minute.

JUDGE JACKSON: Okay. If you're going to go over that, that's fine.

MR. MOORE: Right.

JUDGE BOLLWERK: Let me just mention that obviously the Staff panel is here. If any of you at any point have any comments to make on anything that's being said, you can do so. It would be good to wait until a break, maybe between the slide. And, also, please identify yourself for the record before you speak so the court reporter makes sure we get the right -- any statement attributed to the right person. Thank you.

MR. MOORE: Here, again, I want to mention that this was a study mainly to make sure our site investigation was complete. And as we will see later, it was important to identify the different type of rock formations and their location. Slide Ten, please.

Now, this is another plan view, again, north. Plant north is up. This slide is a plan view of the location of the Pen Branch Fault at our site. It is shown at a depth of 1,050 feet at the base of the coastal plain deposits. Where the Pen Branch Fault separates the Paleozoic crystalline rock to the northwest, that is to the left, from the Triassic sedimentary rock to the southeast, that's to the right. This fault is located -- is a vertical projection to the surface. That's the black line. Here, again, that's where the fault intersects the surface, the bottom surface of the coastal plain sediment. The fault does not extend, displacements do not extend, nor are expressed at this surface.

I want to notice that here, again, this is Unit 4, this is Unit 3, this is Unit 2 and 1. And we will be seeing some additional cross-sections in just a minute. I want to point out, again, of course, the black contours, the blue contours shown here represent the elevation at the top of the Eocene Blue Bluff Marl. And it illustrates over the Site 3 and 4, and 1 and 2, that the Blue Bluff Marl is very level. There's very little change in elevation. But right at the expression of the fault, we see that the Blue Bluff Marl is warped, or what we call a monocline, or dipping caused by the reverse displacement of the Pen Branch Fault.

JUDGE BOLLWERK: That's reflected, I take it, in the fact that the lines on the left-hand side, on the other side of the fault are basically -

MR. MOORE: It's warped down, and we'll show a pictorial sketch of that a little bit later.

JUDGE TRIKOUROS: I have a question. The previous slide that showed the reflection, it seemed to indicate that the fault was northwest to southeast. Did I miss something? Is this black line the fault projection?

MR. MOORE: This -- I'll get to that. I'm going to show -- one of the points I wanted to make, I think will answer your question. The yellow lines here are what we call the reflection lines that were set to do the investigation. The view that I've just shown in the previous slide, Slide Nine, is this yellow line in the far lower left corner. This is line number four. And that view that we were just looking at in the previous slide is taken from that line, and it is basically looking northeast. So, in this way, here again, the plant -- Units 3 and 4 will be up above the Triassic basin rock, and that -

JUDGE BOLLWERK: We're back to Slide Nine now, right? We're now back to Slide Nine.

MR. MOORE: Yes, I'm sorry. We're back to

Slide Nine. Thank you. And, again, this is a section, looking, as we said, northeast, and the site that we're discussing, the ESP site, is located above the Triassic basin rock. And to the northwest of the site there is the crystalline basement rock.

I think that a couple of slides from now, I'll have a section that we can go through this, that will kind of show you the relationship between the Pen Branch Fault, the site, and the soil layers that will -- this information should come together.

JUDGE BOLLWERK: Would you like to go to Ten, or to Eleven?

MR. MOORE: Let's go back to Slide Ten, please. Here, again, as I mentioned, the yellow lines are the seismic reflection lines that were used for this investigation. The information was very valuable in defining the distribution of the different rock types, their properties, and location for development of the Ground Motion Response Spectra for the site, which is discussed in Section 2.5-2. Again, this fault, as other faults in the site vicinity are not capable tectonic sources. And we'll discuss that later, as well. Let's go to Slide Eleven.

Based on the geologic and seismological investigations provided in 2.5-1, it was concluded that none of the tectonic features in the site area are capable tectonic sources. In addition, non-tectonic deformations in the upper sands, depressions and minor deformations due to dissolution can be mitigated by removal. This is provided in detailed discussions in Section 2.5-3, and 2.5-4. The issue of the upper sands will be discussed in just a minute. Could we go to Slide Twelve, please.

Now, this jump to Section 2.5-4, which is stability in sub-surface materials and foundations. This section provides a description of the surface profile, the associated soil properties for static and dynamic analysis. These properties are needed, are required to develop the GMRS that describes in Section 2.5-2 -

JUDGE JACKSON: Excuse me. Can I ask you a question?

MR. MOORE: Sure.

JUDGE JACKSON: Are you through discussing the fault? I was trying to tell if you transitioned into your next -

MR. MOORE: I think that -- if you have any questions, I'd be glad to answer them.

JUDGE JACKSON: Yes, I did. I mean, I'm familiar with trenching a fault, and looking at the slip aging, and dating, when that had occurred, and get an idea how capable the fault is. I didn't hear that part. It may be in there. If you could just briefly tell me how did you evaluate that, that the fault was -

MR. MOORE: The fault had been previously evaluated by Savannah River for the MOC site and so forth, and determined that the Pen Branch Fault was non-capable. Additional studies were done by River Terrace. Since we now had identified the location of the Pen Branch Fault on the Vogtle site, we were able to know exactly where it crossed the river into the Savannah River site. So, there was a river terrace, remains of a river terrace that is, I believe, and I may be wrong on this, but I believe that it's like 1.6 million years old. It was deposited in that time frame. And a geomorphic study of that was performed to determine any deformations of that deposit, and it was determined that that deposit was not affected by the Pen Branch Fault movement. And, therefore, because of the age of that river terrace, and there was no deformations associated with the Pen Branch Fault; therefore, we knew the Pen Branch Fault has not moved in that period of time. And, therefore, it was determined that at that age, that fault can be considered non-capable.

JUDGE JACKSON: Okay. Thanks. I had read that. I just wanted to hear your explanation on it. Thank you.

MR. MOORE: Thank you.

In Section 2.5.4, as we mentioned, we're jumping up to that, because we need to know the surface profile and the properties. Also, I think the Board was very much interested in what sections were affected. This Section 2.5.4 was significantly affected by adding additional information to support the LWA. This additional information is referred to as COL data in the ESP application.

The COL data is the ESP soil data supplemented by a significant amount of data that was developed for a COL. So, this section, a lot of the information was added to support the LWA, and support the responses to RAIs from the NRC.

I want to describe now the layers for you. The upper sands, from the surface down to about 90 feet, we have what we call upper sands, the Barnwell Group. It is very loose, dense, it's very variable. As we mentioned yesterday or the day before, the water table is around elevation 165, which is about 55 feet below the surface. Also, at the bottom of the

Barnwell Group is what we call the Utley limestone. It is a very porous, has cavities and dissolution has occurred. And we'll discuss the upper sands in the next slide.

Right below that, we have the Blue Bluff Marl. It's a Lisbon Formation. It's very hard, slightly sandy, cemented, silt clay, has an average thickness of 70 to 80 feet. It varies in approximately that range. Below that, we have the lower sands, the coastal plain deposits, and those are dense sands about 900 feet thick. And then directly below that, for the ESP site, we have the Dunbarton Basin Rock, is a Triassic sandstone. And we have one boring, Boring B-1003, that was our deep boring that went down around 1,350 feet, so it went into the Triassic Basin rock, but it encountered that rock at 1,049 feet. Let's go to Slide Thirteen, please.

This discusses, as mentioned earlier, there is a non-tectonic feature in the upper sands that indicate stability problems that require mitigation by removal. This slide here kind of describes that, the removal of the upper sands, the Barnwell Group. Here, again, it's highly variable density along the depth, and it varies from borehole to borehole. We have a shale rich, very porous material was encountered at the bottom of the Barnwell Group, right on top of the Blue Bluff Marl, where we had drilling fluid loses as we were drilling through that layer.

These soils were completely removed, and replaced with compacted granular fill for the construction of existing Units 1 and 2. And for these reasons, these soils will also be removed in a similar -- removed, as well, for the constructions of Units 3 and 4.

I want to also mention that the less dense portions of the upper sands in the water table will have a potential to liquify due to an earthquake. That's another reason they have to be removed.

JUDGE TRIKOUROS: What determines how far in the, I'll say this horizontal direction, do you have to remove those sands, and what determines -- how do you determine that?

MR. MOORE: I will cover that later, but let me just answer that we have extensive amount of excavation where we actually came down to the bottom of the Blue Bluff Marl. We made sure that that excavation was extensive enough, such that the structural and seismic response of the nuclear island will be totally within the backfill, that the backfill

-- the zone of influence that would affect the seismic response, and the structure response in the nuclear island will be totally within the backfill. And I will show you a sketch later.

JUDGE JACKSON: Excuse me. On Units 1 and 2, was the excavation clear down to the Blue Bluff Marl?

MR. MOORE: That is correct. It was, basically, the excavation - and I will discuss that later, as well - the excavation procedures will be the same. We will go -- we excavated down to the Blue Bluff Marl, make sure that we are -- the competent part of the Blue Bluff Marl that we cut down until we're satisfied that we were into the Blue Bluff Marl. And then we will excavate, and we'll have side slopes that are two -- one vertical to two horizontal, typically.

JUDGE JACKSON: Okay. Thanks. I had read somewhere that Units 1 and 2, that the excavation may have been somewhat different than what was planned for 3 and 4.

MR. MOORE: I think the footprint, of course, of the excavation will be different, because the layout of the units are different. And the excavation for Units 1 and 2 were done in one large excavation. And, as I think we've seen in the previous slides, that Unit 1 and 2 were just basically adjacent to each other, and they have shared buildings. Whereas, the AP-1000, they're certified as a single unit, and so they stand alone. And, so, we basically are building two units that basically are -- each excavation is for a single unit.

JUDGE JACKSON: Okay. Thanks.

MR. MOORE: Could we go to Slide Fourteen. I think this is a slide that will help us summarize what we were just discussing in regard to the sub-surface profile. This is a real simple pictorial sketch.

I want to note that the sketch is not to scale, but we have really two cross-sections here. And to the right -- we have a little white dotted line, vertical line here. And I just want to point out that this to the right of that line represents a cross-section that cuts perpendicular to the Pen Branch Fault showing the proper inclination of the fault. The fault here is -- to the right of the fault is the Triassic Basin Rock. And that, basically, is -- excuse me, to the left is the crystalline basement rock. Starting at the bottom we have -- our rock is Triassic Basin, and it is at a depth of about 1,050 feet. And that was determined by Boring B-1003, which is shown as this dark vertical line. Then we have 900 feet of coastal plain sediment. And then above that, we have about 70 or 80 feet or so of the Blue Bluff Marl. And above that we have excavated out the upper sands, and put in engineered backfill.

I should point out here that due to the way we did this cross-section, it looks like both units are sitting in the same excavation, but, actually, these units are skewed because of the angle that we had to take this cross-section. And I'll show you -- the next slide will clarify that for you.

JUDGE JACKSON: So, basically, this is a good illustration of why that fault isn't capable, because that material doesn't show the disturbance above. You age that, or date that, and that's very old.

MR. MOORE: Right.

JUDGE JACKSON: Therefore, that gives you a lower boundary on the -

MR. MOORE: I think the Blue Bluff Marl is Eocene, which is very, very old. And this is a warp there, but other deposits from the river on the other side are providing additional information that the fault hasn't moved in millions of years.

JUDGE JACKSON: Okay. I've got it. Thanks.

MR. MOORE: And then, of course, we have the upper sands here that have been excavated, and we'll discuss that in just a minute.

We have another cross-section here that kind of added, but it's to the left of the dotted line. This shows the cross-section at the river. It shows the river, the Savannah River. We have also showing the river bluff on the Georgia side, the high bluff on the Georgia side. And it shows the Blue Bluff Marl. And you see a slight warp. That is the, as we mentioned in the other slide, where the -- we had the contour lines, the blue lines, showing there was a warp in the Blue Bluff Marl caused by the Pen Branch Fault movement millions of years ago. So, this is kind of puts that all together in a single picture for you.

Okay. If we can now go to Slide Fifteen, please. Now, this here, as we mentioned earlier, we are going to do excavations for Units 3 and 4 to remove the upper sands. You've seen this slide before, but I think before it showed the -- included access ramps here for simplicity, that's not shown. The slope to the excavation in the backfill material are similar to that used for existing Units 1 and 2. So, we basically -- Unit 1 and 2 is shown to the right, and the same type of excavation that was done here will be done for -- will be performed for Units 3 and 4. But, as you see here, these two units are right together, and so there was a large excavation done for this. And here we'll have two large excavations.

The excavations are very extensive to assure that the zone of influence of the structures in regards to static and dynamic response will be totally within the backfill. And to answer your previous question, we had, as a minimum, we went out 45 degrees from the bottom of a foundation, and we intersected the Blue Bluff Marl. That was the extent of the -- that was the minimum extent of the excavation down to the Blue Bluff Marl. So there was like a 45 degree minimum of that.

I think this sketch also will point that out to you. I want to point out that the light yellow actually will be the exposed Blue Bluff Marl. And, so, this is the -- so this represents that we have come down, and whatever is the minimum extent from say the deepest building, which is the nuclear island, that is, basically, the -- that defines the limits.

The total excavation for both of these will be about 3.9 million cubic yards. I want to also point out that the nuclear island is just one of the structures, and it's one structure that has the half-circle. That is the nuclear island. That's the only safety-related structure. But other structures will be bounded on the same uniform backfill, so the whole power block, AP-1000 power block will all be supported on a uniform engineered backfill, even though they're not safety-related structures. Next slide, please. Slide Sixteen.

As part of the LWA, the construction of the backfill, that's part of the LWA. And this requires well-defining the backfill design, the material selection and source locations, borehole sources, and esthetic and dynamic properties. To assist in establishing the backfill properties and verifying that the shear wave velocity of the backfill, a test pad was constructed. A side of a hill at the plant was excavated to a 20-foot depth, and we went into about over 60 feet into the hill, and then backfilled using the placement procedures used, and the backfill material used for Units 1 and 2. And with this, we were able to do static and dynamic fill tests, and we also did lab tests of this material, and, plus, lab tests of other borehole sources at the site. And this was performed to document the static and dynamic properties of the backfill.

This slide here, this picture shows the test pad when it was -- when the first five feet of backfill was placed. In the picture kneeling down is Dr. Ken Stokoe, Professor, University of Texas at Austin. He's a renowned expert in soil dynamic testing. And we had him come in and perform what we call a spectrum analysis surface wave testing to determine shear wave velocity. Here, he's sitting down, I mean, he's kneeling down. This is a line of geotherms that are used to surface waves to be able to do a spectrum analysis of that, and determine shear wave properties with depth. Could I have Slide Seventeen, please. Yes?

JUDGE JACKSON: When was this work done?

MR. MOORE: I think it was done in 2007.

JUDGE JACKSON: Okay. Presumably, something like this was probably done in conjunction with Units 1 and 2?

MR. MOORE: No. There was not a test pad built like this for Unit 1 and 2.

JUDGE JACKSON: Okay. I was just wondering if you had some similar data, or something, that had been taken in.

MR. MOORE: I think that -- no, this was not -- shear wave velocity has a different -- the sophistication of the testing and the importance of shear wave velocity in our current thinking is different than what it was back in the construction of Unit 1 and 2.

Anyway, this slide shows Dr. Stokoe performing the test. Slide Seventeen is actually the results of the field and lab tests. It's a very complex slide, but I think it does capture what we have determined. This slide shows a part of the test pad shear wave velocity profile, where the vertical axis is depth, starting at the surface down is zero, go down to 20 feet. That's the backfill, and then we actually have measurements into the in situ material at the bottom of the cut. And the horizontal axis is shear wave velocity, and here we have 500 feet per second, 1,000 per second, so forth.

Shear wave velocity is an indicator, a good indicator of adequate soil, and shear wave velocity is a measure of stiffness, so the higher the shear wave velocity, the stiffer the material. Shear wave velocity is very important, and we do seismic soil structure interaction analysis. This is important to be able to know these values. And, also, it's needed in site response, developing the GMRS.

This slide shows the SASW results, and overlaid that with what we call a seismic crosshole test, to confirm that the SASW was providing adequate results. That's a totally different way of determining shear wave velocity. Crosshole is where we put in three borings, one hole is a source, the other two holes are receivers, and so you actually are measuring within the soil at depth, where the SASW is a surface measurement.

Also shown here, we have some RCTS. That is Resonant Column Torsion Shear Test. These are performed to get lab tests to determine the soil properties as they change with strain. Soil is a non-linear material, and its properties are strain-dependent. But, also, we can from RCTS back out a shear wave velocity, and calculate a number. And this was done here by Dr. Stokoe, and we have some calculated values that fall really close to the measured values.

This results provided a -- the conclusion is that the backfill design and properties are well-defined, and sufficient backfill material exists at the site. We have sufficient borehole sources. We can meet a minimum shear wave velocity of 1,000 feet per second at foundation depth, was obtained. This is an AP-1000 parameter. And we have now ITAACs in place for the backfill in regards to density, as well as shear wave velocity. And they are provided as part of ESP LWA application. And these ITAACs will document that the in-place backfill will meet the design requirements.

JUDGE JACKSON: Just quickly, basically, this was the engineered material. It was pretty -- it was uniform down through the range of these measurements, 25 feet, and so the increased shear wave velocity with depth, I assume, is just the compaction that occurs as you become deeper, and increases the -

MR. MOORE: Sure. Of course, the backfill is very uniform material, and it's placed in a consistent density. And here, a minimum of 95 percent of modified proctor, and shear wave velocity is a direction function that's confining pressure. So that's why at the surface you see that it's much less than as you go with depth. It's the same material, but, basically, the confining pressure is key to -- one of the key elements to defining the shear wave velocity.

JUDGE JACKSON: Yes, that's what I would

guess. I just was trying to make sure that was correct. So, it's certainly a function of depth, and you said at the foundation level the goal was 1,000 feet per second.

MR. MOORE: Right. At this particular test pad, we're reaching 1,000 around 18 or so feet depth. And so we feel very -- we are confident that we will have 1,000 foot -- a shear wave velocity of greater than 1,000 foot per second at a 40-foot depth, which is the depth of the foundation of the nuclear island.

JUDGE TRIKOUROS: When is the ITAAC going to be done, basically, at the end of that process before any construction actually begins of the -

MR. MOORE: For density, I mean, for shear wave velocity, we have an ITAAC that we will -- we will do some testing when we get the backfill up to the foundation depth, which is about 50 feet of backfill. We will do some shear wave velocity measurements at that point in time, but we have no confining pressure at that point. At that point, it's just exposed backfill at the depth of the foundation. But we will have that shear wave velocity measurements as useful information, one, to confirm that, yes, we are getting increasing shear wave velocity with depth.

It is the shear wave velocity profile that we're expecting. That when we finally finish the backfill, we're going to be repeat the measurements again at the same locations we did before, at least the ones that are not in the footprint, and then we will use that as a basis to document an ITAAC, a engineering report that the shear wave velocity at 40-foot depth is 1,000 foot per second. We will be doing more than one measurement. We'll be doing three per unit, to basically provide that information.

JUDGE TRIKOUROS: Those tests will not be done in the footprint.

MR. MOORE: There will be some shear wave velocity measurements in the footprint when we get up to the foundation elevation, but before the backfill goes all the way up to the surface. The purpose of that is to show that those measurements in the footprint are the same measurements that we get away from the footprint. And then when we get up to the 40-foot depth, of course, we have no confining pressure still at the footprint because there's nothing there, but we will have measurements away from the footprint where we have an over-burden of 40-feet of backfill. And that way, we can then determine that yes, the shear wave velocity at that level is 1,000 foot per second. And, of course, when you construct the building, the building itself will confine the backfill directly underneath it.

JUDGE TRIKOUROS: So that ITAAC is a prerequisite for beginning construction of the structure.

MR. MOORE: We could not -- we would have to -- we could not build the AP-1000 at the site. Our commitment is that it has to be 1,000 foot per second, and that's an ITAAC. And that's a commitment that we will provide that kind of backfill.

JUDGE TRIKOUROS: Thank you.

MR. MOORE: Okay. Let's go to Slide Eighteen, please.

Now that we know the site soil and rock properties, let's go back now to 2.5.2 to determine the vibratory ground motion. Per the regulations, 10 CFR Part 100.2-3, the SSE of the GMRS requires uncertainty be considered in developing the SSE, and that's through a probabilistic seismic hazard assessment.

This slide here identifies the steps that were used to obtain the Vogtle site-specific PSHA. Go up to the stride, the first bullet, the PSHA is updated following the guidance provided in Reg Guide

1.165. As part of that Reg Guide, an acceptable starting point is to start -- you can start with the EPRI-SOG PSHA. That was published in 1989. The data that was used to develop that PSHA was up to around 1984, so our task was to assess the information and data from that time to the present. So, one, we assessed the effects of additional seismicity that has occurred since 1985 to mid-2005. That was, basically, the extent -- the range where we're doing the PSHA. We had to look at it and see if there is any seismic source updates that would -- based on new information. We'll discuss that in a minute. And, also, as part of the PSHA, not only looking at seismic source characterizations, we have to look at ground motion models. That's taking the ground motion from a seismic source to your site, and there has been an update in the ground motion models documented of the EPRI-SOG, call it EPRI-2004. So, we updated the ground motion models for the PSHA. I want to point out, too, the PSHA that we finally did is at hard rock, so we have -- remember that our site is a deep soil site. Let's go to Slide Nineteen, please.

The most significant and the major update is shown here, an update of the EPRI-SOG seismic source was required for Vogtle due to new geoscience information about the Charleston Seismic Source. On the slide, you can see where the Vogtle site is identified. And Charleston Seismic Source, where we had the 1886 Charleston earthquake in this area here, which is about 100 miles from the site.

The new information that has been developed since 1984 includes geometry, rate in max, magnitude, parameters for the Charleston Seismic Source, and these needed to be -- we needed to consider these and revise our PSHA. The most significant is the paleoliquefaction data that sand blows indicates that large Charleston-type events have reoccurrence intervals in 500 to 1,000 years instead of the about 2,000 years, as reflected in the original EPRI-SOG. Therefore, a new seismic source characterization model was developed for the Vogtle PSHA, as shown in this slide.

The updates include four alternate sources; A, B, B prime, and C. These alternate sources are to account for different source interpretations. And the more confidence you have of a source characterization, the higher weight you give it. So we're showing here that we have -- Zone A has a weight of 70, and the other zones have a weight of -- of .7, the other ones have a weight of .1.

The update of the Charleston Seismic Source was incorporated into the EPRI-SOG seismic source model. The update of Charleston Seismic Source was peer reviewed by Dr. Martin Chapman, and Dr. Carl Stepp, two of the members of our review panel. And both experts in seismic source characterizations.

I want to point out that due to the update of the Charleston Seismic Source, the Vogtle seismic hazard did increase from the original EPRI-SOG results, so this is the update that was performed for the Vogtle site, so we have a Vogtle site-specific PSHA updated, and it's at hard rock. If we can go to Slide Twenty, the next slide, please.

The updated, as I said, EPRI-SOG PSHA results define seismic hazard at a rock site, but the Vogtle site is a deep soil site where hard rock is more than 1,000 feet below the surface. In order to determine the SSE or GMRS at the ground surface, we need to determine the site PSHA at the free ground surface. In order to accomplish this, we need to take the rock uniform hazard motions and give all those motions to the surface to obtain site amplification factors. Next, we take the site amplification factors and the rock hazard to obtain a soil hazard at the surface, which is represented by uniform hazard spectra at appropriate mean annual frequencies of exceedance. And if we can go to the next slide, Slide Twenty-One.

This is a little bit more information on how that's done. This slide shows the statistical results of the randomized soil rock profiles that were actually used to obtain the site amplification factors that were used to develop the soil hazard at the free ground surface.

Starting at the very top, we have the backfill material, then we have the Blue Bluff Marl, then we have the 900 feet of the coastal plain sediments, and at about 1,050 feet we hit rock. And, of course, Triassic Basin Rock is not hard rock, and so we have different interpretations of how that rock changes with depth. And then we hit about 9,200 foot per second rock, and that is defined as hard rock for the PSHA. So, there were 60 randomizations of the shear wave velocity profile, and there were multiple time histories used to convolve the motion up, and that was used to come up with the mean amplification factors. And that was used to multiply times the rock, uniform hazard spectra, to get the uniform hazard spectra at the surface. If we can go to Slide Twenty-two.

The next step is, once we have the uniform hazard spectra at the surface, we need to develop the SSE and GMRS. And this is developed following a performance-based method presented in ASC 43.05, and later is was adopted in Reg Guide 1.208, entitled, "A Performance-Based Approach to Define Site-Specific Earthquake Ground Motions." So, for the Vogtle site, the SSE GMRS is defined at the free ground surface at the top of the engineered backfill.

Now, the vertical -- this is for the horizontal. The vertical SSE and GMRS is based on a frequency-dependent ratio of vertical to horizontal spectra shapes, which we call V over H. Due to the limited empirical information on V over H for the central and eastern U.S. ground motion, alternate analytical approaches were evaluated and compared to determine the Vogtle site-specific V over H ratio.

JUDGE JACKSON: Let me ask just a question, make sure I understand this. If you start at the Charleston source then, you're going to have some source disturbance, earthquake, or whatever, and you propagate that then through the rock, through the hard rock region.

MR. MOORE: Right.

JUDGE JACKSON: That's how you get from

Charleston, say to the Vogtle site. And then you're saying you then work through this to get from that motion, or that source up to the surface source. And that becomes the site-specific part where you have to know what's going on between the hard rock layer and the surface.

MR. MOORE: That is correct. The PSHA at the rock considers - and it is true that the PSHA at the Vogtle site, especially at the mean annual frequencies that we are looking at, are pretty much controlled by the Charleston source. Of course, there are other sources, too.

JUDGE JACKSON: Right.

MR. MOORE: That are considered, of course.

JUDGE JACKSON: Yes, I was just taking the Charleston as the example.

MR. MOORE: Right.

JUDGE JACKSON: How you get from the source to the site.

MR. MOORE: And, so, what we have done, exactly as you said, once we get the PHSA at the rock, then we have all this information. That's why I went to 2.5.4 to give you all that kind of soil property information, because that actually has to be used to get the rock hazard up to the -- to get our soil hazard at the surface.

JUDGE JACKSON: Okay.

MR. MOORE: So if we go now to Slide Twenty-three, this is the final results. Finally, we have the Vogtle horizontal GMRS shown as a solid black line, and the vertical GMRS is shown as a dotted blue line. The vertical axis is -- this is the response factor of the vertical axis, the spectra acceleration that is responsible, single degree of freedom. And for this particular spectra shape, it's for 5 percent critical damping. The horizontal axis is the frequency in hertz. That is the natural frequency of a single degree of freedom system.

I want to point out that the PGA, that's the Peak Ground Acceleration for the Vogtle GMRS at the ground surface is defined at 100 hertz, but, basically, it's -- here that value is, for your information, is about 0.266 Gs. So, basically, if we have this ground motion, and you put an accelerometer on the ground surface, and maximum acceleration from that measured from that accelerometer will be .266 Gs. So this is the end product of Section 2.5.2.

If we go to Slide Twenty-four, this is another pictorial cross-section of the Vogtle site that kind of summarizes the results presented so far. If we go to the left, it shows the 90 feet of backfill, and about 70 or so feet of the Blue Bluff Marl, and then 900 feet of the coastal plain sediments. To the right of the figure, it shows the location of the GMRS, that's a free field ground motion at the surface. But also included in this sketch is the nuclear island embedded about 40 feet in the backfill, which is the embedment depth. And I want to point out, additionally, we did following the same procedures used to develop the GMRS and consistent, fully consistent with the GMRS, and outcrop spectra motion was developed called the Foundation Input Response Spectra at 40-foot depth. And it's shown here.

This is valuable information to have when you do the source structure interaction analysis that will be shown later. But I do want to point out that the GMRS and FIRS are based on site response calculations, where the nuclear island, of course, is not included. And it's the incorporation of the AP-1000 into the -- is considered site-specific seismic source structure interaction analysis. But this picture is kind of putting everything together.

JUDGE JACKSON: Why do you have -- I

didn't understand why you had to visualize it as an outcrop? Why wouldn't it just be at a level of the foundation?

MR. MOORE: The outcrop is -- the way it was done for Vogtle was, we had one single column, -- soil column from the rock to the surface.

JUDGE JACKSON: Okay.

MR. MOORE: And we did a 1-D seismic analysis through a program called SHAKE. And it will give you outcrop motions. It represents a motion that is representative of that horizon, but it does consider the soil above it. And, so, this gives you basically a characterization of that motion at that horizon. And that motion is then used later to do soil structure interaction analysis. And the importance of defining at the foundation depth is the engineering opinion that the foundation input is the more correct location to do -- more important motion to define motion for soil structure.

JUDGE JACKSON: Okay. That outcrop then is to decouple that when the calculation from what's above it becomes like a free surface. Is that why you think of it as an outcrop?

MR. MOORE: Well, it's an outcrop -- there is different ways of -- there's different ways of defining outcrop. This is defined as an outcrop that is defined using the SHAKE program. I believe the NRC would consider an outcrop motion where there is -- you do not have any downcoming waves. But this was done in a consistent manner, and we have discussed this with the NRC, and there's different ways of calculating outcrop motion. But this was done, and we'll discuss it a little bit later. I will show you some of the results.

JUDGE JACKSON: One other quick question, and then I'll try to stop interrupting you. You said at the surface if you put an accelerometer, you would expect to measure what you had at the 100 hertz. I just wasn't clear -- it wasn't clear to me why you chose the 100 hertz. Why wouldn't it be at 10 hertz?

MR. MOORE: Well, for one, is our calculations go out to 100 hertz, and 100 hertz is considered basically the ZPA, or Peak Ground Acceleration.

JUDGE JACKSON: Okay.

MR. MOORE: And for the eastern U.S. we get, due to the characterization of our hard rock in the eastern U.S., and the seismic source characterizations that we have, that we don't have -- our ZPA is at a higher -- PGA is at a higher frequency. I was using the -- to try to define what a PGA was, I was just using the visual concept of putting an accelerometer from the soil. And based on that ground motion, the GMRS, we had that ground motion, the PGA that would be picked up, the maximum acceleration from that accelerometer would be .266 Gs.

JUDGE JACKSON: Okay. Thank you.

JUDGE TRIKOUROS: Just a question regarding methodology. What methods were used to do these calculations to generate these response factors? Are these analytical methods that are established analytical methods?

MR. MOORE: Correct. They're based on the -- the ground motion is -- the site amplification factors were based on a 1-D soil column analysis. It accounts for non-linear, as I said earlier, the soil behaves non-linearly, depending on the strain, and the ground motion that you put in will affect the strain, you iterate until you get the correct strain levels. And to do this, you have curves -- you have properties that define in a given soil layer the shear modulus. Shear modulus reduces with strain. The damping of the soil layer increases with strain, and this is all incorporated into the 1-D SHAKE analysis, so that you get an appropriate soil column response that's consistent with the properties. Shear wave velocity and the, what we call soil non-linear behavior curves, which is G over G Max, and damping.

JUDGE TRIKOUROS: Is there a name for that tool?

MR. MOORE: It's a 1-D soil analysis. The program is called SHAKE. It's a very common program used by everybody in the industry.

JUDGE TRIKOUROS: That's what I was getting to. So, it's an established method that everybody uses.

MR. MOORE: It's a very common method, yes. It's a 1-D soil column analysis. It's been used and accepted for years.

DR. COSTANTINO: Can I add something to Don's comment? There are studies which have compared the results of these analyses with empirical data to show that the predictions tend to be conservative, compared to measured empirical data from earthquakes. That's really the most important part of that whole aspect.

JUDGE TRIKOUROS: We certainly want to follow-up with the analytical methods with respect to the Staff side of this.

MR. MOORE: All right. Let's go to Slide

Twenty-five, please.

Now, let's focus on the LWA activities, and how -

JUDGE BOLLWERK: You may need to tap on the mic just to make sure you're getting -- you need to tap on the mic to make sure we hear you.

MR. MOORE: I'm sorry. This is Slide Twenty-five, and we want to focus on the LWA activities, and how additional information is required to support it. You have seen in this slide before, I want to point that up to the upper light, under the LWA, backfill will be placed from the top of the Blue Bluff Marl up to the ground surface, about 90 feet. Of course, the LWA also includes the EC wall, mudmat, and waterproof membrane.

The lower graph is a picture that shows the results of the LWA when it's completed, which is basically backfill to the surface for the EC wall, forming an opening configured to the footprint of the nuclear island. Can we go to the next slide, Twenty-six, please.

JUDGE JACKSON: Excuse me. Before you leave that slide, we were trying to look at that slide, and make sure we understood the mudmat, and the membrane. That was a little bit hard to see. Can you just go through where the mudmat is -

MR. MOORE: It's shown in a circle detail in the far right.

JUDGE JACKSON: Okay.

JUDGE TRIKOUROS: It looked like there was mudmat below and above the membrane.

MR. MOORE: What's going to be done is that -- once the backfill -- we'll put a mudmat on top of the backfill, about six inches of concrete. We'll put a spray on waterproof membrane, and then we'll put another mudmat, small layer to protect that, another six inches of concrete on top of that. And that will perform a working surface for them to put the reinforcing chair, so they can start laying reinforcing when that is done later.

JUDGE JACKSON: Yes. Thanks. We just had -- we weren't sure we could see where those arrows ended, and wanted to make sure that the mudmat was on both sides of that.

MR. MOORE: That's correct. Basically, it's -- we're required to put in a waterproof membrane, and we definitely wanted to protect it with laying in the reinforcing for the basemat, so that it's protected when they pour the basemat concrete. And it is a -- the configuration is a mudmat with the waterproof membrane, with another concrete cover to protect it.

Going back to Slide Twenty-six, one of the LWA seismic issues, the backfill directly supports the nuclear island, and construction of the backfill is part of the LWA. Therefore, site-specific analysis, seismic analysis are required to verify that the backfill properties, which we call C, exceed the site-specific demand, which we call D, by an adequate design margin, or C over D has to be greater than a required factor of safety. The Vogtle site parameters require site-specific analysis in order to define capacity, as well as the design. The next couple of slides will provide the basis for the need for site-specific analysis.

JUDGE JACKSON: Where do you get the guidelines for what is an appropriate factor of safety? Is that just -

MR. MOORE: I will present that later, but, basically, the -- for stability, that comes from the AP-1000 criteria. And for seismic demand - excuse me - for bearing, we provide those factors in our 2.5.4, and we use standard safety factors. And they were safety factors as a measure, and that comes from an ASCE design guide for foundations.

JUDGE JACKSON: Okay. So, basically, it's standard -- a professional standard.

MR. MOORE: Correct.

JUDGE JACKSON: Okay.

MR. MOORE: All right. And I'll show you the actual results in just a minute.

Now, if we go to Slide Twenty-seven, please. This slide is from Appendix 2.5A, which is entitled, "Vogtle Site-Specific Seismic Evaluation Report." It was developed to address the acceptability of the AP-1000 at the Vogtle site. It was added to the ESP to support the LWA request. It provides the seismic stability of the nuclear island, and the seismic bearing loads on the backfill.

This particular slide shows the comparison of the Vogtle GMRS, which is the blue line, to the AP-1000 certified design motion, which is shown as red. As you note, there are exceedances. We have GMRS does exceed the certified design spectra at around .4 to .7 hertz, and from about 7 to 60 hertz. These exceedances by themselves would require a site-specific analysis. If we can go to Slide Twenty-eight, please.

This slide is the comparison of the vertical GMRS, shown in blue line, to the AP-1000 certified design, shown in red. The exceedances are less in the vertical direction. Also, I want to note that as part of the 2.5.4, we provided a coefficient of friction between the foundation and the backfill, and that coefficient of friction is specified as 0.45. And that would require also a site-specific evaluation to determine the acceptability in regards to sliding.

Now, if we go to Slide Twenty-nine, please. As mentioned earlier, the Vogtle site-specific evaluation was performed and provided in SAR Appendix 2.5A, pursuant to demonstrate site acceptability. Also, the ESP Section 2.5.4 also was expanded to include bearing capacity to the man information to support the LWA. The site-specific analysis is required for the following reasons.

JUDGE JACKSON: Excuse me. Let me try a quick question, and I don't know if it's fair to ask you a question or not. I just wondered, would this be considered a particularly high seismic hazard area where we are right now? I mean, this part of the southeast? Here's my question. I'm just a little -- I was just wondering why the standard design wouldn't have been sufficiently robust that it would have encompassed what you might encounter in a region like this.

MR. MOORE: The criteria was developed in the '90s. At the time, there was a standard spectra from Reg Guide 1.160 that has standard spectra shape, and it -- the zero period acceleration, or the PGA was specified around 33 hertz. The LWAs were based on that, and what they did was they increased -- they came up to about a .3 G spectra shape. The spectra would be -- they just raised that spectra to .3 G, and at that time it was thought that would be robust enough for the central and eastern U.S. You do notice on that particular Westinghouse AP-1000, they have a slight bump around 25 hertz that was added to account for the central and eastern U.S. high-frequency ground motion that was occurring based on these PSHAs. But when we actually get to doing the site response analysis, they -- we're showing in some cases that these spectras are not -- do not cover, especially in the high-frequency range.

I will show you something later that when we do a site-specific analysis for the site, that these issues will dissipate, due to the fact of the soil structure interaction effects.

JUDGE JACKSON: Okay. Thanks. I was just curious. It sounds like maybe some of the standards or understanding shifted, has been shifting a little bit, and it may have shifted beyond the target.

MR. MOORE: EPRI had a project where they developed some criteria working with the industry on how -- what are the criteria that would be used to define a standard plan. And that was part of it. And, at that time, that was the standard design procedures. It was deterministic. We came up with the maximum P ground acceleration and attached a standard ground response spectra that was really, more or less, based on information developed from western U.S. earthquakes.

JUDGE JACKSON: Thanks.

JUDGE TRIKOUROS: Excuse me. Was there a generic soil structure interaction analysis done for the AP-1000 DCD?

MR. MOORE: The AP-1000 originally certified for hard rock, and it had a shear wave velocity of 8,000 feet per second. Recently, of course, they going in the process of extending that to soil sites, and they are looking at multiple generic soil profiles.

JUDGE TRIKOUROS: As part of the revisions to the DCD?

MR. MOORE: That is correct.

I will say that what we're doing here is basically, for Vogtle, we're just doing the site-specific analysis to assure ourselves that our seismic demand doesn't exceed the AP-1000 design, whatever that design is. Our effort here is to show that our site parameters, are enveloped by the certified design.

JUDGE TRIKOUROS: If I might, could you also tell me what methodology you used to do the SSI?

MR. MOORE: Yes. The SSI was done -- I'm discussing it right here. For the purposes of the LWA, and just overall nuclear island stability on the backfill, and sliding and overturning, we did a 2-D soil structure interaction analysis using SASI. It's a standard fine element program for doing SSI. And I'll present some results here on that.

The first bullet here relates, as I've just mentioned, we needed to do a site-specific analysis. The GMRS exceeded the AP-1000. Also, our soil profile is unique and different than any others. Every site is unique, but we have -- if you remember, we have 90 feet of backfill. Then we have a fairly hard layer, and then we have kind of an inverse -- the hard layer, then we have dense sands that are competent, but they have a lower shear wave velocity than the Blue Bluff Marl, so these are all unique features. Also, I mentioned the coefficient of friction is .45 that we need to consider in site nuclear island stability evaluations.

The second bullet is a 2-D seismic analysis, soil structure interaction models were used to account for seismic stability. Stability is related to overall building response. It's the overall building, how it responds on the soil that's supporting it and the amount of soil that's embedded in it, that the building is embedded. And we determined that the 2-D analysis is totally sufficient, especially if we show large factors of safety, which we do for the Vogtle site. And, therefore, this SSI modeling is used to demonstrate the adequacy of the backfill for the LWA request. And that's what it was done -- that's the purpose that we're providing it for here.

Now, the third bullet is basically what is the model. It's the standard for the Vogtle SSI model, the model, itself, the structural model is the standard AP-1000 2-D seismic model, you have one north-south, and you have one east-west. The north-south model includes the annex building, the east-west model includes the turbine building. Sort of a structure-to-structure interaction that's directly considered. But the difference here, of course, when you use the Vogtle ground motion input, not the certified design ground motion, and we used the Vogtle site profiles.

For SSI analysis, that's deterministic analysis, and so we -- and per the SRP, NUREG 0800 requires that soil profiles need to be -- the three profiles need to be considered to account for variability in soil properties. So, what was done for the Vogtle site was, we came up with a best estimate, basically is the mean shear wave velocity profile. Then we had an upper bound, which is basically the mean plus one standard deviation, and then the lower bound was the -- excuse me, the median plus -- minus one standard deviation. And that goes back to Slide Twenty-one where I showed you the soil profile. So, this was the basic -- how the analysis was done. If we could go to the next slide, Slide Twenty.

I provided this as just an example of the seismic response that is actually provided in Appendix 2.5E. This is the response of Vogtle 2-D SSI analysis. And I only want to provide this to point out some key points for the panel. This location is the horizontal north-south at the top of the nuclear island, the highest point that the responses were calculated. We have three Vogtle in-structure response spectras, because we have three different soil profiles. The green is the upper bound soil case. The blue is the best estimate soil case, and the dotted red is the lower bound soil case. And, also shown here just for information purposes is what Westinghouse provided as their 2-D envelope, AP-1000 envelope, that they have been using when they do kind of an envelope for the 2-D analysis for comparison purposes only.

The overall building response in regards to building stability and foundation bearing pressure is related to the maximum accelerations of the building along its height. The maximum building accelerations at a given location and direction is actually the zero period acceleration of the in-structure response spectrum. That's the acceleration value at the flat portion of the in-structure response spectra at the high-frequency range. As seen here, that's around 30 to 100 hertz.

The two points I want to point out on this is that the maximum building acceleration highest location in the nuclear island for the Vogtle specific analysis is about .7 Gs. So, basically, that same accelerometer on the roof of the shield building, and we did this Vogtle site-specific analysis, that accelerometer would show a maximum acceleration at that point of the structure of .7 Gs. Whereas, the Vogtle - I mean, the AP-1000 certified design kind of envelope shows about 1.6 Gs. Therefore, the Vogtle results for this particular evaluation is about half of what they had calculated for the AP-1000.

The other point I want to point out is, this illustrates that even though the Vogtle GMRS exceeds portions of the AP-1000 certified design, site-specific SSI analysis provides the necessary information to properly evaluate the site acceptability. Note that the AP-1000 seismic demand is based on an envelope for maximum seismic responses in the red curve in their SSI analysis.

I want to also point out that the Vogtle site-specific results, as seen here, are not unique. They are very typical of embedded nuclear power plant type structures on deep soil sites.

JUDGE TRIKOUROS: What determined the requirement for the friction coefficient?

MR. MOORE: We had to provide as part of our submittal what is the coefficient of friction that we have for the nuclear island, and the interface with the foundation. That was provided as a site-specific parameter. At the time we were putting the submittal together, there was a requirement of being -- coefficient of friction being .7. And, of course, that was, more or less, a consideration of a foundation of a nuclear island sitting on hard rock, which is what the basic DCD, I think Rev.15, addresses. But here we have a soil site, and .7 is not a realistic coefficient of friction, but this coefficient of friction is based on the properties of the backfill, and is related to the angle of internal friction. It's basically taking that information, and we use that in a procedure to come up with this coefficient of friction.

JUDGE JACKSON: Let me make sure I understand it. It is the coefficient of friction then between, basically, the bottom of the mudmat and the compacted material that it's resting on.

MR. MOORE: Correct.

JUDGE JACKSON: And, physically, what you're concerned with is you're looking at the horizontal motion, and you want to know the coupling then between what's going on in the compacted material, the engineered material, and the foundation.

MR. MOORE: Correct.

JUDGE JACKSON: And the limit was .7,

somebody determined.

MR. MOORE: That was the specified limit that they have for their -- yes, that was provided to us at that point in time. Correct. I mean, the .7 was provided to us at that time, because that was what the coefficient of friction that was used -- here, again, I'm providing information based on conversations I had with Westinghouse engineering staff, and they said the .7 was based on an analysis for the hard rock, where the nuclear island sits on the hard rock, and there is no site soil. It's just a nuclear island sitting on hard rock.

JUDGE JACKSON: Okay.

MR. MOORE: But we -- as a part of our submittal, we provided this information. And all I'm pointing out here is that that is something that is explicitly considered in our site-specific seismic evaluation. As I mentioned earlier, this whole evaluation is site-specific, so all the different parameters that could affect stability response and everything, like soil profile, input motion are all explicitly considered. And the bottom line is that we show, after we do all these analyses, that the site demand is below the capacity of the AP-1000 design.

JUDGE JACKSON: And you're going to

measure -- there's some measurements involved, was there not, in the coefficient of friction?

MR. MOORE: There is a calculation that has been submitted. The coefficient of friction, .45 has been based on some calculations that have been incorporated into the ESP. There is no ITAAC associated with that.

JUDGE JACKSON: You're saying there was no measurement -

MR. MOORE: There's no measurement made between -- on the backfill. And I think when we see later in the next slide that we have plenty of margin. But this is not a -- here, again, we're doing a site-specific criteria, and this value, we believe, is conservative.

JUDGE TRIKOUROS: So is this a calculated -- if you can't measure it, do you calculate -- do you analyze that?

MR. MOORE: There's a calculation, yes. It's based on the angle of internal friction of the backfill, and that's been done by lab tests, and the value specified for the combined COL is 36 degrees. And there is a -- and then we -- basically, that information -- we then would use a document called the NavDoc, which is a Navy soil document, standard used by soils engineers to define an appropriate coefficient of friction between the concrete foundation and the top of soil.

JUDGE TRIKOUROS: So, would it be a true statement to say that even if the response spectra were within the AP-1000, you would still be required to do a site-specific analysis with respect to the coefficient of friction problem?

MR. MOORE: At the time that we made a submittal, that would be the case, yes. Because they had specified a higher coefficient of friction, they provided us at that time.

JUDGE TRIKOUROS: So you had no choice but to do a site-specific soil structure interaction either way. You had no choice but to do that site-specific analysis.

MR. MOORE: Correct. And, as I said earlier, the whole -- our analysis -- our acceptance of our site is based on the site-specific analysis.

I believe we can go now to the last slide, please, Slide Thirty-one. The final results of the Vogtle site-specific evaluation with regards to stability and adequacy of the backfill is summarized on this slide. Note that capacity, C, denotes the available resistance to preventing sliding and overturning. R, for bearing is the ultimate bearing capacity of the supporting substrata. The seismic demand is the maximum seismic demand determined from the Vogtle site-specific SSI analysis considering all three soil cases, lower bound, best estimate, and upper bound. The calculated C over D provided in the slide represents the Vogtle site-specific safety factors, which, in this slide, is compared to the minimum acceptable safety factors.

Now, let's start at the top. The minimum sliding, C over D, safety factor given in Appendix 2.5E is 1.83, which is greater than the AP-1000 minimum of 1.1. The minimum overturning safety factor is 2.45, which is greater than the Westinghouse 1.1. The static bearing ultimate capacity over the demand is equal to 11.9 for static, which is compared to ASCE standard for acceptable bearing safety factors is about 3, so we have plenty of margin in that, as well. And for dynamic bearing, which includes the static, plus the dynamic bearing from seismic, that's the total C, and the - excuse me. The D for this includes the dynamic bearing loads from seismic, plus the static. That's the D. And then the capacity, safety factor we get is 5.6, which is greater than a typical safety factor for dynamic bearing of 2.25.

Also, in 2.5.4 we provide information on calculations and other information that shows that there is no potential for soil liquefaction of the backfill, or any of the material below the foundation of the nuclear island. In addition, in Section 2.5E, we provide settlement calculations that account for building construction, and show that those calculated settlements are within the AP-1000 accepted limits.

So, the conclusion is that the backfill is fully acceptable, and able to support the nuclear island with a significant margin. And, therefore, supports the LWA. Of course, at the completion of the LWA, as I mentioned earlier, there are ITAACs to document that the backfill design parameters are fully satisfied.

I hope this presentation addresses your request, and, if not, I'll be glad to answer any additional questions.

JUDGE JACKSON: Thanks for your patience in answering questions. I just want to understand one other thing. You get down to the LWA evaluation, and you were looking at factors, such as tipping, and being able to bear the weight of the facility, not settling, et cetera. I see that with respect to the LWA. Now, help me understand, you also, obviously, have to worry about all the structure inside of this building, and the plumbing, and whatever else has to be seismically qualified. And that has limits, or criteria that have to be met for safety of the overall facility. How does that relate to this just tipping, I mean, this LWA evaluation? I'm trying to make sure I understand the relationship.

MR. MOORE: The analysis that we did was basically to support the LWA request, and the analysis that relate to items within the structure, piping, equipment, and what have you, will be covered under the COL evaluations, and that is being -- that is an ongoing process right now.

JUDGE JACKSON: Okay. Thanks. That's what I thought. I just wanted to make sure I knew what was covered when you said it's adequate for LWA.

MR. MOORE: The picture I showed of the finish product for LWA, basically is a backfill to surface with MSE wall that forms the footprint of the nuclear island. And that's all this is covering. The actual adequacy of the nuclear island, I mean, of the structure, the components inside the nuclear island, that's all being fully addressed - will be addressed in the COL process.

JUDGE JACKSON: Thanks a lot.

JUDGE TRIKOUROS: Are the modifications that are being made to the DCD in this, I guess Rev. 17, will they preclude the need to do site-specific soil structure interaction for most of the sites in the eastern part of the United States, at least?

MR. MOORE: I do not -- this is -- you want my opinion? Okay. That we have standard designs, but there is no standard site. Every site -- I mean, what I'm saying is that we -- that there are certain parameters that have to be met, of course, in the standard design. You can check them all, but there is a -- there are all these features that would require some sort of site-specific analysis. And as I was pointing out earlier, the ground motions that we're calculating for the eastern U.S. sites, in some cases are having exceedances. And some of these exceedances can be addressed, and are being addressed, and my understanding is with maybe studies being done by the vendors.

JUDGE TRIKOUROS: That's fine. Thank you.

JUDGE BOLLWERK: Any further questions from the Board at this point? No. Let me just turn briefly to the Staff panel. Do you have anything you want to say about anything we've talked about over the last hour and 15 minutes, or 45 minutes, I guess, at this point? No? All right.

We've actually been at it almost, as I mentioned, about two hours. Let's go ahead and take a break until 10:30, and then we'll come back with the Staff panel. Thank you.

(Whereupon, the proceedings went off the record at 10:17:13 a.m., and went back on the record at 10:31:55 a.m.)

JUDGE BOLLWERK: All right. If we can go back on the record, please. All right. After our break, we're back, and we're going to begin now with the presentation of the NRC Staff relating to seismic evaluation. The exhibit we're looking at is NRC Staff 000065. And who is going to be making -- starting off? All right. Okay. And, again, if you can, just to help the court reporter, if you would let him know who you are before you start speaking, that would be useful to him, I think. Thank you.

DR. STIREWALT: And I'll remember to tap the mic, also.

JUDGE BOLLWERK: I appreciate that.

DR. STIREWALT: I am Gerry Stirewalt. I am Senior Geologist in the Office of New Reactors. My degree is in, in fact, structural geology, which is the specialty that involves looking at faulting and other types of deformation, rather important things for site locations. I have worked with the NRC directly since 1990, the last four years as a real federal employee, but prior to that, as a consultant. Prior to that, some years teaching, about seven, and about 25 years experience actually in site characterization, looking at structures like we're trying to deal with here.

What I'd like to do is address some of the key points really on 2.5.1, basic geology and seismology. If I could have the next slide, please, and the next, and the next. What I'd like to do - and, again, as Mr. Moore laid out very, very well, the Pen Branch was of key concern to us, since, in fact, in 10 CFR Part 100 requires that we look at features like that, if, in fact, they are known to occur at the site. If I could actually go to the next slide, but mostly because geologists like to start with pictures, and not just words, so I want to show you a geologic map, actually, to talk about the issues for the Pen Branch.

JUDGE BOLLWERK: We're on Slide Five, now.

DR. STIREWALT: Yes, this is Slide Five. What I'd like to do is just sort of point out the geometry of the structure that we have called the Pen

Branch, sort of locate where it is. That's this feature right here that you can see extends, in fact, from the site location into the Savannah River location, crossing the Savannah River. So this is the Savannah, the SRS, the Savannah River site. This is the Vogtle site, separated by the Savannah River.

I'd like to point out, also, just a couple of geologic features on this. You've heard a lot about the Blue Bluff Marl. You've actually seen a similar map earlier. But, again, just to locate you where these features are, the Blue Bluff Marl, the foundation unit is, in fact, exposed along the river, as you can see. And I would also like to point out the location of the terraces, and Mr. Moore mentioned those, Quaternary terraces. I'd like to specifically point out the location of the one that's labeled as QTE, which I realize you can't read, so I'll take the liberty of pointing to it. This particular feature is, in fact, located on the grounds of the Savannah River site, but you will note that, in fact, the trace of the Pen Branch Fault crosses that terrace. That's going to be an important point that we're going to discuss in just a moment.

So, again, I just wanted to introduce the geology, particularly point out that terrace, because that's a very important feature, again, as Mr. Moore qualified, helping really logically conclude that the fault is not capable. That was a very important bit of the information. If I may have the next slide, and sort of back down to a reasonable scale, please.

This is number Six, and you may note that, in fact, this is really a section, a cartoon section, if you wish, drawn based on that specific seismic section that Mr. Moore showed. So, you see the trend of the Pen Branch at depth, you see the offset with the sedimentary deposits in the Triassic Basin on the southeast side of that fault, you see the crystalline basement of the good old solid Piedmont hard rock on the west side of that, you see the Blue Bluff Marl. And he mentioned, in fact, that monocline - showed you a nice topographic map - that there is right at the -- really right where the trace of that fault projects to the surface, that monocline occurs. And it's sort of gently shown here, if you can imagine. Now, that's important, because the units above that particular layer, the Blue Bluff, are not deformed. And we know from radiometric dating that that unit is about 33.7 million years old, and what this is tells us then is that deformation movement along this fault, latest movement based on every indication we have from field geologic data, is that it is not younger than 33.7 million years old, which really helps us a lot relative to concept of capability that's defined in Reg Guide 1.208, which qualifies -- basically, if it's Quarternary in age, and that cutoff is 1.8 million, so you can see from this, from our relatively good control in the field, that we have strong evidence that this deformation along that fault structure, along that surface, has not occurred younger than 33.7 million, so well into the definition of being a structure that's non-capable. And may I have the next slide, please.

I mentioned the concept of the stratigraphic evidence that's shown in that first bullet. And, again, that is a concept of using relative ages. We know the age of a unit, we know what's above it. We know that it's not distorted. Consequently, the distortion happened prior to that time frame, 33.7. Now, again, Mr. Moore mentioned that fluvial terrace study. This is a very, very important aspect, and it's kind of exciting geologically, really, because you get a marker that really is Quarternary age that you can use to determine whether or not, in fact, there is Quarternary deformation registered.

Now, the Applicant did a lot of work, a lot of good work looking at the surface. QTE, again, as I pointed out on the map, so you know the location, you know that the trace of the fault crosses, you know it's on the Savannah River side, but they surveyed about 2,600 elevation points on that surface, so they had a really good control of what that surface was doing. Now, that's important because that information on elevations indicated clearly that there was no surface distortion of what really, in fact, is a Quarternary age marker. And, again, geologists get very excited about that, because it really gives us something that we can pin it, and we can be reasonably certain that wow, it's the right age, and it is not deformed. So, that's a pretty important factor.

Now, if I may have the next slide. And geologists, again, are prone to want to show you something in the field. I'd like to just illustrate that surface. This is, in fact, that particular surface, QTE, with two crusty field geologists standing atop for scale. But I think you can see that looks pretty flat. Well, that isn't good enough. But that point is that with the careful surveying of the data points for elevations, there is no place on this surface - and, again, I think this illustration is convincing - but there's no place where you see any distortion, any disruption, any uplift. That's really a nice plainer surface. It's not distorted or deformed, and this is right about the position where the trace of the fault occurs. So, this really is very, very good, again, field evidence that strongly indicates that the Pen Branch Fault, in fact, is pre-Quarternary in age, and, in fact, from our relative ages, older than 33.7 million. Yes, sir?

JUDGE JACKSON: Does that fault -- I'm not sure what your orientation here is. Does it tend to be perpendicular or parallel to the tracks that we can see there?

DR. STIREWALT: Okay. Thank you for that question. The trace of the fault, in fact, runs almost perpendicular to this roadway. And it is dipping beneath, two geologists that you see there. It's dipping southeastward.

JUDGE JACKSON: You're right on it.

DR. STIREWALT: Yes, sir. Okay. Do you have further questions on anything regarding the Pen Branch? Okay. Then I would like to pass the baton to Ms. Sarah Gonzalez, who will speak to 2.5.

MS. GONZALEZ: My name is Sarah Gonzalez. I've been a seismologist with NRC in the Office of New

Reactors for the past two and a half years. And, before that, I was a seismology contractor with NRC for about three years. And my educational background is, I have a Master's degree in seismology from San Diego State University.

So, the presentation on Section 2.5.2 is going to focus on the issues that we felt were most critical to our review of Section 2.5.2. And one of the main review focus areas was the Applicant's update of the EPRI seismic source model. The EPRI source model was developed by six independent earth science teams during the mid-1980s. Since the model was developed more than 20 years ago, the Applicant needed to determine whether any updates were necessary.

As Don Moore mentioned in his presentation, the Applicant updated the Charleston Seismic Source. Their update involved significant changes in geometry, maximum magnitude, and recurrence interval of the Charleston Source Zone. The update was based, primarily, on liquefaction features from historic and prehistoric earthquakes that were discovered since the EPRI study. And, as a result of this update, the average occurrence interval of large earthquakes in the Charleston Source Zone decreased significantly, which resulted in an increase in the overall seismic hazard at the Vogtle site. Next slide, please, Slide Ten.

JUDGE JACKSON: Excuse me. These liquefaction features seem to be very -- pretty important indicator of past seismic activity. Is this something that's fairly new looking for these, or is it just more detailed mapping of the surface that brings these to light, or what?

MS. GONZALEZ: It's fairly new, and a lot of these features in the Charleston area were discovered after the EPRI source model was developed. In the next following slides, Laurel Bauer is going to discuss these features in more detail, and how they were reviewed. But this figure shows the Applicant's updated Charleston Source Zone, and Don Moore already went through it. And he mentioned the largest weight was assigned to Source Zone A. And this weighting, the large weighting of Source Zone A was primarily based on earthquake liquefaction features. And Laurel Bauer will now discuss the Staff's review of these liquefaction features with respect to the Applicant's update.

JUDGE TRIKOUROS: A question, a 20-year period passed for the EPRI data, the EPRI-SOG analysis, and the result of that was that the numbers got worse by a very significant amount. Your slide said from thousands of years to a thousand years. What about 20 years from now, or 40 years from now? I mean, this plant is like a 60-year plant without any -- at a minimum. What makes you think that you've reached equilibrium with your knowledge on that?

MS. GONZALEZ: Well, there's no guarantee that no new information will ever surface. However, based on the Staff's review, we concluded that it was a very thorough investigation of liquefaction features in the Charleston area.

JUDGE TRIKOUROS: Do you think the likelihood of 20 years from now, 30 years from now, new data coming forward that shows that this is non-conservative is not likely?

MS. GONZALEZ: Personally, I think the investigations were adequate in the Charleston area to come up with an accurate model of the source zone. I can't say 100 percent whether some new information will -

JUDGE TRIKOUROS: But is that what the factor of safety is about? The factors of safety, are they there for that purpose, to cover such things as that?

MS. GONZALEZ: Well, part of the

Applicant's model did have a lot of uncertainty incorporated into it. As you can see, there's different source zones, geometries to account for areas beyond where most of the liquefaction features occurred, Source Zone B and B prime. And maximum magnitudes were also part of a distribution, so there's some uncertainty built into the model to account for it.

MS. BAUER: My name is Laurel Bauer, and I've been a geologist with the Office of New Reactors for just over two years, and I have a Master's degree in Earth Sciences with an emphasis in paleoseismology.

Before we move on from Slide Ten, I just wanted to point out the blue -- they're a little difficult to see, but the blue, red, and yellow diamonds that you see in this area, and the black plus sign features represent -

JUDGE BOLLWERK: Hold on one second here. Let's get -- we'll get the right slide up. And you want part of it -- the magnification increased?

MS. BAUER: If we could blow up this area right here, so I could show you -

JUDGE BOLLWERK: Right here? The A, B, and C part?

MS. BAUER: That's correct.

JUDGE BOLLWERK: Sort of the different boxes? Maybe need to be a little higher, or we're good?

MS. BAUER: That's good. I just wanted to point out that the red, yellow, and blue diamonds, and the black plus signs on the figure represent liquefaction features from both the 1886 earthquake, as well as prehistoric earthquakes. Okay. Thank you. Now moving to the next slide, please.

On Slide Eleven, as Sarah Gonzalez mentioned, the Charleston update was based on liquefaction features, was partially based on liquefaction features from historic and prehistoric earthquakes. These features occur in response to strong ground shaking, where you have saturated sands at depth that are affected by the shear stresses, or affected by the cyclic shear waves. And those sediments tend to compact, if they have a high volume change, or high saturation limit, causing the pore pressures to increase to where they exceed the overburden pressures, and those sediments are forced to flow upwards through zones of weakness. And what I have tried to show with the diagrams here on the left is both a plainer and a vertical view of an example of liquefaction, where you see the sand has erupted to the surface, in this case, formed a sand blow at the surface. And then the figure to the right also shows an example of what one of these features might look like in the field. Next slide, please, Slide Twelve.

Abundant liquefaction features from both historic and prehistoric earthquakes are mapped along the South Carolina coast for about 115 to 130 miles to the north, and to the south. And then, further inland from the Charleston area greater than 65 miles. These features represent five similar magnitude earthquakes to the 1886 earthquake, and have been assigned dates that range back for 5,000 years. Next slide, please.

One of the Staff's concerns when evaluating how the Applicant had characterized the source zone was that possibly they had not provided sufficient paleoliquefaction evidence to rule out the occurrence of large inland earthquakes. While there is evidence of prehistoric liquefaction features further inland, they're few, and so we wanted -- asked the Applicant to provide further documentation on whether or not features had been documented or examined further inland. And the Applicant provided additional expert opinion from experts who had actually done liquefaction studies in the late '80s, on through the '90s. And while they did not, necessarily, document in their publications that features were not found, they did look for liquefaction, and those features were not found for their inland, in materials that would be considered moderately liquefiable.

JUDGE JACKSON: Do these normally -- do you examine these from aerial surveys, or something?

MS. BAUER: You can examine them from aerial surveys. Another way is looking at features along stream banks, and exposures along streams where sediments tend to be well-preserved, or where they tend to be easily accessible. It is possible to see the features on aerial photographs, specific -- more likely in earlier aerial photographs before there was much disturbance of the land area. So that is one method of looking for them in an open field, for instance. And, so, some of the inland features that were examined were along stream banks of the Edisto River.

Based on the information and the expert opinion that was documented and provided by the Applicant, the Staff determined that that information was sufficient to close out Open Item 2.5-5, and the

SER with open items.

And, now, Sarah Gonzalez will continue with the seismic presentation on Slide Fourteen, if there are no further questions.

MS. GONZALEZ: The Staff also reviewed the other EPRI seismic source zones that were part of the model, and the Applicant only performed an update of the Charleston source zone, so we wanted to make sure that there were no other source zones that needed to be updated. And these included the regional seismic source zones that surrounded the Vogtle ESP site.

As I mentioned earlier, the EPRI seismic source model was determined by six different Earth Science teams during the '80s. And one of the Earth Science teams, known as the Dames and Moore team, assigned low weights for large maximum magnitude values, and low probabilities of activity to two of their regional source zones. And the Staff was concerned that the Dames and Moore hazard curves for the Vogtle ESP site may not adequately characterize the regional seismic hazard. And this was Open Item 2.5-1.

And in the next slide, Slide Fifteen, this figure shows the Dames and Moore source zones that were used in the Vogtle ESP hazard calculation. The source zone shown in blue, which encompasses the Vogtle ESP site, has a probability of activity of .2. And this means that -- I'm sorry, .26. This means that there's only a 26 percent probability that this area is capable of producing earthquakes greater than a magnitude five. However, the implications of this are not significant at the Vogtle site.

And then the next slide, Slide Sixteen. The Applicant demonstrated that the contribution to the total seismic hazard from the Dames and Moore team was insignificant at the Vogtle site. They removed the Dames and Moore team to show that the increase in seismic hazard is less than 5 percent of the Dames and Moore results, are excluded. So, the Staff concluded that this was sufficient to close the open item.

Slide Number Seventeen, please. The Staff also had an open item regarding the Applicant's decision not to update the Eastern Tennessee seismic zone. This source zone is located just beyond the northwestern edge of the 200-mile site radius. The Applicant concluded that no new information has been developed since 1986 that would require significant revision to the EPRI source model. However, the Staff was concerned that more recent studies suggest revisions to the EPRI source model may be warranted.

And these more recent studies assigned slightly higher maximum magnitude values to the Eastern Tennessee source zone. This was Open Item 2.5-3.

However, the Staff performed a sensitivity study, which showed that increasing maximum magnitude values for the Eastern Tennessee seismic zone did not result in a significant increase in the hazard at the Vogtle site. And the results of the Staff's study can be seen on the next slide, Slide Eighteen.

This figure shows the seismic hard curves resulting from the Staff's sensitivity study. We looked at a range of maximum magnitude values for the Eastern Tennessee source. The second to lowest curve with the circles on it shows the result for a maximum magnitude value of 6.5, which is similar to the more recent PSHA studies. And if you look at the very top solid curve, that shows the total seismic hazard at the Vogtle site. And the contribution to the total seismic hazard from the curve with magnitude 6.5 as a maximum magnitude is less than 1 percent of the total seismic hazard. So, based on this result, the Staff concluded that it's not a significant contribution to the Eastern Tennessee. Slide Nineteen, please.

You saw this slide earlier in Don Moore's presentation. It shows the red curve, which is the

AP-1000 certified design response spectrum, or CSDRS. And it also shows the GMRS, which is the blue curve. As Don Moore mentioned, there are several frequencies where the CSDRS is exceeded. However, in the next slide, Slide Twenty, summarizes the Staff's conclusions why the GMRS is an acceptable site characteristic.

The Staff concludes that the Vogtle GMRS is an adequate representation of the regional and local seismic hazard, and meets the applicable requirements of 10 CFR Part 52, and Part 100. The Staff considers the Vogtle GMRS values to be within the range of values that new reactor designs are generally engineered to withstand. And the appropriateness of the reactor design chosen for the site will be determined at the COL stage. This concludes the presentation for Section 2.5.2.

JUDGE JACKSON: It looks like you looked pretty hard, then, at the source terms to make sure that something hadn't been overlooked somewhere. I mean, that's what those open items seem to be all about.

MS. GONZALEZ: Yes.

JUDGE JACKSON: Thanks.

JUDGE BOLLWERK: Maybe you can explain to me in terms of how is what you've done up to this point going to differ from what happens at the COL stage?

MS. GONZALEZ: Well, for the ESP, we're approving the GMRS as a site characteristic. We're not approving a design for the ESP site. So, the actual -- the adequacy of the design will actually be determined at the COL stage. We didn't look at -- we didn't do any analyses to support that.

JUDGE BOLLWERK: Right. Although, again, if you go back to Slide Nineteen, that was based on the AP-1000. Did I hear you correctly?

MS. GONZALEZ: Yes.

JUDGE BOLLWERK: And, so, you had that design in mind, but, yet, you didn't use it specifically. I guess that's the -

MS. GONZALEZ: For Section 2.5.2, we were reviewing the GMRS as a suitable site characteristic.

JUDGE BOLLWERK: Okay.

MS. GONZALEZ: Some parts of the design are actually reviewed as part of the LWA. And these analyses that were used are going to be discussed as part of the LWA presentation later.

JUDGE BOLLWERK: Okay.

MS. GONZALEZ: So, hopefully, that will

answer some of these questions.

JUDGE BOLLWERK: And, so, in terms of the COL, I mean, are you going to look at, for instance, there's a lot of piping, there's a lot of particular components. You look at those specifically in terms of the AP-1000 in the seismic analysis you've already done?

MR. TEGELER: Your Honor, with your permission, my name is Bret Tegeler. I'm the Senior Structural Engineer. Maybe I can follow-up Sarah's comment.

JUDGE BOLLWERK: Surely.

MR. TEGELER: For the LWA -

JUDGE BOLLWERK: Maybe a good version of American Idol. How is that?

(Laughter.)

JUDGE BOLLWERK: All right. Go ahead. I'm sorry.

MR. TEGELER: As part of the LWA application, we are reviewing certain portions of the design, of the AP-1000 design; namely, the mudmat with the embedded waterproofing membrane. And then we also do a check on the foundation stability, which we'll be talking about that later. And you also heard that through Mr. Moore's presentation.

There are other features that will be covered as part of the SCOL review, and those relate, in particular, to the components internal to the structure. But because the request did not involve installing or constructing those components at this stage, that review has not been done yet. It's ongoing.

JUDGE BOLLWERK: So we're talking about the parameters, the basic parameters of the design, or the parameters of the site. And we'll look at the actual design, and how, if you shook it, that would work at the COL stage. Right?

MR. TEGELER: Right.

MR. ARAGUAS: Let me also add just a clarification, just trying to separate out the ESP and the LWA. With respect to the ESP, we're trying to establish the suitability of the site characteristic, and so, even though we -- this diagram reflects the differences between the AP-1000 and the actual site characteristic for the Vogtle site, that comparison wouldn't have been done until the COL - or, at this point, I know as Bret pointed out, some of that's been looked at at the LWA, but had the LWA not been submitted, and solely an ESP, that comparison would not be looked at until the COL.

JUDGE BOLLWERK: All right. Thank you. All right. I think we're back to -- we were on Slide Twenty.

MS. GONZALEZ: Dr. Stirewalt will now discuss Section 2.5.3.

JUDGE BOLLWERK: I know it's counterintuitive, but go ahead and tap it. Yes, make sure it's on, that's the other -- two-step process. There you are.

DR. STIREWALT: If I would turn it on, that would be beneficial, sir.

Okay. Let me talk a bit about 2.5.3, surface faulting. Mr. Moore alluded to a concern about some non-tectonic deformation. And, really, this came out relative to an open item that the Staff developed for 2.5.3, surface faulting. There were, in fact - during some of the early work, they actually found in the field what they called injected sand dikes. Now, the stratigraphic relationships that appeared to exist suggested that those features could, in fact, be Quarternary in age. And you just heard Ms. Bauer qualify if, in fact, those sorts of dikes that have moved upward were, in fact, seismically generated, that means a tectonic source, so we have tectonic deformation, and there's a real concern.

So, the issue here, in fact, was that the Staff felt, or determined, that the Applicant really didn't initially demonstrate that these particular features were not associated with seismically-induced liquefaction. And, consequently, under that condition, would have been tectonic in origin.

What the Applicant did, is they did a really good and a thorough analysis. They determined, in fact, that these features were very, very local, that they, in fact, spatially -- and they determined that spatial association by doing some drilling, and actually mapping out the top of a particular unit. In fact, that unit was the Utley limestone, where, guess what, you could have dissolution. And, again, Mr. Moore qualified that as being a unit at the base of the Barnwell Group, that overlies the Blue Bluff Marl. But the point, again, is that they were locally developed. And, as it turns out, they were spatially associated with dissolution depressions that they really were able to define, and define pretty well, within the Utley limestone. So, basically, they were equated spatially exactly where those features occurred. And the concept was, then, if you had dissolution of this thin and discontinuous limestone unit that overlies the Blue Bluff, if you had dissolution of that unit, you, in fact, would produce these dissolution cavities. You would get collapse above those. And these were saturated sediments at the time, so they were water-rich, but you'd get collapse into those dissolution cavities, if you wish. And that would be the impetus for producing a fluidized driving force to move the dikes upward. And that, in fact, based on, again, every bit of field evidence that we had, was a very reasonable interpretation, and the Staff concurred.

Now, I might also mention that that is one unit, again, as Mr. Moore defined. That will be part of the Barnwell, and that unit will be removed beneath the nuclear island, so even that aspect of that type of non-tectonic deformation would not be a consideration for the nuclear island. They're going to take that unit out of there. So, the point is, based on that line of reasoning, again, with every shred of field evidence that we had, the Staff felt that the open item 2.5.10 was closed. And, in fact, that the deformation was well-demonstrated to be non-tectonic in nature, so not of a concern. Were there any questions on that, sirs?

JUDGE BOLLWERK: So, from a very non-technical standpoint here, the differences between

Slide Eleven, where you were concerned about liquefaction of sand because of earthquake shaking coming up on to the surface, this, in fact, was something that had collapsed and filled, rather than coming up from the bottom. Have I got that correct? Did you compare what you gave us on Slide Eleven, versus what you just said?

DR. STIREWALT: That's exactly correct, Your Honor.

JUDGE BOLLWERK: All right. Thank you..

DR. STIREWALT: That's exactly correct. If there are no further questions on that, then I will pass the baton to Dr. Carl Costantino, who will begin the discussion of 2.5.4.

DR. COSTANTINO: I'm Carol Costantino. I'm a Professor Emeritus from City University of New York. I received my Ph.D. many years ago in the geosciences. I've been a consultant to both NRC and Department of Energy for the last 40 years on seismic issues, primarily geotechnical, site response and soil structure interaction issues and have been heavily involved with the development of criteria standards for both generic nuclear industry as well as standard review plan developments for NRC. So I've been active for the staff for a long timer.

With this particular review, early on in the development it was clear that the amount of information available was problematic to make generic judgments and the characteristics we sort of knew of the surface materials, the upper sands. We also knew they were problematic. That was based not only on looking at the data we had available but also the data from Savannah River site across the river which had extreme amount of data available to look at.

Anyway, the issues had to do with knowing what were the properties, what were steer wave velocity profiles that we would end up working with since we know that was going to play a role in the soil structure interaction and then in the site response area what were the associated properties that would be appropriate.

The permit condition as I read it said you either remove it or remediate. We all know that remediation is a tough issue. So the Applicant decided to remove.

In response to one of the questions, that came up before during the LWA stage, we asked the Applicant to look at the extent, the lateral extent, of the excavation that would be required and actually computations were made to show that the configuration that was presented to you earlier does not have a significant impact. The remaining soils to the outset of that do not have a significant impact on any of the seismic responses both of the site soils as well as the surface structure. So the use of the one-dimensional convolution is appropriate and the analyses carried over into the structure are still appropriate even for that configuration. So the 2-D aspect is not a significant issue. We know that.

Based on the additional data that was taken during the LWA studies, all the open issues that we had concerns with in the call action items were closed essentially since we now have enough data primarily with the back flow that was being brought in. The criteria that was developed, we reviewed that and agreed with it. The test bacterial (phonetic) program was extensive, more extensive than we typically see at sites and the process that's going to used to put that 3,000,000 or 4,000,000 cubic yards of material back in is a process that follows standard procedures in the heavy construction industry and will end up with the characteristics in this particular problem mainly uniformity of placement across the entire area as well as shear wave velocity requirements that we have to ensure that you won't end up with any significant large settlements or discontinuities in the current construction stage and we won't end up with unusual behavior which impact both the walls and the base metal of the structure. Next slide please.

Well, I think I just said this. During the LWA. Next slide please.

Just to get a feel for the amount of data that was added during the LWA you can see the original borings where a standard sampling was performed there were only 14 borings and they upped it to 174. Now many of those were taken through the upper soils that are going to be removed, but we ended up with an additional 42 borings across the site which went down into and through the Blue Bluff Marl into the remaining soils that will be providing the primary support to the system in addition to the back fill.

The one penetrometers were taken through the upper soils. So they were not able to penetrate the Blue Bluff Marl, but they do provide velocity information for materials that could be used for fill material. The test pits also were based on -- The only purpose of the test pit would be to characterize soils you're going to use for the back fill.

The P-S loggers, there are six P-S loggers that were taken through the LWA. The purpose of that was to get down to the materials that are going to remain which are the Blue Bluff Marl, the soils below and then finally the Triassic rocks below that and then the profile below that deck.

The P-S logger generates shear wave velocity information and the purpose not only of having six of those is to make sure we have adequately captured variability in that data across the site. So we have a pretty tight set of data to define the soil velocity profile from the Blue Bluff Marl on down and what we need is information on the backfill.

JUDGE BOLLWERK: You're tapping into our --

DR. COSTANTINO: What we need remaining to complete that picture for site response is the definition of the properties of the backfill from the top of the Blue Bluff up to the ground surface. Next slide please.

JUDGE BOLLWERK: Now it's slide 25.

DR. COSTANTINO: Yes. Again this says that during the LWA we took enough additional data to supplement what we had during ESP and take care of our questions we had during the ESP. So the combination of both programs really gives us reasonable assurance that we're not going to have any significant problems provided the backfill is placed to satisfy the criteria as stated. Next slide please.

This is a picture of the profile that we used. Don Moore showed something similar to this. This is really a base case profile which is used to start the probabilistic site response analysis calculation. The information we need not only this base case velocity profile, but the variability of that layer by layer based on the number of P-S logger profiles we have available. So we need basically the best estimate which is this together with the sigma or the uncertainty on the velocities.

In the 1-D response analysis, it's a probabilistic site response analysis, we generate many realizations of this calculation of this profile and for each one we generate a surface motion using the PSHA down at the top of crystalline rock come up with the 1-D using the 1-D shape. In this case, they used shape. There are other codes that could be used, all of them pretty much doing the same thing.

As I mentioned earlier, I think there's significant number of comparisons of these 1-D calculations with empirical results to show that the computation works even for 1,000-foot soil comp. That is we get conservative estimates of our ground motion at the surface.

The issue of vertical ground motion in this convolution is a separate issue. That's why we use a lot of the emphasis on V/H ratios which come from the empirical database. What you end up with at the surface or at the foundation level is a probabilistic estimate of the response spectra. The reason why we use an outcrop with respect to your question before is you could easily develop a probabilistic in-column motion, not an outcrop, if you'd like.

Then the issue becomes when you carry it over into the SSI using this probabilistically determined in-column motion which is relatively smooth putting it into a deterministic SSI and that leads to sort of crazy results. So what we try to ensure is that when we make this probabilitistic 2-D deterministic switch we're going to do this in a relatively consistent fashion and that's the reason why we use outcrops and not in-column motions.

There are discrepant, I shouldn't say discrepant, there are alternate procedures to define this outcrop. That's in addition to then the process. The Applicant has done it one way. We do it another way. That's written in the standard review plan. There are differences. But the basic check at the end we ask them for the SSI analysis with the building, take the ground motions you're using for the three analyses and make sure they envelope to GRMS. So we're confident that we don't have any holes in whatever process they are following. We've gone through that step. The next slide.

The issue of soil degradation and damping ratio is it turns out a very important aspect of the problem. Soil degradation and damping really are ways to get information on the soil, nonlinear behavior due to the seismic results into the problem. And the issue was the backfill. The stream levels down below the Blue Bluff Marl and not very large. So there's not much nonlinear behavior down there due to confinement issue. But in the backfill, we need site specific data because that dominates the calculated GMRS. So we have to have a good handle on the degradation models.

And the soil damping ratio information site specific testing was done by University of Texas using samples taken from the backfill that was proposed for use and those were subjected to the resident column soil, resident column torsional shear, laboratory dynamic test results and then we have results from that which we use in the latest site specific calculation. Prior to that there were estimates of these properties that we used and then now with the latest set of data from LWA we have the data available and we know the site response. So we have confidence in the GMRS computed at the soil surface. Next slide.

Under condition one, we talked about that or you talked about that yesterday. Since all of the soils that are going to be subjected potentially to liquefaction effects are being removed. There really is no longer an issue. You sort of qualify that. If you get a big enough earthquake, everything liquefies. So that movie kind of earthquake is not going to -- It's not part of the design. So liquefaction is not an issue and all of those soils both under and to the side which could impact the response of the facility have been or are going to be removed. Next slide please.

JUDGE TRIKOUROS: I was surprised given what you've said that the horizontal extent wasn't in the perma condition. Just specifies general remove the soil.

DR. COSTANTINO: That was why we asked

that the amount removed be checked. So one of the specific calculation that was made was a 2-D dynamic wave propagation calculation that was performed to show that if we go as far as they propose to go then there's no input. So I mean that was a I think serious issue. If they said they were just going to excavate under the footprint you would obviously think of that as being potentially a problem. So the amount of soil proposed to be removed is adequate and we don't think there's a serious concern with that. Next slide.

JUDGE BOLLWERK: We're now on slide 29.

DR. COSTANTINO: Yes. The issue of bearing capacity we went around on that quite a bit to make sure that we were capturing computed bearing capacity and overturning factors of safety to make -- This is sort of a difficult area since these factors of safety are relatively -- The analyses conducted to support factors of safety are relatively crude and we incorporated both static and relatively new dynamic loading conditions into these evaluations. So that's we'd like even though the standard review plan says you could use factors of safety of 1.1 on the sliding conditions for dynamic the idea of the 1.1 being acceptable is the idea that the dynamic load isn't on for very long and you're not going to get much collapse, potential collapse, of the soils underneath going dynamic loading. The safety factors actually computed were very much larger. So we have essentially no concern with those kind of bearing capacity issues at the site. Next slide.

The call action items that were put in place were to develop those properties that we just talked about. Everything that we talked about during ESP and LWA were satisfied. All that's left to do is actually build the facility and make sure that the backfill that's placed is placed in a satisfactory, consistent and uniform manner and it should be a straightforward problem. Next slide.

As far as stability of slopes, there are really no safety related slopes that could impact the facility nearby. So it's not an issue. And I think that's the end and I'm going to pass it back to Dr. Stirewalt to summarize.

DR. STIREWALT: Thanks, Carl. Now I'm going to move to slide 32.

What we'd like to do now is effectively unless there are no further detailed questions on what you've heard, we'd like to just sort of have each staff member who presented some of the technical information just really do sort of quick overview summary and I would like to start with 2.5.1. I believe from what you've heard and what we were able to qualify that the Applicant in fact really did provide a thorough and an accurate characterization of the geologic and the seismic characteristics as required by various pieces of 10 CFR Part 100 which of course is the means of helping us draw the conclusion that there's an adequate basis to conclude that there are no capable tectonic structures in the plant site area that might in fact generate surface or near surface fault deformation, default displacement.

MS. GONZALEZ: The staff based on its review of Section 2.5.2, Vibratory Ground Motion, concluded that the Applicant provided a thorough characterization of seismic sources surrounding the site. The Applicant's GMRS adequately represents the regional and local seismic hazard and the proposed Vogtle ESP site is suitable with respect to the vibratory ground notion criteria for new nuclear power plants and meets the applicable requirements of 10 CFR 100.23.

DR. STIREWALT: And if I may have the next slide please.

Quickly address the summary part of 2.5.3

on Surface Faulting. The staff believed that the Applicant did in fact present an adequate description of the information leading us to conclude that there really is no solid evidence, no evidence, to indicate that either surface or near surface faulting or non tectonic deformation will present a hazard for the site.

DR. COSTANTINO: Next slide please. With respect to stability of subsurface materials and foundations that are going to be used for the site, we have enough information now to adequately describe the site, characterize the site and use that data to generate site inputs into the soil structure interaction problem, namely the GMRS, and we also have enough information to judge that the stability of both static and dynamic and sliding issues are really not issues for the plant. We have suitable factors of safety.

DR. STIREWALT: Honors, that concludes the presentation of the information that we had for 2.5.

JUDGE JACKSON: It was a good summary. Thanks.

JUDGE TRIKOUROS: Thank you.

JUDGE BOLLWERK: Anything further from the Judges?

(No verbal response.)

All right. I think we're ready to move on then. Thank you very much. We're going to be starting with slide 30 -- I think you renumbered them again going on the next one. Is that correct?

(No verbal response.)

So we're still in the same presentation. Haven't moved. It has additional parts to it. Probably you'll want to go to about 34.

(Off the record comment.)

Thirty-eight. Okay.

(Off the record comment.)

Right about there. Okay. All right then. Who is making this presentation?

MR. TEGELER: I am, Your Honor.

JUDGE BOLLWERK: Okay.

MR. TEGELER: As I mentioned earlier, my name is Bret Tegeler. I'm a Senior Structural Engineer in the Office of New Reactors Division of Engineering. We're going to present to you the structural engineering evaluation of the Applicant's LWA application. My co-presenters in this presentation starting from your right are Dr. Carl Costantino, Dr. Wesung Wong (phonetic) and Dr. John Ma. And just as previously mentioned by Sarah, I'm going to be helping John out because his voice is a little sore today. So I'll essentially read his slide and he can answer the detailed questions.

JUDGE BOLLWERK: All right. Very good.

MR. TEGELER: Next slide please. And I apologize. I don't know that I can see the slide numbers. So I may have some trouble.

JUDGE BOLLWERK: All right. Why don't we go ahead and move to the next slide. I think we're onto number three probably.

MR. TEGELER: Thank you. The purpose of these presentations is essentially to present, as I said, the structural engineering review. In this presentation, I will describe the scope of the LWA which was mostly previously covered by Don Moore and then Carl Costantino will provide the background summary of what was done as part of the geotechnical evaluation and then myself and John Ma will provide a summary of the evaluation and findings of the structural engineering portion. Slide four please.

As the Applicant mentioned previously, the scope of the LWA involves soil foundation work, the placement of a concrete mud mat, a waterproofing membrane, a mechanically stabilized earth wall which you'll hear me refer to as MSE retaining wall and temporary drains.

We discussed earlier what was supporting these elements. So I won't go into much more detail, only to say that the supporting media that are shown on this slide are considered in the detailed soil structure interaction analysis which I'll go into shortly.

I just want to also add on this slide that the Applicant referenced the AP1000 DCD Rev 15. Next slide please.

This slide was also shown earlier. My intent for having this slide was just to provide really a way to identify two important locations relative to the Vogtle site or at least the site specific analysis. That is the location of the GMRS and the foundation input response spectra. I think Don covered this fairly well, but I just wanted to add that it's the foundation input response spectra that is used as input to the SSI analysis. Next slide please. Slide 6.

Don also presented this slide earlier. I don't have any other information to add to this slide the Board has a follow-up question. My intent on showing this slide was similar in that I just wanted to point out the location of the waterproofing membrane and the mud mat relative to the foundation structure.

JUDGE BOLLWERK: All right. I think we can go on.

MR. TEGELER: Next slide please. Slide 7. At this point, I will turn the presentation over to Dr. Costantino.

DR. COSTANTINO: I think that much of this information was mentioned a short while ago. The extra data that was generated during the LWA came from the extra borings together with samples and testing that were done to satisfy the request from the staff. It was reviewed and all of that data was used to close all open issues that were generated previously. Next slide please.

The additional data that was generated I mentioned for the backfill were really to determine dynamic properties that were appropriate as well as compaction data to make sure that when it's placed compaction criteria could be determined. So not only were the dynamic properties generated, but also requirements on the amount of fines that were incorporated into the soil sample were limited to make sure that it can be placed without any significant problem and placed uniformly.

The dynamic properties which came from the laboratory test, the resonant column torsional shear are really used directly in the computation of the GMRS and the FIRS. The GMRS is as stated equivalent to the site safe shutdown. Next slide please.

Based on the data we have, the amount of information, the additional P-S logger data that was taken, the staff considers the site investigations adequate to generate the information we need which are basically computation of GMRS and the FIRS using the SSI and criteria for placing the backfill. One of the big issues is to make sure that the backfill is placed uniformly, have a given minimum shear wave velocity at the depth of the fill and provide enough static capacity. We have enough information to make those judgments. Next slide please.

As I mentioned before, the 174 borings, most of those were really through the upper soils which we used for site characterization of those soils. Forty-two penetrated the Blue Bluff and below and those were used in the characterization of the site soil column below.

One of the issues on transportation, of course, when we take samples, so-called under served soil samples, the issue is to get the sample out of the hole without too much disturbance and over to the laboratory. So one of the big issues is how do you transfer from the site to the laboratory. That's always been a big issue. On some sites, we actually, Savannah River for example, we bought first class air tickets and standard samplers up in the seat. The issue was getting it through the x-ray machine at the site. So you don't want to turn the samples horizontally. So those are all details. At Los Alamos site, we actually put accelerometers on the box to make sure the box is not shaken too significantly. Next slide please.

There basically is a seismic -- There used to be seismic category 1 and seismic category 2 which had different compaction criteria. But then that was changed. I mean that's a difficult control issue during construction. So that was finally changed. So whatever backfill is going to be placed has a given grain size distribution characterization, a given compaction criteria and if we follow that we'll get a uniformly compacted backfill to satisfy all our uniformity criteria.

If we had both category 1 and category 2 with different compaction criteria that always is a problem out in the field. And it's the slide points out there. There is some mention of flowable backfill, but those are going to be relatively minor around local problems, problem areas, the pipe connections or whatever. But that's not a major issue in the compaction problem. Next slide please.

JUDGE BOLLWERK: You're now on slide 12.

DR. COSTANTINO: Slide 12. The physical characteristics I think I mentioned before is to limit the percent of fines. Fines are defined as grain sizes less than or not less than 200, passed the number 200 sieve which is 200 openings per inch. If the fines in the sample are too high, percent fines are too high, you have trouble in compacting. If any water gets in, it makes compaction, it makes the program miserable. So if you have the fines too high and it rains that day, then there's a problem.

The compaction criteria is part of the ITAAC. There are grain size testing done on soils as they're brought in and then the soils are placed in thin lifts, eight to 12 inches in thickness, and rolled and compacted and density measurements are made per lift to make sure that no lift is too soft and that's standard practice that's been used in the construction industry for many years. Can I have the next one? That one.

So the ITAAC is -- The first one is the ITAAC on the backfill material. That reading requires testing as you go to make sure that we're going to have a compact backfill and then at the end as Don Moore mentioned there's going to be actually at two places. When the fill gets up to the bottom of the foundation mat there's going to be some shear wave velocity testing to make sure we're not seeing anything strange and then when it gets up to the top we're going to again measure velocities and those velocities have to satisfy the criteria that at the 40 foot depth we at least meet 1,000 feet per second shear wave velocity. Next slide please.

We have as you heard Don mention during the test pad program there was shear wave velocity measurements that were taken to make sure that in that program within the 20 foot depth we were able to reach 1,000 feet per second. Since we're going to be down well below 20 feet, we should have no problem in meeting the 1,000 foot per second minimum requirement.

There's a phase one, phase two that's listed. Phase one is really the program that was done for the test pad. Phase two, there are some specific details that have to be ironed out. When you start now placing large volumes of soil for the actual compaction program, the details on what equipment you're going to use and how that's going to be placed, rolled and water content, all of those issues, are going to have to be worked out and reviewed by the staff to ensure that there's no potential problem coming downstream. Next slide.

So the general summary I think we made we think that we know the material properties well enough to go forward the site. The site is adequate if we follow all of these, if the actual characteristics match what we think is going to be there. Then we have an ITAAC program to confirm that it's placed as we think it should be placed. Next slide.

JUDGE BOLLWERK: I think we're on slide 16 now.

MR. TEGELER: This is Bret Tegeler again.

JUDGE BOLLWERK: You need to tap the --

MR. TEGELER: This is Bret Tegeler again starting the structural engineering review on slide 16. As I mentioned earlier, the LWA involves the placement of the concrete mud mat with an embedded waterproofing membrane. Just to provide a little more detail on perhaps what we heard earlier with respect to the MSE wall and mud mat, the mud mat will be constructed with pre-cast concrete panels with tiebacks that will be approximately 40 feet in height, which corresponds to approximately the depth of embedment of the nuclear island.

The footprint of the mud mat also corresponding to the footprint of the nuclear island is approximately 160 feet by about 260 feet in plan which is approximately an acre in size just for scale. The mud mat to be placed will be 12 inches thick in total. It will be comprised of two six inch layers with the waterproofing membrane sandwiched between the two layers and that concrete should have a compressive strength of about 2,500 psi.

The waterproof membrane itself, the Applicant has stated it will be an elastic spray-on membrane, approximately 80 to 120 mils in thickness and as I mentioned will be the sandwich between the two layers. That membrane will also extend vertically up the MSE wall. The Applicant also provided a waterproof membrane ITAAC which states that testing will be done to confirm that the membrane-mud mat interface has s coefficient of friction of 0.7 and as I said earlier the Applicant also referenced AP1000 Rev 15 in this. Next slide please. Slide 17.

The LWA does involve foundation elements construction or preparation for the category 1 foundation structure. As such we reviewed those elements under SRP Sections 3.7.1, 3.7.2 and 3.8.5. Those mostly relate to the seismic design parameters and seismic analysis methods and then the foundation stability.

The staff believes that the basis for the approval of the LWA will not be impacted unless there's a major change in the footprint of the nuclear island basement. Additionally, moderate changes in the structural design will not invalidate the basis for the LWA approval. Next slide please. Slide 18.

I mentioned earlier the various SRP sections, but I think the main takeaway from my slide is these three sections involve essentially the review of the dynamic analysis input parameters such as the foundation input response spectra, the soil layering characteristics, structural damping parameters and then the subsequent review of the actual analysis and does the SSI model adequately capture the AP1000 structural characteristics and is it embedded properly in the soil and then the output of that analysis which would be essentially the demand on a nuclear island or the loads are then assessed in a foundation stability analyses concluded on the 3.8.5.

JUDGE TRIKOUROS: Could I ask you to go

back one slide?

MR. TEGELER: This slide?

JUDGE TRIKOUROS: Yes. That's the one. "Moderate changes in structural design will not invalidate basis for LWA approval." What do moderate changes? I mean, how does that carry forward?

MR. TEGELER: This point addresses the issue that the LWA is referencing the Rev 15 standard design. What will be constructed is something other than that, perhaps 17. The assumption here and I think the staff has reasonable confidence that changes that have been identified as part of the amendment would not likely alter the conclusions reached as part of this review.

What I mean by that is as long as the most important characteristics remain the same primarily in this case for foundation stability would be the size of the footprint, the overall dimensions, which I mentioned earlier, the overall weight of the nuclear island. There may be moderate changes to mass or even internal connections within the structural elements, but the thought is that those changes would not significantly impact, for example, again the overall weight or the inertia or the footprint size.

Combine that with the margin that we

identified from the Applicant -- I'm sorry. The margin that the Applicant identified as part of the site specific evaluation, I think the staff has convince that this is a true statement.

JUDGE TRIKOUROS: So when Rev 17 is approved, the DCD Rev 17 is approved, then the Applicant submits its amendment to accommodate that you basically have already looked at that is what you're saying.

MR. TEGELER: That's correct, Your Honor.

JUDGE TRIKOUROS: Okay.

MR. ARAGUAS: This is Chris Araguas. I also wanted to add in respect to your question that the regulations state that the LWAs perform at the Applicant's risk and so it's the responsibility of the Applicant to address any changes that could impact what was done as part of the LWA at the COL stage and that could cause some challenges on issuance of the COL. But again that addresses part of the COL.

MR. TEGELER: Okay. Should I proceed?

JUDGE BOLLWERK: Yes. Are we on 19 now or are we still back on 18?

MR. TEGELER: Slide 19 please.

This slide I'll just quickly summarize the application of 3.7.1. As it was mentioned earlier, the Vogtle site ground motion response spectra, the GMRS, exceed the AP1000 certified seismic design response spectra in both the high and low frequency ranges. As a result of this, the Applicant performed site specific analysis.

The foundation input response spectra is also defined at the foundation elevation. That is something that we check in this portion. Next slide please, 20.

This is a slide that was shown earlier. This is again a comparison of the horizontal GMRS, the site specific GMRS and FIRS with AP1000 CSDRS and again this is just to highlight the accedences in that low frequency range, 0.7, maybe 0.4 to 0.7 range, below 1 hertz if you will and greater in the range and then there's an accedence in the higher frequency range of about 7 to perhaps 60. Next slide please.

Similarly, this slide also shows the accedence in the vertical direction. I won't go through this because this was already covered. Slide 22 please.

As I mentioned earlier, the staff does perform an evaluation of the input parameters to the site specific analysis. One of these parameters is the vibratory ground motion or in this case the FIRS.

As Dr. Costantino mentioned earlier, an alternative method was used for developing the FIRS. However our view indicates that the method did result at least in this case as a conservative estimate for the horizontal seismic demand.

The staff also evaluated whether or not the FIR satisfied the 10 CFR Part 50 Appendix S requirement that the free field motion at the foundation elevation be a minimum ZPA value of 0.1 Gs. We also look at critical structural damping values and we would the values that were used, the analysis, were consistent with regulatory guidance and we also as I mentioned earlier evaluated the supporting media below the nuclear island to make sure that the analysis assumptions were consistent with the measured values at the site. Next slide please. Slide 23.

In Section 3.72 as I mentioned earlier, we performed the evaluation of the site specific models. Again, the Applicant did perform the 2-D site specific models for evaluating the sliding and overturning stability. The Applicant used SASSI, essentially 2-D SASSI stick models for the nuclear island and the adjacent buildings. The models did account for the 40 foot embedment below the oil surface. The analyses were performed in three directions and as was mentioned earlier used the upper best estimate and lower balance soil properties to address uncertainties. The Applicant then compared the in-structure responses at six key locations and then also computed the maximum seismic shear forces for use in stability and dynamic bearing pressure evaluations. Next slide please.

To summarize our evaluation findings on the 2-D SSI analysis, the staff finds that the use of the 2-D SASSI models is acceptable for the evaluation of the sliding stability and bearing pressure demands. Further, as a way to in a sense perform a confirmatory check on the Applicant's analysis, we compared the analysis results at the nuclear island center of gravity which you might consider to be a rough approximation of where you have the average inertial acceleration.

We compared that acceleration level with the AP1000 soft soil case. That would be Rev 16 and 17 and found them to be similar. Again, it was just an approximate check.

We also performed independent calculations to essentially check that the seismic shear forces calculated by the Applicant's 2-D analysis were reasonable in range and we found that they were realistic values based on our own calculations. Next slide please. Slide 25.

I mentioned earlier that I'm going to present this for John Ma. The Applicant provided a waterproofing membrane ITAAC where the design commitment of the ITAAC states that the friction coefficient to resist sliding shall be 0.7 or higher and that testing will be performed to confirm that the mud mat/waterproofing membrane/mud mat interface beneath the nuclear island base mat has a minimum coefficient to resist sliding of 0.7.

JUDGE JACKSON: Let me just make sure. I thought he was talking about the base of the mud mat. I mean the membrane is embedded, right, and so it's locked in. There's no issue there.

MR. TEGELER: The concern on this particular ITAAC is you're correct that below the mud mat we discussed earlier about the friction coefficient of 0.45. The concern here is that the membrane itself whether or not that presents a weak plane, if you will, a shear plane, that could potentially fail and then slide. So we want to check to make sure that material, the membrane material itself, has at least the coefficient of 0.7 which the DCD requires.

JUDGE TRIKOUROS: And how is that done? How would that be done?

MR. TEGELER: The Applicant provided some information from a proposed vendor. I think it was a bridge. They provided a test report that was done using a similar application of this particular material sandwiched between two concrete surfaces and I believe they did an incline plane test to assess what the angle of sliding might be and then they can compute the coefficient of static sliding. That was based again not -- The intent of that test was I think to provide staff with confidence that this material and sandwiched between these two materials, concrete and concrete, would achieve this friction value and then these tests were done with that aim.

JUDGE TRIKOUROS: This ITAAC reads as if it's already done. Is that correct?

MR. TEGELER: I think

DR. MA: This is John Ma. This ITAAC is not done yet because we are asking them to give us the information whether this is creditable, has been done before. So they sent us a report. It's been done before. You can reach 0.7. But sometimes they did not reach 0.7. It was 0.4 to 0.8 the data shows. What they did was they put in like a concrete block over the concrete surface and raised the angle when the box started sliding.

So this ITAAC they would have to do at a site to do the same kind of test for the material they used for concrete surface over another concrete surface which is the mud mat. The six inch mud mat would be on top of the other six inch mud mat. In between there's a membrane. So this test would be done at the site.

JUDGE JACKSON: I thought that they were going to spray this membrane on. Did I have that right? The membrane you put the first layer down. You spray the membrane. Then you pour the next.

MR. MOORE: That is correct. The actual test has not been done. The information that was provided to the NRC was information that we, the Applicant, were able to get from the vendor as an example to give them and then give us some assurance that we would be able to meet the ITAAC. But the test has not yet been done.

JUDGE JACKSON: Yes. I would say I mean you would have to do it really under those conditions with those materials. I think that would make a big difference. It would be different than putting a couple of slabs around a membrane.

MR. MOORE: That is correct. Here again we're spraying on -- We're pouring concrete on top of it and it would have to duplicate. Our commitment is to duplicate how it is constructed on the site and we'll do the test. We'll come up with a test plan that duplicates that construction technique.

JUDGE JACKSON: Do you think it would be a sliding test similar or would it be one where you mechanically --

MR. MOORE: I'm sorry. I'm not able to answer that. I have not yet seen any of the plans.

JUDGE JACKSON: Okay. But it will be some kind of credible measurement.

MR. MOORE: Yes. An ITAAC we will perform this and then the NRC can review the test report and they have the ability to review that and determine if this is acceptable.

JUDGE JACKSON: Okay. Thanks.

JUDGE TRIKOUROS: This will be done at the site.

MR. MOORE: I'm not sure. Can I answer that I'm not sure where it's going to be done? It's a commitment by the Applicant to perform the test. I'm not sure exactly where it will be done, but we have a commitment to duplicate the type of installation so it will be representative. As John Ma has mentioned, this test that we provide, it will be basically a block sitting on the material and letting it slide. We're basically pouring concrete on top of a spray-on material. So that has to be represented correctly in the test that's going to be performed as part of the ITAAC.

JUDGE TRIKOUROS: The ITAAC is rather nebulous. It just is testing. It doesn't say anything more than that. The acceptance criteria actually just says that another report exists. I'm surprised by the acceptance criteria. They don't say that -- I mean it's implied that it would meet 0.7, but the acceptance criteria doesn't say that that test that's performed will meet a 0.7 criterion. It just says you're going to do a test and the acceptance criteria is that some report exists somewhere.

MR. MOORE: The wording here I understand your comment. The wording here is very common in the ITAAC that the design commitment is defined. These things are very -- The ITAACs are written in very limited -- I mean they describe the report will exist. The details on how that's done typically is not put in the ITAAC wording itself.

For example, the wording for the ITAAC for the shear wave velocity, measurements for the backfill a lot of information has been provided in the SSAR to describe some of the techniques and so forth.

JUDGE TRIKOUROS: I think I'm reading this incorrectly. This is a report that will exist. This is a report that will exist in the future.

MR. MOORE: Right.

JUDGE TRIKOUROS: This is not referring to the information that was provided, preliminary information that was provided.

MR. MOORE: That preliminary information was provided to provide some assurance that this type of material can perform as we expected.

JUDGE TRIKOUROS: That's fine. Thank you.

MR. TEGELER: Your Honor, if I could just add. Sorry.

JUDGE TRIKOUROS: Go ahead.

MR. TEGELER: Perhaps the confusion, I mentioned that there was a test report done and the staff has asked an RAI as part of their review of this portion that for the Applicant to demonstrate that it's reasonable to conclude that you could actually achieve this in a real application. So in response to that RAI, the staff provided a test report done on a -- I'm sorry. The Applicant provided the test report which was done using the same spray-on material, perhaps slightly different material, roughness, etc. But there was enough information to give the staff confidence that the 0.7 value is achievable.

JUDGE TRIKOUROS: Right, but Dr. Ma has indicated that there wasn't 100 percent. So you need to do something more.

JUDGE BOLLWERK: Does the staff have any expectations as to how this report will be prepared or how the test will be done that you --

DR. MA: This is John Ma again. My own personal opinion is the test has to be done at that job site because the temperature, moisture, the condition should be simulating the site condition.

JUDGE BOLLWERK: I take it other than what we just heard. Have you expressed this to the Applicant? Are they aware of that? You are now I guess. Go ahead.

MR. MOORE: We are totally aware of that and our intent was to provide a test that truly indicates the site conditions, the unsolved conditions.

JUDGE BOLLWERK: All right. So it seems everyone is possibly at least at this point on the same page. All right.

MR. TEGELER: Slide 25. The final bullet, the soil test data indicated a bearing capacity of 42 ksf. This was mentioned earlier by Dr. Costantino. Next slide please.

This slide summarizes the staff's review of the Applicant's stability analysis for the nuclear island. The staff reviewed the maximum horizontal seismic forces and maximum friction forces below the basement. This table summarizes those seismic reactions corresponding to the earlier mentioned lower bound best estimate and upper bound analyses.

Based on this table which indicates that the maximum friction force results in about 117 kips. Sorry. I'm checking with John.

DR. MA: Yes.

MR. TEGELER: Okay. Results in a maximum friction force of approximately 116-117 kips. The staff concludes that the nuclear island will not slide during the SOC because of the friction forces is greater than the inertial force. Next slide please. Slide 27.

The maximum dynamic bearing pressure on the soil for the nuclear island, the rad waste annex and turbine buildings, are 18, 1.7, 7.2 and 2.54 ksf, respectively, during the SOC. The minimum factor of safety with respect to a failure of the dynamic soil bearing capacity during the SOC is 2.34 which is equivalent to 42 ksf/the demand of 17.95 ksf. Next slide please.

In summary with respect to the seismic design parameters, the Applicant adequately developed the seismic design parameters and has met the applicable regulatory requirements. With respect to the seismic systems analysis, the Applicant adequately performed the site specific, 2-D SSI analysis for the purpose of determining the maximum seismic demands and has met the applicable regulatory requirements. The staff's evaluation of in-structure response which is as we mentioned earlier will be done as part of the SCOL review.

With respect to the foundation analyses, the Applicant has demonstrated that the mud mat and waterproofing membrane are adequate and that the nuclear island foundation is stable during a safe shutdown earthquake event. The Applicant's proposed mud mat and waterproofing membrane design meet the applicable regulatory requirements.

I think this concludes unless you have further questions.

JUDGE BOLLWERK: Any questions from either of the Board members on this?

(No verbal response.)

All right. Then we can move onto the next portion of the presentation which is the environmental review.

MR. ARAGUAS: Before we move, I just wanted to make a clarification.

JUDGE BOLLWERK: All right.

MR. ARAGUAS: There was a question that was asked as part of Don's presentation earlier with respect to demonstrating completion of the ITAAC as being prerequisites to future construction activities and I wanted to clarify that the completion of the ITAACs are not prerequisites of future construction activities. So to clarify that, they would do the tests as they do the construction activities, but the submission of a notification stating to the staff that the report has been done that documents this would not need to be done prior to continuing their construction activities.

JUDGE BOLLWERK: Having said that, as you mentioned before, anything they do relative to the LWA is at risk, for any construction they do, if it turns out late or not to be acceptable to the staff.

MR. ARAGUAS: That's correct and if the

staff inspects the ITAAC and determines that they didn't meet the ITAAC I mean the risk is to the Applicant.

JUDGE BOLLWERK: I take it if the ITAAC, if the report, is given to you soon after the fill is put in I take it it's something you're going to review and indicate to them whether it's acceptable or do you simply hold it until the end?

MR. ARAGUAS: I'll try and answer this to the best of my ability. I'm not very familiar with the inspection program that's set forth, but it is my understanding that the staff is not intending to inspect every ITAAC closure and look at every single report. So whether or not we would look at that specific report for that ITAAC I can't speak to.

JUDGE BOLLWERK: I guess, doesn't that put the Applicant at some risk that they may not want to be at. If they ask you to review the report and sign off on the ITAAC before they can continue the construction wouldn't you want to do that? Maybe not. Mr. Moore, I don't know if you have anything you want to say about that.

MR. MOORE: I'm not the right person to answer that question.

JUDGE BOLLWERK: All right. Well, maybe

that's an interesting procedural question. I have no idea.

JUDGE TRIKOUROS: I'm not sure that I heard correctly. Staff is saying that if asked to review and sign off on that ITAAC before construction they might not. Is that what you're --

MR. ARAGUAS: Well, again, I'm not very familiar with the inspection program that we have going forward, but I don't think it's necessarily a submission or a report. I think it's that they submit a notification to the staff that states that they have completed the ITAAC and that a report exists such that when the staff comes and does its inspection activities they have that opportunity to look at that report to verify that the ITAAC had been met. Whether or not that specific report would be looked at, I can't speak to.

JUDGE BOLLWERK: It is what it is I guess. All right.

MR. MOULDING: Let me just a brief clarification.

JUDGE BOLLWERK: Sure.

MR. MOULDING: The staff does review every ITAAC to determine that the ITAAC has been closed. But as Mr. Araguas said, the inspection of each ITAAC depends on the details of the inspection program and I'm not sure we know all the details of that at this point.

JUDGE BOLLWERK: So what you're saying is there's a difference between checking the box that the report actually exists and then reviewing the report and seeing that it really is adequate.

MR. MOULDING: I believe that is the distinction, Your Honor.

JUDGE BOLLWERK: And the inspection process is where the report is actually reviewed for adequacy.

MR. MOULDING: Yes sir.

JUDGE BOLLWERK: All right. Thank you.

Any other question with respect to this part of it?

(No verbal response.)

Thank you, sir, for the clarification. Let's then move on to the environmental review.

MR. NOTICH: Thank you. This is Mark Notich and I am again the staff's Environmental Project Manager for the Environmental Review of the Plant Vogtle Early Site Permit Application.

The Board requested a presentation that discusses the seismic evaluation performed for the plant Vogtle ESP and that the presentation should have an environmental perspective. Next slide. Thank you.

This is slide three. NEPA's reviews focus on the impact of the proposed action on the environment. By contrast -- I'm sorry. For the plant Vogtle ESP, the staff focused on the potential impacts that construction and operation of two reactors and associated facilities based on the AP1000 design and would have on the site and the surrounding environment. By contrast, seismic analysis is a safety review focused on the potential impact of the environment on the proposed facility. Next slide please.

This is slide four. The staff used NUREG 1555, the Environmental Standard Review Plan, as a basis to perform the environmental review for the plant Vogtle ESP. The ESRP does not contain guidance for environmental review of seismic information. Instead the ESRP in Section 2.6 guides the environmental staff to refer seismological analysis and evaluations to the SER or the SSER. The staff followed this instruction in preparing the final EIS for the Vogtle ESP.

JUDGE BOLLWERK: All right. Thank you very much. Appreciate the input. All right. Any

Board questions for the staff panel in terms of the seismic evaluation? Anything further?

(No verbal response.)

Mr. Moore, let me turn to you and see if you have anything further you wanted to say relative to what you heard during the presentation by the staff.

MR. MOORE: No, I do not.

JUDGE BOLLWERK: All right. Anything further the staff wants to make the Board aware of relative to the seismic evaluation? Anyone?

(No verbal response.)

All right. Then we thank you very much. This was an important issue. Seismic is always a question and while we know you spent some time before the advisory committee on reactor safeguards on this subject, we thought it was a matter that we ought to be taking a look at as well. I think the overview you've given us and the presentation and the detail you've gone into has given the Board a fairly good sense of what occurred here, what the issues were and how they've been resolved in terms of the staff's analysis as well as the input from the Applicant and I think we very much appreciate the effort you've put into this. And thank you for the information and for your service to the Board, all of you. Thank you..

All right. At this point, it's about 12:15 p.m. Unless the parties have another approach, what we would propose to do I think is to proceed on and try to get in the last two presentations rather than going and taking a lunch break if that's acceptable to you all. All right?

(No verbal response.)

Then let's go ahead and move to the presentation on severe accident mitigation design alternatives and this is a staff panel.

MR. MOULDING: Would it be okay to take a brief, maybe a five minute break?

JUDGE BOLLWERK: Yes, we can. Absolutely. Why don't -- Five minutes? Ten?

MR. MOULDING: Perhaps ten.

JUDGE BOLLWERK: Let's say a ten minute break then and we'll come back and start with that presentation. Off the record.

(Whereupon, a short recess was taken.)

JUDGE BOLLWERK: All right. Let's go ahead and go on the record then please. We are back from the break and we're going to start with the -- We have two presentations left, the first one dealing with severe accident mitigation design alternatives or

SAMDAs as they're often referred to and I believe we've got the witnesses. Why don't you go ahead and present the witnesses and I think we have one exhibit we need to get into evidence.

MR. MARTIN: Thank you, Your Honor. I will introduce the witnesses one more time. I think we've met them both. On the left is Mark Notich and next to him is James Ramsdell.

JUDGE BOLLWERK: Okay. Thank you, gentlemen. You both were sworn previously and you remain under oath.

MR. MARTIN: We have one exhibit for this presentation. It's Exhibit NRC000066, Staff Presentation 8, Severe Accident Mitigation Design Alternatives.

JUDGE BOLLWERK: All right. And the record should reflect that Exhibit NRC000066 as described by counsel is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000066-MA-BD01 for identification.)

MR. MARTIN: And the staff would like to move to have this exhibit admitted as evidence.

JUDGE BOLLWERK: Any objections?

MS. SUTTON: No objection.

JUDGE BOLLWERK: Thank you. Exhibit NRC000066 is admitted into evidence.

(The document referred to having been previously marked for identification as Exhibit NRC000066-MA-BD01, was received in evidence.)

And I believe at this point we're ready for the panel's presentation on SAMDAs.

MR. RAMSDELL: If you can move to slide 3 please. Yes.

This slide is here just as an introduction SAMDAs and as an explanation of why and how SAMDAs got into the environmental review. I don't think it requires a lot of more discussion. Environmental Standard Review Plan 7.3 provides ESP applicants with an opportunity to address SAMDAs or SAMAs. Southern in its ESP application for the Vogtle site chose to include a SAMDA analysis in its environmental report. Therefore the staff included a SAMDA analysis in EIS.

This is the first time that a SAMA or SAMDA analysis has been included an ESP EIS. The previous three were based on a plant parameter envelope that encompassed several reactors and therefore, SAMDA analysis was not appropriate. The next slide please. It will be slide 4.

JUDGE TRIKOUROS: Could I ask you just one question?

MR. RAMSDELL: Yes.

JUDGE TRIKOUROS: You referred to both SAMDAs and SAMAs and there is a distinction. Could you explain that to us please?

MR. RAMSDELL: A SAMDA is a design alternative. A SAMA is a more generic alternative that includes procedural and training alternatives that in general would be most appropriately evaluated near the time of fuel loading when the plant has been constructed and the procedures are being developed rather than some eight or ten years prior to the development of procedures.

JUDGE TRIKOUROS: Okay. Thank you.

MR. RAMSDELL: The Vogtle ESP application cites Revision 15 of the AP1000 design. It's a certified design. Design certification is incorporated or part of Appendix D of 10 CFR Part 52. Paragraph VI(B)(7) of Appendix D states that SAMDA issues are resolved "for plants referencing this appendix whose site parameters are within those specified in a severe accident mitigation design alternative's evaluation." This in essence where we're going, where the staff is going, in its SAMDA review.

The question is are the site parameters at the Vogtle site within those considered in the SAMDA review conducted during design certification. The next three slides will talk a little bit about what was done in the design certification review. We'll talk then about what the staff has done. Next slide. This is slide 5. All right.

The AP1000 SAMDA evaluation was evaluated by staff in NUREG 1793 Chapter 19. The staff looked at the probabilistic risk assessment provided by Westinghouse for the AP1000. It looked at the way in which Westinghouse went from a list of the order of 100 or more potential design alternatives and narrowed it down to 16. It looked then -- I guess 14 of the design alternatives identified by Westinghouse. Two added by the staff.

It then looked at the results of the uncertainty analysis conducted previously for the AP-600 and finally it looked at the potential benefits from reducing or implementing these design alternatives. The results of the staff review were documented in an environmental assessment that accompanied the design certification rule. If you go to the next slide please. It's slide 6.

In that environmental assessment, the staff included the following conclusions. First, that none of the potential design modifications evaluated are justified on the basis of cost benefit considerations. It also concluded that it is unlikely that any other design changes would be justified in the future based on the basis of person-rem exposure because the core damage frequencies are very low based on an absolute scale.

And then finally on the next slide, it's slide 7, the staff included in its findings that the evaluation that it had performed provides reasonable assurance that there are no additional SAMDAs beyond those currently incorporated into the AP1000 design which are cost beneficial whether considered at the time of approval of the AP1000 design certification or in connection with the licensing of a future facility referencing the AP1000 design certification where the plant referencing this appendix is located on a site whose site parameters are within those specified in Appendix 1B of the AP1000 design control document. These issues are considered resolved for the AP1000 design.

JUDGE BOLLWERK: Just one question. Could you give us just for the record if you could a couple of examples of the sort of SAMDAs that were looked at relative to the AP1000?

MR. RAMSDELL: No.

JUDGE BOLLWERK: No. All right. Then we'll --

MR. RAMSDELL: I might be able to think of something but not right off the top of my head.

JUDGE BOLLWERK: All right.

MR. RAMSDELL: The next slide please. Slide 8.

The staff in preparing the EIS reviewed or attempted to determine whether the site parameters or the site was within the bounds of the generic site considered in the AP1000 design certification review. It's not easy. It was not easy because the slight parameters that are involved in the SAMDA analysis include a year of meteorological data for parameters. That's about 35,000 numbers. Economic adjustment values for a variety of locations. Population at 160 sectors, so forth. So the staff decided that the site specific information that is most appropriate for us in determining whether the Vogtle site is bounded by the generic site were the person-rem per reactor year and the offsite economic costs of a cost risk in dollars per reactor year. These are the values that are included among the risks that are used to determine the maximum or the total risk of the severe accident. Appendix B1 of the AP1000 DCD includes these numbers for the generic evaluation.

Next slide is slide 9. It includes a comparison of the Vogtle site specific values based on the severe accident analysis that was discussed earlier and compares those with the DCD values. In all cases, the Vogtle site specific numbers are lower than the generic values included within the design control document, Appendix B1 table. Therefore, the staff concludes that the Vogtle site is in fact bounded by the generic site considered previously and that therefore the issues related to SAMDA are resolved for an AP1000 at the Vogtle site Revision 15.

JUDGE BOLLWERK: Based on Revision 15 to the DCD, right?

MR. RAMSDELL: Yes.

JUDGE BOLLWERK: All right.

MR. RAMSDELL: The conclusions are in slide 10. Yes. Are there any questions?

JUDGE TRIKOUROS: This is always interesting, these types of analyses, because I mean the conclusion is that you shouldn't spend more than $30,000. The numbers are on your slide, but I'm just approximating.

MR. RAMSDELL: Right.

JUDGE TRIKOUROS: Something like $30,000. Any modification that costs more than $30,000 should not be done. You know that really has no meaning. Basically it says that you couldn't possibly come up with any change to the plant.

MR. RAMSDELL: You can't even talk about it always.

JUDGE TRIKOUROS: Right, and that would include any procedural change for that matter, you know, be the $30,000. It would be very difficult to develop and implement procedures for $30,000.

MR. RAMSDELL: In respect to procedures, the procedures do not exist. What we are asking applicants to do at the COL stage is to provide an assurance that procedures as they are developed will be based on risk information that is available within the probabilistic risk assessment and that we ask that they provide us a time schedule when those procedures will be developed.

JUDGE TRIKOUROS: But the probabilistic risk assessment assumed procedural actions in determining its results. So I assume there was some set of guidelines that they had, some procedural guidelines. Does the staff feel comfortable with these numbers or is it really in a situation where the DCD -- Does the staff feel comfortable with these numbers?

MR. RAMSDELL: Yes. If you compare the numbers for core damage frequency of the AP1000 with the core damage frequency of current generation plants you understand why these numbers are down in the $30,000 range rather than the $300,000 or $3 million range. If you go to license renewal, you're seeing numbers in those ranges. This plant was designed following the probabilistic risk assessments of the existing the plants and a large number of the design alternatives that would be considered in a current generation plant have already been included within this design.

JUDGE BOLLWERK: Judge Jackson, do you have any questions?

(No verbal response.)

No. Anything further, Judge Trikouros?

JUDGE TRIKOUROS: No.

JUDGE BOLLWERK: All right. Then thank you very much, gentlemen. We appreciate your service to the Board and the information you provided. Thank you.

All right. I think we're down to our last topic, The AP1000 Design Certification Revisions.

MR. MARTIN: The staff would like to request Mr. Ramsdell staying on for this presentation as well. He wasn't originally on the witness list, but if the Applicant has no objection, we think he may be able to provide extra detail.

MS. SUTTON: We have no objection.

MR. MARTIN: All right. Thank you.

JUDGE BOLLWERK: Then why don't you go ahead and introduce the panel you're going to have for this presentation then.

MR. MARTIN: I was just notified that they would also like to have Mr. Tegeler up there to discuss any differences for the safety aspect of the revisions if the Applicant has no objection.

MS. SUTTON: Again, no objection.

MR. MARTIN: Thank you very much.

JUDGE BOLLWERK: So let's go ahead and introduce the panel then for the court reporter's benefit as well as ours.

MR. MARTIN: Okay. Starting from the left again we have Mr. Mark Notich and then James Van

Ramsdell and then Christian Araguas and Bret Tegeler.

JUDGE BOLLWERK: All right.

MR. MARTIN: And then we have one exhibit for this presentation.

JUDGE BOLLWERK: All these gentlemen have been previously sworn. Gentlemen, you remain under oath.

MR. MARTIN: We have NRC000069 which is Staff Presentation 11, AP1000 Design Certification Revisions.

JUDGE BOLLWERK: All right. The record should reflect that Exhibit NRC000069 is marked for identification.

(Whereupon, the document referred to was marked as Exhibit NRC000069-MA-BD01 for identification.)

MR. MARTIN: The staff would now like to move to have this admitted as evidence.

JUDGE BOLLWERK: Any objections?

(No verbal response.)

JUDGE BOLLWERK: Hearing none, then Exhibit NRC000069 is admitted into evidence.

(The document referred to having been previously marked for identification as Exhibit NRC000069-MA-BD01, was received in evidence.)

JUDGE BOLLWERK: All right. And then at this point I believe we are ready for the presentation then.

MR. ARAGUAS: We can move to the next slide.

This slide I just wanted to cover a little bit of background about what was submitted to the staff. The Site Safety Analysis Report Rev 0 that came in August 2006 for the Early Site Permit Application for the Vogtle site was based on Revision 15 of the AP1000 Design Certification document. All subsequent revisions to the Site Safety Analysis Report were based on Revision 15 of the AP1000 DCD.

In August of 2007, the Applicant submitted its Limit of Work Authorization Request and that also referenced the AP1000 Rev 15 DCD. The Final Safety Evaluation Report for the ESP and the LWA at the Vogtle site is based on again Revision 15 of the DCD. Next slide.

I just wanted to provide some context to the ESP safety review. For the safety review of the ESP application, the staff does rely on a very limited set of design information. Those values that the staff used or relied on have been incorporated into or are proposed to go into the permit. But the clarification is that issuance of an ESP that references a certified design does not indicated NRC approval of the site for that specific design. That review is done at the COL stage. Next slide.

Now let me a little context with respect to the LWA review which is a little bit different. With respect to the LWA an applicant must submit a description of the activities being requested under the limited work authorization in addition to the pertinent design and construction information related to those activities. Since design information is required in an LWA to support the requested activities, an applicant must either incorporate by reference a certified design or furnish design details for review under an LWA. Granting of the LWA by the NRC approves the requested activities under the LWA as well as that specific design information that were within the scope of those LWA activities and for the Vogtle LWA request, SMC again has incorporated by reference the applicable portions of the AP1000 DCD. Next slide.

In summary, just to go and address the

Board's question with respect to impacts regarding any changes and sort by design, for the ESP the staff is aware that the accident source term proposed in Revision 16 of the AP1000 DCD has changed from that that was looked at with respect to Revision 15 and this is just one example. Because the Applicant referenced Revision 15 to the DCD, changes in design that occur in Revision 16 and Revision 17 and any subsequent revisions are not considered in the staff's safety review.

Currently, the staff is proposing to include the AP1000 Revision 15 accident source term as a set of bounding parameters in the ESP. So at the COL stages, any differences between those source term would need to be reviewed and resolved at the COL stage. Next slide.

Now with respect to the LWA as Bret discussed earlier, the basis for the LWA approval will not be impacted unless there is a major change in the footprint of the nuclear island base mat. Any moderate changes in the structural design will not invalidate the basis for the LWA approval. Any incapabilities between the design information approved in an LWA and design information submitted in a COL application would need to be reviewed at the COL stage and as I mentioned earlier any activities undertaken under an LWA are undertaken entirely at the risk of the Applicant, namely that the COL or CP may not be approved where the design ultimately selected is incapable with the LWA construction.

JUDGE BOLLWERK: And I take it just going back for a second to slide 6 and I believe your last point that at this point the Applicant when they actually adopt or Revision 17 for instance we heard some counsel saying yesterday that, it's sometime in May, Rev 17. At that point, the staff would begin an active review of Rev 17 relative to the combined license application.

MR. ARAGUAS: That's my understanding.

JUDGE BOLLWERK: Obviously, you're aware of the revision already.

MR. ARAGUAS: Right.

JUDGE BOLLWERK: That's public record for the most part. All right.

JUDGE TRIKOUROS: Well, the one thing that is clear then is that no COL will be issued until all revisions of the DCD or the latest revisions of the DCD are incorporated into the COL application reviewed by the staff.

MR. ARAGUAS: That's absolutely correct.

JUDGE BOLLWERK: Unless the Applicant chooses not to incorporate the revision. Correct? In other words if for whatever reason Southern or some other applicant decided "All right. Things are moving along. We're going to stop at 17" even though there's 18, 19 and 20 they can do that subject to whatever concerns the staff might have.

MR. ARAGUAS: They could do that. But again they wouldn't have the level of the finality on those differences that would be resolved under rule-making. So, for example, if there was some change that would certify that didn't coincide with one of the previous versions that would be treated as I guess sort of custom design and we would read it separately.

JUDGE BOLLWERK: All right. Thank you. I think we were then about to go to slide 8. I'm sorry. Slide 9.

MR. NOTICH: Okay. Again, I am Mark Notich. I'm the staff's Environmental Project Manager. Slide 9. Thank you.

Part 3 of Southern's Application for Early Site Permit at the Plant Vogtle site submitted to the staff in August of 2006 contained a Rev 0 of the Environmental Report. Page 1.2 of the ER stated that Southern has selected the AP1000 and that the NRC has approved the design control document for the AP1000.

At the time of submittal of the ER and Rev 0, we approved a DCD for the AP1000 was Rev 15 and likewise a Revision 1 on November 2006 and Revision 2 submitted in April 2007 of the ER and were both based on Rev 15 of the AP1000 DCD. Subsequent in revisions to the Plant Vogtle ESP application did not include revisions to the ER. So subsequently the Final Environmental Impact Statement for an Early Site Permit at the Plant Vogtle Electric Generating Site or the FEIS is based on Revision 15 of the AP1000 DCD. Next slide please. Thank you. This is now slide 10.

This slide shows the Rev 15 design parameters that the staff used in determining their impact characterizations. A detail listing of the actual parameters is contained in Appendix I of the Final EIS. Next slide please.

Southern submitted commits on the Draft EIS in closure one entitled "New Information and Substantive Comments Of a Letter" dated December 26, 2007. In a limited number of subject matter areas, Southern's comments contained new information that was based on design parameters proposed in Rev 16 of the DCD amendments under staff consideration in a separate DCD review process.

As this information was submitted by the Applicant, the staff believed that it was important to assess how it would affect the staff's analysis of the parameters in Rev 15. Accordingly, the staff responded to the comments in Appendix E of the Final EIS and revised portions of the FEIS to provide additional analyses based on the new information. In particular, sections of the FEIS that were revised include 3.2, Plant Description; 5.2, Meteorology and Air Quality; 5.3 Water Related Impacts; 5.4, Ecological Impact; 6.2, Transportation Impacts; 7.3, Water Use and Quality; and 7.5, Aquatic Ecosystem. Next slide please.

The staff's analysis of the new information provided in Southern's December 26th letter focused on information that could potentially affect the analysis of impacts. The staff reviewed new information on the circulating water, water system use, final effluent discharge, auxiliary boiler emissions, additional diesel generators, fuel irradiation levels and surface water system usage. Next slide please.

There were values directly dependent on a design parameter. The staff analyzed how a Rev 16 change would affect the impacts analyzed for Rev 15.

The staff determined that the new information provided by Southern would not affect the impact conclusions stated in the FEIS. Changes in parameter values in the design ultimately selected for the combined license application and would be considered as new and potentially significant information for staff review at the combined license stage.

For instance, with regards to Rev 17, it is under staff review in a separate AP1000 design amendment process. Design changes associated with Rev 17 do not need to be considered in the ESP environmental review because any significant changes from the parameters evaluated in the ESP and would have to be considered as part of the COL stage environmental review.

JUDGE BOLLWERK: All right. Let me ask a procedural question and then we'll see if any of the Board members have questions. You mentioned it sounds like with respect to at least Rev 16 that in terms of the environmental side you actually did look at the revision and make some analysis based on the revision given the comments you received.

MR. NOTICH: Yes sir.

JUDGE BOLLWERK: So I take it at least from staff's perspective going forward that analysis and those revisions for the COL process assuming that the ESP were to be granted would be basically cut off. There is no further analysis that's going to be done relative to Rev 16.

MR. NOTICH: The ESP as I've stated is based on Rev 15. When the next revision of the DCD is approved by the staff, that is the data that the staff would look at to see if there was anything new. If there is anything new, then the staff would make a determination if it was significant. Then the staff would look at their impact characterizations at that time.

JUDGE BOLLWERK: Right. But if you've already analyzed Rev 16 then obviously I guess it follows that it's not going to be significant change since you've already looked at it once.

MR. NOTICH: Right. Yes sir.

JUDGE BOLLWERK: Okay. Let's move on then to Rev 17 which was two scenarios. One is let's say that you look at Rev 17 and decide there are -- And the Applicant in theory in May or sometime thereafter is going to adopt that revision. When you look at that you decide there are no significant informational changes. What in terms of the process do you do? Do you issue a letter? Do you issue an environmental assessment? Do you issue or supplement the environmental impact statement? You don't do anything because in theory there is no significant information and you don't have to say boo. Procedurally, how is that handled?

And again the assumption here just so we're clear on the hypothetical is that you look at it and you decide there's no new significant information. What do you need to do?

MR. RAMSDELL: At the COL stage, we will issue an EIS. In that EIS, we will address each issue that we addressed previously. In the cases where there is new information, we will make a determination whether the information is significant or insignificant. If it's not significant, then we will adopt the conclusions of the EIS at the ESP stage. If it's significant, we will go on with a detailed analysis at that point.

JUDGE BOLLWERK: For the COL there is going to be a document that looks something like this document which is the Final Environmental Impact Statement.

MR. RAMSDELL: That is correct.

JUDGE BOLLWERK: And basically you will go through the same subcategories that you had and indicate whether there were any significant changes.

MR. RAMSDELL: That is correct.

JUDGE BOLLWERK: For each one of the items that is in here.

MR. RAMSDELL: Yes sir.

MR. MOULDING: This is Patrick Moulding for the staff. Let me briefly clarify part of what the staff witness had been saying. Part of the process of the COL stage is that the applicant is responsible for identifying new and significant information and that's the information that would be submitted to the staff.

As Mr. Notich and Mr. Ramsdell have indicated, the staff's intention for a COL referencing an early site permit is that there would be a supplement to the Final EIS that would address significant new information and I believe that's what Mr. Notich is referring to. It's considered to be a supplement to the Early Site Permit Final Environmental Impact Statement. That is the procedural posture that the staff is using.

JUDGE BOLLWERK: So what that will be is a supplement to this document which deals with the ESP not necessarily a new EIS for the COL.

MR. MOULDING: That's correct, Your Honor.

It's not considered to be a separate, sole COL document. But it is an environmental impact statement that's supplement to the Early Site Permit Final Environmental Impact Statement and as Mr. Ramsdell it would address significant new information in any of the resource areas analyzed for the early site permit.

JUDGE BOLLWERK: All right. So then again anything that comes up that's new or significant relative to environmental impacts is going to be in a supplement to this document. It's not in a separate EIS dealing with the COL.

MR. MOULDING: Just to be clear, I wanted to make sure that was new and significant information. The supplement to the Final EIS would not discuss all new information, but information that was determined to be new and significant.

JUDGE BOLLWERK: All right. And would that supplement be issued in draft with public comments.

MR. NOTICH: Yes sir. Yes, it will be issued in draft, made available for public comments. There would be a public comment meeting probably in this room and then the staff --

JUDGE BOLLWERK: Maybe a little bit better sound system.

MR. NOTICH: Right. And upon the staff's assessment of those comments and responses, the staff will then issue the Final EIS.

JUDGE BOLLWERK: All right. And let me go back to one other question I asked. Let's say that you looked at whatever the Applicant submitted. You said first the Applicant will submit an environmental report or a supplement to their environmental report.

MR. NOTICH: Right.

JUDGE BOLLWERK: Identifying anything that they believe is significant and new. Is that right?

MR. NOTICH: Correct.

(Off the record comments.)

JUDGE BOLLWERK: And if you were to determine there was nothing new and significant, let's say the Applicant took that position and you agreed with it, what would you do?

MR. NOTICH: We would still issue a Draft Supplemental EIS which details that the staff looked for new information in each one of the subject areas and that if none was found then that issue resolved.

JUDGE BOLLWERK: Okay. So there will be some document called Supplement.

MR. NOTICH: Yes sir.

JUDGE BOLLWERK: Which identifies and

analyzes new and significant information or says, "We've looked at all these different areas. We've looked at what the Applicant sent us. We've just decided there's nothing." I take that would go out for comment as well.

MR. NOTICH: Yes sir.

JUDGE BOLLWERK: So if a member of the public disagreed they could say, "No, we think you missed this." Then you would have to analyze that in the Final.

MR. NOTICH: Yes sir.

JUDGE BOLLWERK: Thank you. That's very helpful in terms of understanding the process.

MR. NOTICH: Sure.

JUDGE BOLLWERK: All right. Let me turn to Judge Trikouros then.

JUDGE TRIKOUROS: Okay. Let me go back a little bit to page six of the presentation. The last bullet, it's basically saying that the COL applicant has to demonstrate that the accident doses, "the value of the ESP are bounded by those of the chosen design."

MR. ARAGUAS: That's correct.

JUDGE TRIKOUROS: Why is that not a COL action item or a permit condition?

MR. ARAGUAS: Are you saying why don't

have a permit condition for it?

JUDGE TRIKOUROS: Where is that document? In other words, this is a bullet in a presentation.

MR. ARAGUAS: Right.

JUDGE TRIKOUROS: Is that a documented requirement as a COL action item?

MR. ARAGUAS: This promulgates at the permit condition that we talked about yesterday. If you recall the permit condition that I had on the --

JUDGE TRIKOUROS: No, remind me. There is a permit condition that covers this. That's what I'm getting at.

MR. ARAGUAS: There is a permit condition that addresses the idea that if an applicant references a certified design that they don't need to actually demonstrate that the source term that were imposed on the permit are bounded by the source term on the design, but that they only need to demonstrate that if the design Chi over Qs bound the site Chi over Qs that would be sufficient enough to demonstrate that the doses were met. That was the intent of the permit condition.

JUDGE TRIKOUROS: That's the permit condition.

MR. ARAGUAS: That's the permit condition.

JUDGE TRIKOUROS: That you're referring to.

MR. ARAGUAS: Correct.

JUDGE TRIKOUROS: That's fine. I just wanted to make sure of that.

MR. ARAGUAS: Okay.

JUDGE TRIKOUROS: And I have just one other.

MR. ARAGUAS: Absolutely.

JUDGE TRIKOUROS: It seems as if the new information associated with Rev 16 you've taken pains to make sure that your FEIS covers that information so when it occurs that the COL is updated to include these later revisions you'd be able to say fairly comfortably that there's no need to modify the FEIS because you've covered that information already.

MR. ARAGUAS: Let me just interrupt you if I may. The analysis that was done as I understand it and you can chime in after I'm done for the FEIS was not on the staff's -- Let me start over again. The staff is supposed to review the application at hand and the application at hand references Rev 15. That's for both the safety and the environmental.

The reason for the review of those specific issues associated with Rev 16 that was done on the FEIS was necessitated through the comments that were submitted by Southern.

JUDGE TRIKOUROS: I understand. It's a very convenient situation in the sense that now the FEIS is current to Rev 16.

JUDGE BOLLWERK: At least in part anyway.

JUDGE TRIKOUROS: AT least in part, right. Correct. So the question that I have is was there any application of that to the SER. In other words, if I ask the same questions on the SER that were asked on the EIS, will there be a separate SER entirely for the COL rather than a supplement to an ESP SER?

MR. ARAGUAS: There would be a separate SER for the COL. That's correct.

JUDGE TRIKOUROS: On the safety side, there will be an entirely new document and it will --

MR. ARAGUAS: An entirely new document on the safety side.

JUDGE TRIKOUROS: And that's why there was no effort to factor in any of the information on the safety side.

MR. ARAGUAS: Correct.

JUDGE BOLLWERK: We still have one -- Yes.

MR. MOULDING: Can I add something briefly to what Mr. Araguas said earlier? Judge Trikouros, you asked about a specific scenario about the demonstration that accident doses evaluated at the ESP are bounded by those of the chosen design and I just wanted to point to the overarching regulation that governs how that comparison is done is in 52.79(b) which discusses what occurs at the combined license stage for a combined license application referencing in the ESP and one of the things it mentions is that the final safety analysis report, again this is for a COL application, must either include or incorporate by reference the early site permit site safety analysis report and must contain in addition to the information and analyses otherwise required information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit. So that's a part of the general (Inaudible) on that comparison.

JUDGE BOLLWERK: I think you faded out there at the end.

JUDGE TRIKOUROS: Okay. For the Final SER we'll fill in all the sections that weren't in the SER for the ESP, but the sections that were ESP sections will be included in that SER. So it would be one Final SER that's complete.

MR. MOULDING: Sorry. What I was reading

from there is that site safety analysis report, in other words, this is the contents of the Applicant's application. We're not talking about the safety evaluation report from the staff, rather the contents of the application, and to what extent that is supposed to incorporate the material submitted for the ESP application, in other words, the Applicant's site safety analysis report.

JUDGE TRIKOUROS: All right. Thank you.

JUDGE BOLLWERK: Judge Jackson, do you have any questions?

JUDGE JACKSON: No.

JUDGE BOLLWERK: All right. Let me make one comment and then I'll ask then one more question relative to a matter that the Board raised.

I recognize much of this we talked about is procedural but it is important and useful to us to understand and I think the other boards that might come after this one. We've heard for instance there may be another ESP filed in the near future. Who knows what will happen. But in any event to understand how this process works and how the interrelationship between the different aspects of the safety side and the environmental side both with respect to the ESP and the COL operate and we appreciate the information you've provided us.

Let me raise one other question that the Board raised in March 6th memorandum and order at page five. We posed the question, "What impact if any would the Commission's recent rule change on aircraft crashes have relative to the early site permit?"

MR. ARAGUAS: Let me start off by saying that I have not personally had a chance to read through the rule, but it's my understanding that the Aircraft Impact Rule would not affect the issuance of the ESP or the LWA. Additionally, it's my understanding that the rule has not been published yet.

JUDGE BOLLWERK: That's true. Nonetheless, the Commission has voted it out, but apparently nobody has seen it.

MR. MARTIN: If you would like, I can add a little bit more detail. As Mr. Araguas has noted, it hasn't been published yet. We had the staff requirements memorandum from the Commission and they've asked the staff to have it published by June 5th and there's a 30 day effective date after that.

But regardless of when it's actually published, the text of the rule itself, specifically Section 50.150 discusses to whom the rule applies and it doesn't apply to applicants for an early site permit or for an LWA. It specifically applies amongst others to COL applicants and also applicants for design certification. So by the terms of the rule, it does not appear to apply to an ESP applicant.

JUDGE BOLLWERK: All right. Anything the Applicant wants to say about that?

MS. SUTTON: Your Honor, we would agree with that. The text of the rule is clear on its face that it does not apply to this particular proceeding. In addition, with respect to the COL, we just would note that Westinghouse did voluntarily submit information to the NRC in April of '08 addressing the rule and that is currently the subject of the ongoing DCD Rev 17 rule-making and therefore that places it outside of the scope of the adjudicatory proceedings.

JUDGE TRIKOUROS: Is that technical report I think it's 126? Is that the one you're referring to?

MS. SUTTON: Your Honor, I don't have the number on it. I have the April 2008 date.

JUDGE BOLLWERK: All right. Anything further that the staff then wants to say on that subject or the Board? Other Board member?

(No verbal response.)

JUDGE BOLLWERK: All right. At this point, gentlemen, we appreciate the evidence that you've given us, the information you've given us, on this subject as well as the others you've helped us with and thank you very much for your service to the Board being with us these past three days. Thank you very much. Appreciate it.

All right. At this point, I think we have completed all the presentations that we had scheduled for the Early Site Permit Mandatory Hearing. I've checked through briefly. I believe all the exhibits have been marked and admitted. This record as is the case with the one in the contested case will not close until after we do the transcript corrections and that again would be under the order that we issued I believe 14 days from today.

The transcripts are beginning to show up or should be showing up in ADAMS soon if you haven't seen them already. I'm not sure about the status of the -- Maybe Mr. Cutchin while I'm speaking can check with our folks back in Washington. Are the videos of the contested hearing on the DDMS yet? We'll check that out.

Again without the transcript we have nothing to correct it against, but did you all order a separate set of the transcript? Have you received it yet? I know I've seen an electronic version anyway.

MR. BLANTON: We have not seen any transcripts of the contests hearing yet, Your Honor.

JUDGE BOLLWERK: We'll be checking on that back in Washington actually to find out where it is because I know there is an electronic version that's floating around. So we need to find out about when they could get that on. Did you say you put in a separate order?

MR. BLANTON: We did and we've contacted the court reporting company and they informed us they had delivered at least some days of the transcript to NRC, but it has not shown up on ADAMS as of this morning. I just got an email.

JUDGE BOLLWERK: All right. I take it -- Did you order a separate paper copy or were you just going to wait for the HD?

MR. BLANTON: We ordered a paper copy as well and have not received that.

JUDGE BOLLWERK: Okay. That would be something you need to take up directly with the court reporting service but in theory they exist. I've seen the electronic version. So you may want to check on that.

I should mention with respect to those and we'll be probably be putting our an order. There will be revisions to be made. I know some of the exhibit numbers because of the number of zeros in them at a minimum we had on all this are going to need to have some changes made to them. That may be the case with this transcript as well, but that's something we can work through. I don't think that's a big problem.

It is also our intent with this transcript and with the contested case at some point to be able to marry them with the video and the DDMS and you'll have that available to you hopefully before your proposed findings are due. So at least that would be of some use, although it may be within -- I think we're going to have to wait until after we do the transcript provisions which we won't be able to do until we get the information from you all in terms of what you want to change.

With respect to the mandatory hearing, I should mention again that there was a separate date for the proposed findings which I believe is May 22nd. That date was set again with the expectation that you all then would have some period of time after the reply findings were due in the contested case to be able to prepare those. So that would be the date that's applicable here.

We only ask for one round of proposed findings and conclusions. I think that would be probably adequate. Having said that, if after reading what you have exchanged, anyone feels the need for reply findings you can contact the Board. We'll be certainly willing to consider that request.

But at this point, I think based mostly on my experience with the Louisiana Energy Services cases, it seemed that one round from each party was sufficient. If you all disagree and you think there's something else you want to file let us know and we'll certainly consider it.

In terms of the mandatory hearing process itself that we've conducted, I think the Judges are very well satisfied with the information we've gotten and the way the presentations were made by both parties. We think the witnesses were very forthcoming. We thought the slide presentations were on the whole very good and provided us the information we needed.

So I think this seemed to work for us. I'm not sure how it worked for you and I'm not sure how it worked for you. That may be something we need to have in some offline discussion or some other form a discussion about because although it's not clear we're going to be doing any more mandatory hearings, at least, through the Board. Maybe you can take this experience and pass it along to the Commission. I have no idea how that's going to play out. But again we do appreciate the information you gave us. It was useful to us and will help us in making a well-reasoned decision relative to the mandatory hearing side.

I do apologize for the audio problem. As you know, we had a good system I think with the contested hearing. We had a major component fail on us that worked Friday afternoon and didn't work when we got here on Monday and it didn't work on Sunday afternoon either for the limited appearances and I apologize for that. But hopefully you will still find what's in the DDMS in terms of the video if you want to use it useful notwithstanding all the tapping on the microphones and again I apologize for that.

We aren't happy with it and I know you aren't and I think one of the lessons we learned from it is maybe we need to have additional backup. Although it's always a question of just send money for the additional backups for some of the major components of the system in case they do fail because we thought the system worked well in Augusta. But it didn't hold up here. In fact, I think we're talking about taking these microphones back because we don't think they're working properly in any event.

In terms of the logistics that were involved here, I obviously very much appreciate the help of our IT specialists, Joe Deucher, Mack Cutchin, the folks in Washington, D.C., Andy Welkie who is still online. We've been doing a lot of -- We have actually a chat function through DDMS we can use and they've been in consistent communication to try to keep things updated in terms of the exhibits so we know what's going on back there as well and they are aware of what's going on here. When we had new exhibits coming in, they were informed pretty promptly that was going to happen.

Wen Bu, our law clerk, has been an invaluable assistant to the Board. Ashley Prange who is actually now in Crow Butte up in -- I believe she's in Rapid City, South Dakota. She's sort of spent a little time with us and headed up there. So it's a busy time for the panel and the boards and we appreciate the help she was able to give us here.

Our court reporter who has been with us

the whole time. I think he has a few gray hairs given the size of the panels we've presented him with, but we do appreciate his efforts as well.

And here at the Augusta Technical College, the Waynesboro/Burke Campus, Vicki Garrison who has been of invaluable assistance to us. If you all are looking to use this facility, Vicki Garrison is your contact person. She's been wonderful with us and I hope she would give the same benefit and then Robert Rutledge who has gotten the building open for us. If the front doors aren't open and we get here at 7:45 a.m. this doesn't start and he's been great in terms of both opening them and closing them at night keeping our equipment safe. So we do appreciate his efforts as well.

I am told that last week is ready on the DDMS in terms of the video if you want to be in looking at it and for this week in terms of the mandatory hearing by Thursday or perhaps Friday the video should be available as well. And in terms of the transcripts, we'll certainly check from our end. If you ordered a separate copy of it though, you should check with them because you've paid for that and in theory they should be doing what they need to do with you and the staff obviously depends on what we are.

I know the electronic version is around for the last week. I just don't know where it is in terms of ADAMS and the paper copies. They may be sitting on your desk back in Washington for all I know.

Any of the Board members have anything they want to say at this point?

JUDGE JACKSON: I'd just like to thank everyone for their patience in answering all our questions. We appreciate it very much.

JUDGE TRIKOUROS: I'd second that and again I'll reiterate that everything has been very professional, extremely pleasant, for us to work under these conditions and we thank you for that.

JUDGE BOLLWERK: And it's been a long ten days here, seven days of hearing, ten days in all when you look at all the travel time and the weekend in between. This was not a sprint. It was a marathon, but I think we've gotten to the end and I would certainly agree as I expressed in the contested case last week very professional on the behalf of everyone that's been involved. We do appreciate it.

One other thing I should remind you. I still do need -- I have the staff's I believe. From the Applicant, I do need your cross examination or proposed cross examination questions in electronic version emailed to me at some point and I haven't seen frankly the ones from the Joint Intervenors either. I may well issue something on Friday that we have an exhibit to deal with that we still have to admit and I may have some time deadlines just to help folks along to do that.

MR. BLANTON: I've got one thing to raise just out of an abundance of caution.

JUDGE BOLLWERK: All right.

MR. BLANTON: Your Honor, before we close here, your question from the first of the week about which questions the Board is to answer and the 52.24 findings in the notice of hearing started me thinking about what we've done here this week and I note there are a couple of -- One is sort of pro forma finding about all the notifications to agencies, local governmental agencies, have been made in 52.24. There's another one about the technical qualification of the Applicant to engage in activities. In this case, I would assume that would be the LWA that have to be made.

I don't think there's any controversy or probably any dispute about either one of those, but I also note that there wasn't a presentation on either one of those either. So I was hoping we could put on the record either that the Applicant and the staff are both satisfied that the answer to those questions that the application complies with the requirement and see what the Board wanted to do about that.

JUDGE BOLLWERK: Right. We've kind of gotten caught in between here. I mean we're sort of in a change between the regulations and the notice of hearing as we talked about. If you believe it would be appropriate to provide us with an additional affidavit either jointly or from separate witnesses that addresses those particular issues, we can certainly take that.

Again, my intention would be to close the record fairly soon after we get the transcript corrections. Having said that, it still leaves a couple weeks. Would that be your preference if you feel there's something missing from the record? We're not trying to play Yahtzee here with anybody.

MR. BLANTON: Right. And I think it's implicit certainly in the SER that the Applicant is technically qualified. But I wanted to try that argument out on the Board to let you know that's what we would be saying if we didn't put anything else in there. But putting some sort of affidavit in that specifies that we are a licensee of the six nuclear units and that we've made all the required notification under Part 2 which is simple.

JUDGE BOLLWERK: Anything you want to say about this, Mr. Moulding?

MR. MOULDING: I think we'd be happy to confer with the Applicant about that and see what.

JUDGE BOLLWERK: All right. I think the Board is certainly not in any way opposed to accepting additional information whether it's an affidavit from the parties on that particular subject.

MR. BLANTON: I'm just thinking forward to writing a brief and then having somebody scratching their head, coming back, asking me where this is in the transcript.

JUDGE BOLLWERK: I agree and where it is in the record and you're trying to do a proposed finding that has no basis for support and I would agree. I appreciate you bringing that to our attention. I would suggest talk to each other. If you need to submit another affidavit, we'll certainly take it for the record. The record isn't going to close anytime within the next couple weeks.

MR. BLANTON: All right.

JUDGE BOLLWERK: Do you want me to set some kind of a deadline for that or do you prefer to get back to us and tell us what you want to do?

MR. BLANTON: I would always prefer to get back with you and tell you what I want to do.

JUDGE BOLLWERK: Okay. Let's do this. Certainly by the time you file your proposed transcript corrections if there's going to be something about it -- That falls outside the parameters of that, but that would be the point to let us have that. That still gives you two weeks. Is that --

MR. BLANTON: Certainly, we'll do that.

JUDGE BOLLWERK: All right. Let's go ahead and set that down. All right.

Anything else from any of the Board members?

(No verbal response.)

Well, again it's been a long haul. Some of us have been together for the past two weeks. Some of us have been together this week. But I think we have -- From the Board's perspective, it's been a very useful experience and exercise. You've given us a lot of good information. You're going to give us some proposed findings of fact and conclusions of law that tell us how you think all this ought to be organized and what we ought to be determining and we then -- The ball will be in our court as the saying goes to issue our decisions. Right now, we're scheduled to do the contested case in the middle of June and a little bit closer to the middle of July for the mandatory hearing. We hope to keep that schedule. That's our intent.

But Judge Trikouros is headed out to Yucca Mountain next week. So who knows what will happen with him. Hopefully we will still have his services from time to time.

Again, on behalf of Judge Jackson and Judge Trikouros as well as other members of the NRC team that have been here dealing with this, we appreciate all your efforts. Thank you very much and we stand adjourned. Off the record.

(Whereupon, at 1:28 p.m., the above-entitled matter was concluded.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of: Southern Nuclear Operating Co

Name of Proceeding: Mandatory Hearing

Docket Number: 52-011-ESP;

ASLB No. 07-850-01-ESP-01

Location: Waynesboro, Georgia

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Tobias Walter
Official Reporter
Neal R. Gross & Co., Inc.