Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title:	Advisory Committee on Reactor Safeguards AP 1000 Subcommittee
Docket Number:	(n/a)
Location:	Rockville, Maryland
Date:	October 18, 2011

Work Order No.: NRC-1215 Pages 1-303

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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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AP1000 SUBCOMMITTEE

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TUESDAY

OCTOBER 18, 2011

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ROCKVILLE, MARYLAND

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

SUBCOMMITTEE MEMBERS:

HAROLD B. RAY, Chairman

DENNIS C. BLEY, Member

CHARLES H. BROWN, JR. Member

JOY REMPE, Member

MICHAEL T. RYAN, Member

ACRS CONSULTANT:

WILLIAM HINZE

DESIGNATED FEDERAL OFFICIAL:

WEIDONG WANG

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

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

8:28 a.m.

CHAIRMAN RAY: The meeting will now come to order. This is a meeting of the AP 1000 Reactor Subcommittee, a standing subcommittee of the Advisory Committee on Reactor Safeguards.

I'm Harold Ray, chairman of the Subcommittee. ACRS members in attendance are Dennis Bley, Mike Ryan, Joy Rempe and Charles Brown. ACRS consultant Dr. Bill Hinze is present also. Weidong Wang is the Designated Federal Official for this meeting.

In this meeting, the Subcommittee will review -- I'm sure we were ready to go on the corner. I guess we are. In this meeting, the Subcommittee will review Levy Nuclear Plant Units 1 and 2 subsequent combined license application. Previously, we've reviewed a SCOL for an existing site. This will be our first opportunity to do so for a greenfield site.

We will hear presentations from the NRC staff and the representatives from the EOV COL applicant, Progress Energy, Incorporated. We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

For the agenda item on loss of large area due to fire and explosion, which is on the agenda for tomorrow, a presentation will be closed in order to discuss information that is proprietary to the applicants and its contractors, or security-related information pursuant to 5 U.S.C. 552(b), (c), (3) and (4).

Attendance at this portion of the meeting dealing with such information will be limited to the NRC staff and its consultants, Progress Energy Incorporated, and those individuals and organizations who have entered into an appropriate confidentiality agreement with them.

Consequently, we need to confirm that we have only eligible observers and participants in the room for the closed portion of the meeting. Again, that's on the agenda for tomorrow. The Subcommittee will gather information, analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full Committee.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the *Federal Register*. A transcript of the meeting is being kept and will be made available, as stated in the *Federal Register* notice. Therefore, we request that participants in this meeting use the microphones located throughout the room. When addressing the Subcommittee, the participants should first identify themselves and speak with sufficient clarity and volume, so that they may be readily heard.

We'll now proceed with the meeting, and I'll turn to the staff, to see if they have any comments. But the first item on the agenda will have us taking up an overview presentation, and I believe the presentation will be made by the applicant as the first item; is that correct?

MR. ANDERSON: That's correct. The applicant is up with an overview presentation to start. The NRC staff will provide an overview presentation immediately following them.

CHAIRMAN RAY: All right. Now I have -- please come forward then. I have discussed with the staff briefly, and I would discuss with the applicant as well, that depending on how things go today, I think it would be prudent, if we can do so, to look to our agenda tomorrow, to bring anything forward to today if it's available and can be presented, in order to ensure that we don't have a problem with timing tomorrow.

So I'd ask Progress if you folks have the resources and ability to -- I haven't selected any items, but I'd just alert you to the possibility that we would do that. Again, I'm sure you all would be just as glad that we get done tomorrow on time or early if possible.

So today, we'll try and make sure we make good use of all the time that we have here today in that manner. Denise, did you have anything you wanted to say?

MS. McGOVERN: Not at this time.

CHAIRMAN RAY: Okay. All right, with that, we'll turn it over to the applicant then.

MR. ELNITSKY: Well good morning, sir, and good morning members of the Advisory Committee on Reactor Safeguards. My name is John Elnitsky. I'm Progress Energy's Vice President for New Generations Programs and Projects. In that role, I'm responsible for the licensing and construction of the Levy Nuclear Power Plant project.

I will provide you a brief overview this morning. Bob Kitchen, the guy that really does all the hard work here, our licensing manager, is going to present with his team the final safety analysis report, with a focus on the site-specific aspects of our application.

In selecting the site for new nuclear generation, Progress Energy considered dozens of site locations suitable to serve our entire service territory. A rigorous evaluation resulted in selection of the Levy greenfield site, which we think has many advantages for power generation.

In fact, in August of 2009, after a public hearing process, the governor of Florida and his cabinet, sitting as a siting board in Florida, approved our proposed selection of the Levy site, for two AP 1000 nuclear power plants. Our focus today will be to discuss the challenges that we have identified and how each of these have been addressed.

The company submitted the Levy combined operating license application in July of 2008, the NRC docketed for acceptance review in October of 2008. The initial COLA submitted was based on the AP 1000 DCD Revision 16, but has been updated to reflect DCD Revision 19, with our most recent COLA submitted on October 4th of this year.

Our application has no departures or exemptions from the Tier 1 material in Revision 19 of the AP 1000 DCD. We have maintained the standard design through our active involvement in the AP 1000 Design-Centered Working Group, and we will discuss specific features during our presentation today and tomorrow.

Nuclear power remains an important element of Progress Energy's balanced solution strategy to provide reliable, low-cost power to our customers. We continue to pursue a strategy for contracting for the construction of the Levy nuclear power plant, that enables us to rely on the expertise of the industry, as a reasonable cost effort.

We initially signed an engineering procurement and construction contract with our consortium vendors of Westinghouse Electric Company and Shaw Stone and Webster in December of 2008. In March of 2010, Progress Energy and the EPC vendor modified that contract to revise the plant in-service state for the first unit to 2021.

The planned in-service state supports our generation needs in Florida, and the time line extension also allows Progress to benefit from the experience of other companies that are beginning to construct nuclear plants today. The proposed Levy County nuclear project is expected to generate about 3,400 jobs during the construction period, and 800 permanent jobs in Florida.

Carbon-free nuclear power will further improve Progress Energy's fuel diversity, especially in our Florida region. We expect and estimate Floridians will benefit from up to $1 million per year in avoided fuel cost, and up to as much as 500 million per year in avoided carbon emissions.

There are many reasons that the Levy project is important to Progress Energy in the state of Florida, and this meeting is a significant milestone for our project. Our team is ready to present the license applications, so you will able to find reasonable assurance that Levy can be built and operated without undue risk to health and safety of the public. We look forward to the successful completion of this licensing process and the start of construction activities.

Finally, on behalf of the leadership and the employees of Progress Energy and our customers, we appreciate the significant effort that the NRC staff and the ACRS have put into reviewing the Levy COLA. Staff's review has been extensive and thorough, and accomplished with the highest degree of professionalism.

With that, I will turn over our

presentation to our licensing manager to my left, Bob Kitchen. Bob and his team will describe the final safety analysis report and how it incorporates the Tier 2 material from the AP 1000 DCD.

CHAIRMAN RAY: John, before you do that, just as a matter of curiosity, and that's all it is, did you consider pursuing a ESP at any point, if you did and decided not to do it?

MR. ELNITSKY: Very early in the process we did, prior to the submission of our original COLA application. However, at the time, when we began this process and we laid out our anticipated schedule for in-service dates, that would not have supported our construction plan.

CHAIRMAN RAY: So it just didn't fit with the schedule at the time, even though now the schedule's changed somewhat? There isn't any particular reason to -- I just wondered historically how that happened.

MR. ELNITSKY: You know, when we originally started the process, the planned in-service date for the first unit was 2016, and that was the basis of the contract that was signed in 2008. As the economy slowed, as carbon legislation slowed and as we looked at the economic needs in Florida, that's when we began the process to negotiate an amendment to our contract, and allowed us to move the schedule.

That fits well, we think, with the low growth anticipated in Florida, and since we had made such substantial progress at that point, in our licensing process, it didn't seem the right move at that point, to move backwards to ESP.

CHAIRMAN RAY: Okay, thank you.

MR. ELNITSKY: Sure. Bill.

MR. KITCHEN: Thank you, good morning. Chairman Ray, just to elaborate on that a little bit, we did actually submit a limited work authorization, or LWA initially, and because of the schedule that John mentioned, we were trying to drive.

But in looking at that and working with the staff, we determined the actual controlling review time for that was the geotechnical issues, which were the same ones controlling the COL. So no advantage to an LWA --

CHAIRMAN RAY: Well, but the ESP would have taken up, would have addressed the geotechnical issues. Vogtle, for example, did an ESP and I just wondered why you guys didn't see benefit there. I understand John's answer.

MR. KITCHEN: Okay, to go ahead and

start, I'd like to first give the committee an overview of the Levy site, because many of the things we'll talk about today and tomorrow are tied to features of the site.

Obviously, we'll focus mainly on plant specifics. This is a map of the Levy County site. You can see down on the lower right-hand corner here the state of Florida, with the location, just to kind of get the bearings, and an expanded map is shown through the majority of the slide.

The Levy site is shown here. I'm moving the mouse. I guess that works effectively for folks --

MEMBER BLEY: Just to help me out, how far are you from the coast?

MR. KITCHEN: We're about eight miles from the coast.

MEMBER BLEY: Eight miles?

MR. KITCHEN: Yes sir. You can see we're located just about eight miles due east of the Gulf of Mexico. The nearest town is Inglis, Florida, which is about four miles to the southwest here. You'll also note, as Chairman Ray mentioned, Levy is the first greenfield site this committee as looked at.

We're also located near to our existing

Crystal River energy complex, which includes, of course, Crystal River III, which is a nuclear plant. So as a result, that distance being about 9-1/2 miles, we have overlapping emergency planning zones for emergency planning. We'll discuss that when we go through that section as well.

You can see the barge canal here. This is sort of an interesting feature. The Corps of Engineers had a project actually started I think back in the 1960's or so, and the plan was to run a barge canal literally across the state of Florida for commerce. This is how far it got.

So you can see the barge canal ends here at Lake Rousseau. That does provide an advantage for Levy for a couple of reasons. You can see the site location here, which is about three miles to the north of the barge canal. So our source of water for cooling for the cooling towers is Gulf of Mexico salt water, which is also different than you've seen with Vogtle or Summer.

The other feature here, we plan to use the barge canal for shipment of materials during construction. For example, aggregate or even the modules that are for construction of the AP 1000, we can ship those up the barge canal. That of course means that we'll need to put a barge slip, which we plan to locate, and I'll show a picture of this in just a minute. The barge slip in this area --

MEMBER BROWN: Maybe I didn't understand that. You said salt water for the new plant, is going to be salt water cooling? Did I miss something?

MR. KITCHEN: Salt water cooling for the cooling towers.

MEMBER BROWN: It's evaporative cooling.

MR. KITCHEN: Evaporative cooling.

MEMBER BROWN: Even though you're eight miles from the Gulf?

MR. KITCHEN: Yes sir.

MEMBER BROWN: Yes.

CHAIRMAN RAY: Well, it's just makeup to the cooling tower

MEMBER BROWN: Yes, I understand. I mean just I -- that just seems --

CHAIRMAN RAY: It's going to be real interesting. I've had a reason personally to look at --

RR Barge canal is salt water?

MR. KITCHEN: Yes, it's salt. So actually the --

RR The barge canal is salt water.

MR. KITCHEN: Actual distance for the intake pipe is about three miles.

MEMBER BROWN: Oh, okay.

MR. KITCHEN: It would be here --

MEMBER BROWN: From the barge canal?

MR. KITCHEN: Yes sir. We'll get -- I'll show you a picture --

MEMBER BROWN: All right. It's just a long distance, that's all.

MR. KITCHEN: It is.

CHAIRMAN RAY: Well, I've taken, in another life, a close look at salt water for evaporative cooling on the Pacific coast. I'll be interested in what you have to say about that, things like salt drift and things of that kind.

MR. KITCHEN: Okay. We'll try to cover that for you. In addition to barge canal, you can see Lake Rousseau here. Lake Rousseau was created.

There's actually a dam located here that we'll talk about briefly in terms of our flooding evaluations. The dam is what obviously created Lake Rousseau. It also blocked the upper section of the Withlacoochee River, which is shown here.

That created the necessity for a bypass canal, which you can see this second water stream here, for water which was the original stream of water for the Withlacoochee River, to run down this bypass canal, and then tie in with the original Withlacoochee path. That was done as part of the barge canal. It has nothing to do with Levy. It's just a feature. So anyway, those are the key things.

You can see also Highway 19 is located here, and that's the major route north-south, and there's also Highway 40, which runs east-west near the Levy site. This is an aerial view. Same thing, you can see the map here. You've got to get your bearings a little bit in the upper left. Same map we just looked at, the Levy site. This is just an aerial shot.

The yellow area shown here is the actual Levy site. When we talk about the Levy site, this is it. We also have the property to the south, which is shown in the blue highlight here, and this provides an advantage for us, in terms for Levy, of being able to run transmission lines, pipelines and also I'll show you for heavy haul roads for construction from the barge canal up.

You can see the orientation of the plant itself. The switchyard is shown in the gray square here, and you can see Unit 1 to the south and Unit 2 to the north. The cooling towers are shown here, the lines. The cooling towers of Levy also are a little bit different from the other sites. It's a mechanical draft cooling towers, as opposed to natural convection.

We've also purchased property to the west of the site for facilities such as the training building, visitors center, and then to the south, we have a property that allows us to put in an access road to the south. So that's the general layout. This is an even closer look.

MEMBER RYAN: Quick question on that Levy site. In the lower left hand, from my view, is that the nearest community right there?

MR. PATTERSON: Yes, that's Inglis.

MR. KITCHEN: This is Inglis right here.

MR. PATTERSON: That's the one stoplight.

MALE PARTICIPANT: I-N-G-L-I-S.

MEMBER RYAN: Yes, Inglis, thanks.

MR. KITCHEN: It's pretty small. This is a close-up of even more of the site itself, just so you can see the features of the site. This is looking to the west, you can see Levy 1 here and see the locations planned on the site.

This site has been used for timbering

culture for over 100 years. In fact, it was a timbering property when we purchased it, and you can see the furrows in the land here for that. Just a little background on use of the site.

DR. HINZE: Those particular sites were chosen because of the sites for Unit 1 and Unit 2. Is this a geotech decision, or is there some other factor?

MR. KITCHEN: Primarily a geotech decision, although other factors were wetland impacts. But primarily geotech conditions, and when we looked and we did an extensive investigation of the site, which we'll talk about quite a bit. But here it is, that we picked the sites that's generally appeared to be a preferred location, from geotech.

This is a good aerial picture. This is actually looking from the Inglis lot, which is between the barge canal and Lake Rousseau. It's no longer used at all for passage, but that's the structure you see here. You can see up in the upper left-hand corner, just in terms of perspective, Crystal River site you can see in the corner here, and you can actually see the Gulf of Mexico right on the horizon.

Again, that distance to this barge canal is about eight miles to the Gulf. We plan to put in a barge slip here as shown, and that barge slip will allow us to ship in material, offload here. We'll also construct a heavy haul load road path from the barge slip, along this island or peninsula here, and then proceed north to the site. That's for the heavy components required for construction of the module, modular construction for the AP 1000.

The other thing located here will be an intake structure that will provide our cooling water to make it up to the cooling towers.

MEMBER RYAN: Are you going to have to -- you're going to have to build a bridge to go to the site?

MR. KITCHEN: We are. There's a bridge there now. It's the recreational area. But of course the bridge we're going to need to put in would be for heavy haul. So the bridge would not only accommodate the heavy haul components, but also for pipeline and power. That would be part of the construction.

Just another here, same map again you've seen before, but just to note our discharge. We look at discharging our blowdown from the cooling towers straight into the Gulf of Mexico. We could have gone out -- in fact, originally, we thought we would discharge out the barge canal.

A couple of problems with that, primarily in the environmental area, in terms of impact to sea grass and also cost, because the Gulf of Mexico is very shallow and flat. We would have had to run the pipe considerably out to fit that. But we looked at it. It made more sense to run the discharge to the Crystal River discharge canal.

So that's the pipeline route you see here shown in red. Actually, blowdown from the cooling towers will run down south to the barge canal, along the barge canal through a transmission right-of-way, and then actually into the Crystal River complex discharge canal. That's shown right here on the photograph. This is our Crystal River energy complex. We actually have five power plants there. Four of them are fossil plants, and the one is Crystal River III nuclear plant.

Three of the plants use once-through cooling, so they have an intake canal you can see here, and the intake canal, once-through cooling through these three plants, and then discharge back to the Gulf. We also have two fossil plants located over here, which use basically recirc for makeup for the cooling towers off the intake.

Our plan for the Levy blowdown that I

showed you the route for on the previous slide, will tie in right here with the Levy barge, excuse me, discharge canal.

MEMBER BLEY: How concentrated will that blowdown be in salts going back to the sea? I mean it's going to have to run pretty well continuously, I assume, to prevent buildup.

MR. KITCHEN: It will. We're going to run a higher blowdown, because we're using salt water cooling, and it cycles for keeping the salt in the complex down. A.K., could you address that for me.

DR. SINGH: We are using --

CHAIRMAN RAY: A.K., just introduce yourself, please.

MR. KITCHEN: A.K., the mic please. It's around the column.

CHAIRMAN RAY: Well, there's on right here at the table.

DR. SINGH: Yes. We're using --

CHAIRMAN RAY: If you'll introduce yourself, please.

DR. SINGH: Yes. A.K. Singh. I'm the project manager for Sargent & Lundy on the Levy project. We're using a 1.5 to 2 cycle of concentration for salt water. That compares to typical 3 to 4 if we were using fresh water. So we are not concentrating the water as much as we would if it was freshwater. It's a relatively small volume reduction.

That's typical of, Bob mentioned Units 4 and 5 at Crystal River. They use cooling towers near the fossil plants, and they also use salt water, and it has a similar 1-1/2 to 2 cycle concentration. So we're basically mimicking that process at Levy.

MR. KITCHEN: The other thing I should mention along those lines, the amount of flow from Levy is less than five percent of the flow in this discharge. So it's kind of a large volume, in terms of what's there already. With that, I will go ahead and talk about Chapter 1, go through Chapter 1, and then I think the NRC will present their introduction.

You'll see throughout our presentation, we have incorporated the DCD by reference largely. So I know that the Committee's reviewed the AP 1000 and the reference COLA. So you've seen that material in a sense before.

We've also, as John mentioned in his introduction, maintained the standard design. So as you know for the reference plant, that means that we replicate text. So we don't reference to the other

COLAs, but we replicate the same text in there. So when we say "standard material," you'll see that throughout our presentation. That's what we mean. We've replicated the text that you've seen through Vogtle or Summer.

The other thing in Chapter 1 I'm just going to touch on is the site layout. The folks, the agents and contractors that we've worked with for both the COLA licensing application and for plant construction, and the interfaces that we have to the standard design.

This is just a graphical of our site layout, and you can see our north aerial here. So we're actually looking, essentially, from the Gulf perspective east. The Unit 1 and 2, again you can see here Unit 1, Unit 2. The cooling tower locations are shown here. Again, we're planning to use mechanical draft cooling towers.

We could also see from the switchyard, up in the northeast corner of the site, our planned routing of the transmission lines is to the south, along that corridor that I showed you from the barge canal. Also of note here you can see some ponds that are located, one labeled here Pond A.

These ponds are for storm water

management, located on the site. Finally, we have a meteorological tower, which of course has been in place for some time, and collected the data that we used for our environmental and for our COLA meteorological analysis.

MEMBER RYAN: What's the capacity of your ponds in terms of inches of rain?

MR. KITCHEN: I'm sorry?

MEMBER RYAN: What's the capacity of your storm ponds for inches of rain?

MR. KITCHEN: We're designed for the 25-year storm, and that's the environmental regulation. So they're really sited in terms of managing for environmental requirements, as opposed to safety.

MEMBER RYAN: It's a hurricane you manage for? Because I mean it's not only the total inflow of water, but the rate.

MR. KITCHEN: The site, the storm, the ponds are for the 25-year storm. The site, of course, is designed to manage probable maximum hurricane, which we'll talk about. But that's not just the storm ponds. The storm ponds are there for 25-year rainfall.

MEMBER RYAN: Basically the water runoff, right?

MR. KITCHEN: Right, and then beyond that, they would overflow and you would have runoff. But we evaluated all that, and that's one of the discussions that we'll have later today actually.

MEMBER RYAN: Fair enough. I'll wait. Thanks.

MR. KITCHEN: The other thing, in terms of preparing the license, we've used Sargent & Lundy, Worley Parsons and CH2MHILL and many, several folks from those companies are here today. We'll talk a bit about what we have. They've allied, as a joint venture team, so they worked basically as one company in support of us preparing the, in doing the site investigations.

We also, as John mentioned, had an engineer procure constructor, EPC Contract actually in place, which we've suspended at this time. That was with Westinghouse Electric and Shaw Group, for the -- that's the planned vendors that will support construction, design and construction of the plant.

Then other technical support. Of course, we have need on many occasions for experts in the various areas to support COLA development. In fact, Dr. Paul Rizzo is here, who is the geotechnical engineering firm, and they've provided considerable support, for example, and we've used others in terms of specific areas.

Interfaces for standard design. Nothing here that you haven't seen. We have standard departures and standard exemptions. The standard departures are, one is with regard to the format and numbering of the COLA FSAR, which was a departure from the DCD.

The other is we took a departure in DCD. It states that the voltage regulating transformers would have a current limiting device. Actually, that's not necessary. We have isolation breakers on the input and output, and so we don't plan to put in a feature of current limiting. We have current interruption and protection in that manner. So that's a departure, and both of those are standard departures.

Also, we have two standard exemptions, and again, we've seen there. One is the COLA organization of numbering. It doesn't follow the DCD, which is identified in Part 52, and the other has to do with special nuclear material, a detailed description of a material control and accounting program.

Basically, the exemption here makes the Part 52 plant requirement the same as a Part 50 plant, in terms of material control and accounting programs, which are described in the COLA. But there are other elements of that part that we take exception to. So that's our introduction in Part 1.

FEMALE PARTICIPANT: You need to reboot.

MEMBER BROWN: One question. What's the general elevation?

MR. KITCHEN: I should have mentioned that. I meant to mention that. I'm glad you asked. The site elevation is 43 feet above the Gulf. I mean that's the --

MEMBER BROWN: That's the reference point? I presume that's the reference point.

MR. KITCHEN: But the number that is important and you'll here it many times, the plant design grade is 51 feet. So all of our evaluations, in terms of flooding and hurricane and that sort of thing are to the plant grade. So the 51-foot elevation for plant design grade is, I think, 100 foot for AP 1000 in the design.

MEMBER BROWN: So your lower grade will be -- is that -- I have no idea. I'm not a hydrologist and everything, but I presume you'll be addressing that, in terms of that. Is that a deviation?

MR. KITCHEN: Absolutely, yes.

MEMBER BROWN: Okay.

MR. KITCHEN: It's basically a mountain in Florida, but we'll talk about it, and we looked at our evaluations, in terms of the flooding potential etcetera, for 51 feet. I'm glad you asked.

CHAIRMAN RAY: Well Bob, before Denise starts, we have a short comment about the use of evaporative salt water cooling. The towers are very similar to Palo Verde. It looks to me like, well you've seen forced draft evaporative cooling towers, and this is something that would be addressed, I know, fully in your environmental. Again, a matter of -- and therefore not here.

But I am interested in the setting in which you're in, of forced recirc and so on. Is salt drift an issue, and how is it generally addressed? It can affect safety in terms of the switchyard is about all and the plant. But the environmental effects can be substantial, and I just wondered how it was addressed.

MR. KITCHEN: We've done, as you mentioned for environmental, considerable evaluations on salt drift. It's an issue, because it's a contention with regard to Levy.

CHAIRMAN RAY: Yes.

MR. KITCHEN: In terms of do we believe it's an issue, no. But we did evaluate considerably the impact of these type towers and the extents of the drift, and the impact on vegetation, etcetera, in the area. We have other folks who are better equipped to address that in detail than me. In fact --

CHAIRMAN RAY: I don't want to get into the environmental impacts. I just wondered -- you've, I think, answered my question by saying it is identified and discussed as an environmental issue, as well as I'm sure in the impact it would have on the plant and its operation. So go ahead and finish anything you want to say. But I don't want to take up the environmental impacts here.

MR. KITCHEN: I was just going to say, we discuss them with the hydrology this afternoon, and that team is basically the same team, looking at hydrology and meteorology, etcetera, that could address that in more detail if you'd like.

CHAIRMAN RAY: Okay, very good.

MR. KITCHEN: Okay.

CHAIRMAN RAY: Denise, how do we --

(Simultaneous speaking.)

MS. McGOVERN: I'm pretty sure I can do that.

MR. KITCHEN: You can do that from here and not --

MS. McGOVERN: I can do it from here.

MR. KITCHEN: Okay.

(Off mic comments.)

MS. McGOVERN: Good morning. Denise McGovern. I'll be presenting a very brief overview of Chapter 1 for the staff. It was brief to begin with. I think they were so thorough, it will be even more brief than I had planned. I don't want to sit here and read slides and repeat the same information.

Staff review team for Chapter 1. It has many different topics in it, so we had help from different offices, as well as help from within NRO. Technical staff included Aaron Szabo, John Frost, Duncan White, Ed Roach, Stan Echols, Greg Chapman and James Downs. I was the project manager for Chapter 1.

This is an overview not only of Chapter 1, but of the staff's presentation, what we are planning for the next two days. We do not intend to brief you on standard design information. You've seen it before. You've heard it before. So things that are completely IBR, such as Chapter 4, Chapter 5 and Chapter 7, that's not what we are going to be presenting to you.

Consistent with the March 17th, 2010 memo to ACRS, if there were any issues related to hardware, material changes, the applicability envelope, analysis methodologies, DAC or combined license information that was different from standard or different from the DCD, those will be covered.

MEMBER BROWN: Before you leave that, when will issues of cybersecurity, technical support, center support, emergency operation?

MS. McGOVERN: Chapter 13 --

MEMBER BROWN: Chapter 13 will be covered? Are you all covering that? I'm looking back at the list.

MS. McGOVERN: Cybersecurity, there is nothing that's site-specific on cybersecurity. So cybersecurity will not be presented.

MEMBER BROWN: Okay. So the lack of information on the AP 1000 will not be amplified any at all in these presentations?

MS. McGOVERN: If that's the way you would like to characterize it.

MEMBER BROWN: Yes, thank you.

MS. McGOVERN: That is standard concept information. It will not be presented separately.

MEMBER BROWN: I understand you can go on.

I just wanted to know if there was going to be any additional discussions, based on their location or anything like that?

MS. McGOVERN: No sir.

MEMBER BROWN: Okay, thank you.

MS. McGOVERN: You'll hear in emergency planning, I believe the one difference is that they do not have the TSC outside the building. So their TSC is in the original DCD location, which is the auxiliary building, okay.

MEMBER BROWN: Okay, all right.

MS. McGOVERN: So but that doesn't change their cyber plan.

MEMBER BROWN: Okay.

MS. McGOVERN: Okay. Over the next two days, the staff will provide a high level description of the site-specific content on a chapter by chapter basis. Some of the overviews will be brief, but we will be here to answer questions on those. The Levy county application included the design control document information, two parts. The part in the first bullet there are the things that are already included in the rule, in the current rule.

The second bullet there represents the current application and rulemaking package that is going through the process right now. You have been fully briefed on all that, and I think have had interactions going up to, I think, September on that.

Again, you've seen this before. Staff took advantage of standard content, which references both Vogtle and Bellefonte. Standard content in the staff's SER is easily identified using the double indent italicized format, so that you can see it.

The Bellefonte information, which is taken from the Vogtle SE, is clearly identified. It represents information from the Bellefonte safety evaluation with open items, which can be found and is an official agency record of the staff's evaluation of those issues. And of course, the Levy County plant-specific information.

You saw this in the applicant's information. These are the parts of their application. Everything is standard for an AP 1000 application, with Parts 1 through 10. The only slight difference is I think the last SCOLA you saw, Summer went 11, 12, 13. They just kept numbering, where all the other information, Levy has put in Part 11.

So you'll see things like QA, cyber and loss of large areas. That all goes into Chapter 11, I'm sorry, Part 11. Also including that would be the materials planning, information letter, MC&A, programs, things like that.

Overview of the FSAR Chapter 1 and the staff's review. 1.2, 1.4 and 1.8 contain most of the site-specific information. Much of this is standard content that you've seen before, the financial information, the siting information. That's the kind of information that you'd find here that is site-specific.

Again, the applicant covered this. These are the departures and exemptions related to the numbering, relating to the voltage-regulating transformer which is standard to all AP 1000 COLs and the exemptions related to the special nuclear materials, MC&A.

One clarification. The exemptions for the material control and accounting program, the exemption is as to what is required to be in the application. So there is no -- there's no technical information that's not there. It's just that they want to be able to take advantage for all of the programs that are in place for an operating plant, because of the timing differences between licensing, between Part 50 and Part 52.

Some of that information had to be brought forward, but the information is the same. So it's the content of the application for which the exemption was requested, and that the staff recommends. It's parts of the application. It's not exemption from actually having to have a program or a safety security program. That's all I have, if you have any questions.

MEMBER BLEY: I have a procedural question.

MS. McGOVERN: I'll try and answer it.

MEMBER BLEY: We've seen a couple of orders and we anticipate a few more from NRR in the Commission with respect to the Fukushima event. Those orders, when do they apply to new plants, or do they have to address them as you're getting the next step of the license.

MEMBER REMPE: This is Frank Akstulewicz from the staff. The orders would apply only to actual licensees. So in order to apply it to an applicant, we would have to insert a particular requirement in the licensing there as a condition, or some other vehicle.

MEMBER BLEY: Do you expect you'll do that, or once they get their license, will they suddenly be faced with complying with those orders?

MEMBER REMPE: Actually, the question that you ask is the question before the Commission right now, which is what they're deliberating on, which is when to issue the licenses with new conditions, or to wait until after the licenses get issued, to establish what new regulatory requirements would come into play.

MEMBER BLEY: Okay, thanks.

MS. McGOVERN: Anything else? Thank you.

CHAIRMAN RAY: Thank you. Now we will get into matters which are unique to the Levy site, involving geology, seismology and geotechnical engineering.

(Off mic comments.)

MR. STEPHENSON: Are you ready?

CHAIRMAN RAY: We are indeed.

MR. STEPHENSON: Good morning. Progress Energy would like to present Chapter 2.5 and the foundation design sections of our Levy COL application. Before we get started, I'd like to introduce the presenters. I'm Vann Stephenson, the general manager of Engineering for Corporate Development Group.

With me, I have Dr. Paul Rizzo from Rizzo Associates and Dr. A.K. Singh from Sargent Lundy. Both of these were key individuals in putting together these different sections of the application. On the phone, I'm checking to see who we have on the phone there supporting us. Bob Youngs, are you on? Don't have Bob Youngs.

CHAIRMAN RAY: Well, let's see. We haven't done anything to check and see that the line's open, so let's take a minute.

MALE PARTICIPANT: He's on. He's talking. I hear him.

CHAIRMAN RAY: Okay.

MR. STEPHENSON: That's Bob Youngs. He's supported our seismic response development for the Levy site. Kathryn Hanson.

MS. HANSON: Yes, I'm on.

MR. STEPHENSON: Okay. Kathryn was involved in our geotechnical development of some of our COL application. Bill Elliott?

MR. ELLIOTT: Yes, I'm on.

MR. STEPHENSON: Bill Elliott was also involved with the geotechnical sections, and Mike Edwards.

MR. EDWARDS: I'm here.

MR. STEPHENSON: Okay.

MEMBER BLEY: They're all with you, I mean with your company?

MR. STEPHENSON: No, they're not. Mike

Edwards, who just spoke up, is with Rizzo and Associates. Kathryn Hanson and Bob Youngs are with AMEC, and Bill Elliott is with CH2. They're on the phone in case we need some additional support. Okay.

MEMBER BLEY: Yes.

MR. STEPHENSON: What I'd like to do this morning is I'll give an overview of the different sections of 2.5 and the foundation design. I'll touch with the key points that we'll be covering later. After my overview presentation, we'll give a detailed presentation of each of these sections. Dr. Paul Rizzo will cover the geology and geotechnical sections. He'll then follow up with a discussion on our Levy foundation design concept.

Then Dr. A.K. Singh will follow up with a detailed discussion of our Levy site seismic response development, okay. This slide shows the layout of the two AP 1000 units at the Levy site. The dots you see are the locations for our subsurface borings that were part of the site characterization.

The site was characterized in accordance with the requirements of Reg Guide 1.132. We used literature and map reviews, surface investigations, ground water investigations in addition to the subsurface boring program.

These dots represent 116 borings that were part of our original site characterization, and they range in depth from 45 to 500 feet.

DR. HINZE: Was there a general boring program to look at the site before these sites, actual sites for Units 1 and 2 were selected?

MR. STEPHENSON: Yes, yes. That was all part of our site selection, where went and did borings at the --

DR. HINZE: What criteria were used in the selection of those sites? Was it a grid or was it --

MR. STEPHENSON: A.K., could you?

DR. SINGH: As part of the site selection process, we did go into the final three sites and perform geotechnical investigations relative to the subsurface conditions.

DR. HINZE: And the current site is one of those sections?

DR. SINGH: Correct, and at this site, we basically ran borings north-south and east-west, just to make sure that the subsurface is acceptable for a nuclear power plant. So these were exploratory borings, which went up to 100 feet, or in one case almost 200 feet, to make sure that what we expect is what it is on the ground.

But those were all done prior to the site selection. Once the site was selected, we came up with the program for the COL site investigation. So that is what that presented.

MR. STEPHENSON: Yes, and if you'll notice the layout of the two units, you'll see they're kind of offset a little bit. The reason they're offset like this, a lot of it was dealing with the geotechnical data that we got back from that original boring program. That helped us locate it in the best possible position, based on the results we got back from that original, you know, subsurface boring program.

In addition to the wetlands, also was another reason that we kind of oriented the plants like this.

DR. HINZE: This is the high point then? This was a relatively high part of this particular site?

MR. STEPHENSON: Well, not really. I mean the average elevation, as Bob covers, is 43 feet above sea level. It does vary a little bit across the site.

We are going to raising the plant grade to elevation 51. So this is not necessarily the high spot. It's more that's located -- these two just are located like they are based on the results we got back from the subsurface borings, and to try to mitigate the impacts on wetlands.

DR. HINZE: And major criteria there was the depth to the Avon Park?

DR. SINGH: We wanted to make sure that Avon Park limestone is where we thought it was, based on geophysical. However, the design and all the safety evaluations were done using the safety-related borings, which Vann has shown.

So we did the pre-selection boring, but that was just for information. All the information we presented in the FSAR are based on these 116 borings, which are all safety-related.

MR. STEPHENSON: And all 116 borings, you can see they're all around the perimeter of the plant. I think it was 25 of those on Unit 1. They were actually under the safety-related nuclear island, and 19 on Unit 2. So a good majority of the total borings were under the safety-related structure.

DR. HINZE: So sites were never moved as a result of these borings? You following what you thought you were doing?

MR. STEPHENSON: That's correct. Okay. All right. We just kind of touched on this a little bit. The Levy site is located on the Avon Park bedrock formation. At the Levy site, it's located approximately 67 feet below the existing grade.

Bob Kitchen covered the existing grade at the Levy site is elevation 43. We are going to be providing field on the site to raise the plant grade to elevation 51, which lines up with elevation 100 for the standard AP 1000.

The water table at the Levy site does vary by season. It varies between one to eight feet, so there's a high water table, and that's below the existing grade of elevation 43. I'll just touch on a couple of the key areas of our sole boring program. Dr. Rizzo is going to get into a lot more detail on each of these areas.

But during the original site characterization, we did identify some isolated zones in a few holes at low recovery for our foundation design, which Dr. Rizzo will also get into in quite a bit of detail. We did conservatively assume these to be karst features, when we put our foundation design together.

We did follow up with a supplemental subsurface investigation after the original site characterization borings, 116 I mentioned. Dr. Rizzo will refer to that as the offset boring program. We went in about approximately five feet from these locations where we had some low recovery, really just trying to ensure that we really understood the situation around those holes, and we really tried to maximize getting recovery.

We used a larger core barrel. We put more control over our drilling pressures and our drilling fluid and, as Dr. Rizzo will get into, we did find that in those areas where we in the original program had some low recovery, we did get recovery of material, and it was original material, not infill. Dr. Rizzo will get into that.

We also identified a few isolated pockets around the perimeter of the nuclear island that had the potential for liquefaction. Those areas, we'll show those to you a little bit later. They were isolated, and we are putting in a vertical drain system to relieve the core pressure and to eliminate the potential for liquefaction.

Okay. This starts the nuclear island foundation time set for Levy. As I mentioned, we do have a high water table at the site. So to deal with that during the excavation, you can see we're excavating down quite a ways, 67 feet to the top of the Avon Park.

We will be installing a diaphragm wall. This is a 3-1/2 to 4 foot thick concrete wall. It will be going down approximately 30 feet below the bottom of the excavation, all the way around the perimeter of the excavation. We also will be, will have a 75 foot grouting zone. We'll actually grout the Avon Park for the first 75 feet below where we'll be excavating.

This will form a low probability section, as Bob's pointing out, that in conjunction with the diaphragm wall will really form a bathtub, if you will. So this will allow us to seal off the ingress of water, allow us to handle any kind of leakage we may get, and allow us to install our foundation for the nuclear island.

Once we get the nuclear island area excavated, we'll be cleaning off the top of the Avon Park, level it out. We'll use some dental concrete to do that. Then we'll be installing our 35 foot thick roller compacted concrete bridging mat, and this is an unreinforced bridging mat that will be spanning across the area to be excavated, and will be the support foundation for our nuclear island.

CHAIRMAN RAY: You said you'd be able to

handle any leakage you would get with this design?

MR. STEPHENSON: Right.

CHAIRMAN RAY: Are you going to talk about that later?

MR. STEPHENSON: Well, Dr. Rizzo will talk about that. I think 100 gpm is our in-leakage requirements, but we'll get into that little bit later.

So just to kind of top things off for the foundation design, on top of the RCC bridging mat, we will be installing the standard plant AP 1000 base mat, which is a six foot thick reinforced base mat.

Okay. Now I'll give a quick overview of our seismic response development for the Levy site. The red star that you see represents the Levy site. You see the 50 and 200 mile radius circles around the Levy site. All those shaded dots, circles, according to how small or big they are, are historical earthquake locations that were used for the development of the Levy seismic spots.

We did use the EPRI seismic owners group catalogue and we did update that catalogue with events and information through 2006, including the events in the Gulf of Mexico. The results of our seismic response was that our acceleration at our foundation input level was .08 G's. That was less than the .1 G that is the minimum requirement for 10 C.F.R. 50, Appendix S. So we are using .1 G for all of our seismic design at the plant.

Okay. These two graphs show a comparison of the Levy ground motion response spectra. That's the blue line on the bottom, versus the AP 1000 certified design response spectra, which is the red enveloping line. The, I guess it's on your left, is a horizontal comparison. In your right is the vertical comparison.

As you can see, in both cases, the Levy ground motion response is well-enveloped across the entire frequency range, by the AP 1000 certified design spectra. Oh, as I just showed, the Levy ground motion response spectra is well-enveloped across the entire frequency range.

We did run a 3D soil structure interaction analysis for the Levy site, really to calculate the in-building accelerations and response, based on the site-specific characterizations of Levy.

We performed that analysis. Westinghouse helped us in putting that together, and the conclusions were that the Levy in floor responses were enveloped by the AP 1000 DCD for responses at all locations.

Okay. One point that I didn't make at the very beginning, I guess, is we did have Chapter 3, originally as a part of this presentation. I think we've redone the agenda now, and we're grouping that with Chapter 19, the PRA. So we will not be covering Chapter 3 in this presentation. I think it comes right after this, is that correct, and we'll group it with 19.

Okay. With that, we'll get into the detailed presentations, and Dr. Rizzo will start out with Chapter 2.5.

DR. RIZZO: Thank you, Vann. I'm going to use a pointer.

(Off mic comments.)

DR. RIZZO: Okay. We'll ad lib it here.

MR. STEPHENSON: We'll let Bob read your mind.

DR. RIZZO: Okay. I'm part of the team that is adapting the AP 1000 to the Levy site. My responsibilities have been to given geological conditions at the site, the seismic environment and the groundwater conditions at the site, to develop a foundation concept that will support the AP 1000 standard design.

We start off with a very quick overview of the geology, and then move quickly into the geodetical conditions. I have three figures, this one and two others, that basically close in on the geology. This is a regional picture of the geology, where you can see the site in the very center of that star, the 200 mile radius circle there.

This sits on the Florida platform, a large platform of sedentary deposits, that are bounded on the west side by the Gulf of Mexico shelf, and on the east side by the Mid-Atlantic shelf. On the next slide, we close in a little bit to a 25 mile radius, and on this slide, there's two takeaway points here.

You see the red star in the middle, which is our site, and immediately northwest of the site is the blue colored formation, and the rest of the area is a red-colored formation. We actually are in a yellow.

Now the yellow are generating sediments, undifferentiated. The blue is the Avon Park. Where it outcrops, and outcrops just northwest of the site, and that is the area of some quarries. You can also see the Avon Park and riverbanks.

The light blue is the Ocala formation, and in the light blue you'll notice there's quite a few pockmarks around. Those pockmarks represent sinkholes that have been mapped by the Florida Geologic Survey. The key point here is that yes, the Ocala has numerous areas of sinkholes. The Avon Park does not for various reasons, one of which is the Avon Park is more dolomitic limestone than the Ocala.

DR. HINZE: Can I ask you a question about that Paul?

DR. RIZZO: Yes sir.

DR. HINZE: Where you call it the Avon Park, the limestone in your diagram.

DR. RIZZO: Dolomitic limestone, yes.

DR. HINZE: Well, it's represented as a limestone. The question that I have relates to how much of that is dolomitized and how it is dolomitized, in terms of variations, because dolomitization is one of the critical factors that have been used for the decrease in the dissolution of the Avon Park.

So can you give us, you know, do you have a map that shows the percentage of dolomitization across the area or a cross-section? Help us with where that occurs.

DR. RIZZO: Okay. I don't have a figure that shows that, but you are correct. We take credit in our analysis, of the slower rate of dissolution that occurs in the Avon Park than it does in the Ocala, because of the dolomite.

Now the dolomite content in the Avon Park is hot and variable. It varies all over the place, from none to significant percentages, and it varies with depth, all right.

DR. HINZE: Right. But is it consistent with depth? In reading the report --

DR. RIZZO: No.

DR. HINZE: That's the impression that I had. There are zones that are deeper, that are more dolomitic.

DR. RIZZO: That's correct, that's correct. It varies with depth.

DR. HINZE: How about lateral?

DR. RIZZO: Varies laterally as well. Varies laterally as well. So there's no way that I can present a figure that shows how it varies.

DR. HINZE: Is this the primary dolomitization then? Was this primary at the time of formation?

DR. RIZZO: This was -- no, this dolomitization was secondary.

DR. HINZE: It was secondary.

DR. RIZZO: Brought in by moving waters

and displaces the calcium with magnesium, a secondary alteration.

DR. HINZE: Well then how can you take credit if there's this dolomitization?

DR. RIZZO: How can I take credit for it?

DR. HINZE: For the decrease in the --

DR. RIZZO: Well, the only way I can take credit for it, quite frankly, is qualitatively. I don't take, I don't say the range of numbers. No numbers, that's right.

DR. SINGH: Well, we did do the test in 18 of 20.

DR. RIZZO: Yes. We found that we had some thin site, thin sections. We had 20 of them. In 18 of those, we find dolomitic content, in 18 of the 20. But the rate, the variation, the quantity was -- it varied significantly. We're unable to nail down a pattern or a quantitative assessment, to do it, show analytically what it is.

But on the other hand, our foundation concept offsets that. All we notice is that there's no pockmarks in the Avon Park, where those in the Ocala, and the explanation is simply that there's more dolomite content in the Avon Park.

Now I don't say anywhere in our analysis of our foundation concept hey, my rate of deposition, rate of dissolution here is 10 to the minus 4 versus 10 to the minus 5. I don't do that, don't have to do that.

DR. HINZE: Well, that was another one of my questions. You cite the 10 to the minus 4th percentage for this.

DR. RIZZO: Yes.

DR. HINZE: How variable is that, you know, you don't have any uncertainties on that. That has to be very uncertain.

DR. RIZZO: Exactly, it is, and it stems basically from experience down at Crystal River, which is the Ocala, and that's the rate for the Ocala, 10 to the minus 4. We just believe that the Avon Park will have a slower rate than the Ocala because of dolomitization.

DR. HINZE: So you're not really taking credit for the dolomitization?

DR. RIZZO: Quantitatively not taking credit for it, that's right. I'm going to -- when I get to the end here, I'm going to --

DR. HINZE: But certainly when you read the documents, you get the impression that it's this plus sign morphology and the dolomitization, which inhibits dissolution.

DR. RIZZO: Exactly right. But when I design a foundation for the structure, I basically ignore that, okay. You can't have it both ways, right? I basically ignore it. I can't quantify it, I don't take credit for it, and if it's there or faster or slower, I've got it covered with a foundation concept. I'm going to explain that, how I do that when I get to the end here.

DR. HINZE: Okay, thank you.

DR. RIZZO: The next slide, which is a close-up again of the five mile section, and the most important feature here on this map is that there are three faults that were mapped previously in the early 1950's, that would appear to cross the site.

We did a fair amount of work to see if these really existed. We concluded, along with many other people in the state of Florida, that they do not exist. They were developed by a gentleman named Vernon from the Florida Geologic Survey, and since then, the Geologic Survey has dismissed them as non-existent, and they don't even map them anymore.

But we assessed them ourselves with a number of different investigations. The next slide --

CHAIRMAN RAY: Are you going to describe

those?

DR. RIZZO: Yes. The next slide is our assessment was surface faulting. We did an extensive literature review, and expert interviews with the Florida Geologic people and other experts in Florida. We did our own photo-geologic interpretation for lineaments across the site.

Could not line them up. We looked at the geomorphic analysis of the site topography, looking for features that would suggest offset, that would suggest varied features, that might be indicative of those faults, and then went out and looked at the quarries and the river beds, the Waccasassa River, northwest of the site, where the Avon Park is exposed.

We could find no evidence of faulting. We had concurrence from that on geologic survey. So this is the conclusions regarding these faults, that since we had no --

CHAIRMAN RAY: Before you go to the conclusions, let me ask you a question. No refracting surveys or anything to -- at the subsurface?

DR. RIZZO: We did do geophysic surveys, yes. We did that.

CHAIRMAN RAY: Will you describe them a little bit?

DR. RIZZO: I would rather have people from Kathryn Hanson or Elliott on the phone to describe those actual surveys. Bill or Kathryn?

MR. ELLIOTT: This is Bill. We did downhole geophysical surveys as part of the geotechnical investigation, and some surface to downhole geophysical investigations to look at seismic shear wave properties and velocities, that type of thing. But as far as large-scale surface seismic refractive geophysical surveys, we didn't do anything like that as part of the COLA investigation.

We did do geophysical surveys on the site, during the site selection study, and mainly were looking at the variability at top of rock, and that's how we were able to use that information to select the initial borings at the site that we did, to characterize the site.

But we didn't do a large-scale geophysical survey as part of the COLA geotechnical investigation.

CHAIRMAN RAY: Okay. So this was in the context of establishing whether or not there's any faulting, and the surveys, as I understand it, in the way that you've described, weren't directed at obtaining subsurface information that would let you determine if any faults existed by that means.

MR. ELLIOTT: Right. We didn't actually do large-scale geophysical surveys with the goal of looking for faulting, no.

DR. HINZE: Just to make certain that we're all on the same page, we're really talking about reflection surveys here, and that's how one really goes about looking at the faulting.

DR. RIZZO: Yes. I used the wrong term. I realize that.

DR. HINZE: But I want to make certain that we get it on record, that there have been no reflection surveys. Is that correct? Is it Bill?

DR. RIZZO: That's correct.

DR. HINZE: Yes, that's correct, and actually the technique that we were using for the initial work, we found that offset seismic refraction survey was a better tool for mapping the top of rock there, just because of the shallow nature of the depth of the bedrock and the relatively low seismic velocities of the limestone, compared to say, an igneous rock.

DR. HINZE: But these would not be very good for mapping faulting?

MR. ELLIOTT: No. That wasn't their intended purpose.

CHAIRMAN RAY: Okay. Well, I mean I think that we're both trying to establish the same understanding. But did you have anything more on the question of why we wouldn't have used that technique?

DR. HINZE: It was -- my reading of your documents indicated that you have done some geophysical surveys, and found them to not be very definitive. One of the questions that I think we should ask is could you be a little more definitive about their not being definitive? What went wrong?

What kind of technology was being used, and what were the problems, to lead you to not carry through with any geophysical techniques other than downhole? I think that's the question.

DR. RIZZO: Yes. Bill, you want to address that.

MR. ELLIOTT: Sure. What we were trying to do initially, again, was look at the depth to rock and the nature of the contact between the overlying sediment and the top of rock.

As far as faulting goes, we had already done some work with lineament analysis and with -- preliminary work with lineament analysis and review of geologic literature and some field work, to try to confirm any faults that were postulated by previous studies.

We even worked with the current state geological survey folks, and were unable to confirm some of these earlier postulated faults by Vernon and others, and that information that we had at that time showed that we didn't have any faults that we would expect to see crossing the site that we were working.

But we did try to use a couple of different geophysical techniques when we first went to the site for the site selection study, and again offset seismic refraction gave us the best information. The problem we were having, one of the problems we were having was that the transition between the overlying quaternary sediments and the underlying Avon Park formation in some places is pretty gradual.

You don't have a sharp, defined hard top of rock in some areas. You have a gradual transition, say, from a silty sand to a dolo-silt, which is kind of a precursor of a limestone in a shallow marine environment, to a fossiliferous limestone, which is not very cemented, to a more well-cemented or dolomitized limestone deeper.

So what we were seeing was a lot of variability in the signal that we were getting back for the top of rock, and we weren't seeing a hard reflector for the top of rock. So we were really trying to get a handle on that, and tie that in with the borings that we were doing.

That's how we were able to determine that that transition between the overlying quaternary sediments and the underlying Avon Park was a, at some places, pretty gradual transition, and it was not easily observed with the typical surface geophysical techniques.

That's why we decided to do more in the way of borings, and less in the way of surface geophysics.

DR. HINZE: Can I ask another question that really relates to what Bill has been talking about here, and that is that in this type of geological train, I would expect that the bedrock topography would in some way be controlled by the more solutioned areas, solution zones.

Certainly faulting is one of the things that can lead to greater movement of groundwater through those zones and dissolutioning. I'm wondering if your bedrock topography map gave you any clue as to the existence of these faults? I didn't see a bedrock topography map, and yet -- in the reports, and yet the bedrock varies from a few feet to a couple of hundred feet at the edge of the site.

This tells me that there's a lot going on in the bedrock topography, and I'm wondering if that isn't giving you some kind of information regarding the faulting.

DR. RIZZO: Let me speak to that a little bit. There was no bedrock topography map in the COLA. However, if you look at Figures 2.5 --

MALE PARTICIPANT: 2.5.2, 2.16.

DR. RIZZO: 2.16, you will see the locational borings, and beside each boring you'll see the depth to rock. It's interpreted from the core, based on the original 116 borings. If you look at those numbers carefully, you will see that they're all over the place, as you point out.

The variability is very dependent upon, in this case, upon the driller's ability to start coring. That was the criteria that they used to determine top of rock, when they could start coring, as opposed to standard penetration.

DR. HINZE: Yes, the -- zone.

DR. RIZZO: Yes. So it depends on the driller, the drill weight, the down pressure of the core barrel and so forth. So we didn't place a lot of emphasis on that data per se.

Now when it comes to the point of trying to line those up, okay, you notice on the figure -- I could bring it up, I guess, if we could find it, that you can line up at least one lineament with a series of borings that had low recovery.

Another zone, for example, the one you've cited, the northwest/northeast corner of Unit 2, where the rock dropped way off, try as you might, you can't find a lineament that runs through that area.

DR. HINZE: Well, are we talking about a surface lineament?

DR. RIZZO: Yes, surface lineament. We suspect that there may be a paleochannel through there, could be, and we suspect there could be a paleochannel that lines up with several other borings, and that had low recovery. These are off the main island, the main nuclear island area. They're not underneath our site. They're either that northwest corner, which is under the turbine building, or between the units.

Now you could go one step further, and that is the units I had on the structural map that I had here, the structural trends in northwest/southeast, and that is the direction of the fractures in the area as well. When you line up the fractures, you can line up some low recovery zones.

True, and those fractures are probably the path of groundwater through the area, that would cause dissolution, and potentially result in -- one could postulate that those vertical fractures line with some bedding planes, and you get plus sign geomorphology. That is part of our design basis.

We didn't find much of that, but there is some evidence that that potential could exist, and those linear paleochannels or those linear zones certainly could be faults. It could. I mean their origin could be faults. I can't dismiss that, but I'm interpreting as being fractures.

DR. HINZE: That's right. It's very, you know. You know, I looked at the figures you're talking about, and it's very difficult to get a good feeling for the bedrock topography. I personally would have loved to have seen the bedrock topography map or isopack of the quaternary sediments, to give a much better feeling for it.

DR. RIZZO: I think that's part of Bill and Kathryn were saying, is that the uppermost quaternary is actually quaternary in Avon Park. That's why you had so much difficulty with the geophysics. You couldn't get a strong reflector --

DR. HINZE: There's a lateral variability as well, which is really inhibiting the refraction work. That's the killer. So I think when we move along to the foundation concept, you see how I kind of defeat that challenge or that issue, and I reserve the right to come back to this.

DR. RIZZO: Absolutely, sir.

CHAIRMAN RAY: Well, the foundation is one thing, in terms of what you and Bill have been talking about, but I think the question that I'm still pondering is the way that we conclude there's no capable faulting that needs to be considered here. I confess I'm not clear on how you reached that conclusion, based on the four bullets you got listed up there.

MS. HANSON: Bill, this is Kathryn Hanson. I'd like to just briefly summarize the approach that we took here. We looked at these postulated faults by (fading out).

The evidence for those faults had been that he interpreted displacement in tertiary bedrock units. He had also seen, he did a lineament analysis and concluded that some of the lineaments you saw were faults.

Some of those coincided with defamation features we saw in quarries. Subsequently, the state of Florida has looked at those points where there was close deformation and concluded that they were due to dissolutions, karst features, localized features, and not faults or tectonic deformation. The stratigraphy has been reevaluated, and there are no (fading out).

CHAIRMAN RAY: Kathryn. You're fading on us Kathryn.

MS. HANSON: I'm here again. The inferred stratigraphy or stratigraphic offsets are, were not confirmed. The new stratigraphy was not correlated units, or there's no basis for those correlations, and such that the state of Florida in studies that they have done to reevaluate, systematically look at the hydrogeology of the entire region, have shown that there are no significant or offsets of bedrock units based on those studies.

We then looked at regional to site-specific lineament analyses, to evaluate whether there were any through-going structures or geomorphic expression of faulting, and we looked at those digital elevation models from ten meter data sets, which also showed that there were no strong lineaments associated with the faults that we had postulated would project into the tight area.

We also did analysis of historical photographs, 1949 photographs that were the oldest photographs we could find, which predate much of the modification of the properties. We also looked at more recent photographs. So we compiled lineaments and looked carefully for evidence for through-going features, and we did not feel that we were seeing any.

The property itself is there's a thin veneer of quaternary sediments over much of the property. We presented the map. We did not contour the data points that we had from the borings because we felt that this was more representative and true to the information that we actually had.

We recognized there can be variability due to shallow surface-related tar features, as well as potential for varied paleochannels. So based on that, we feel that through the site, we're looking at probably a thin veneer of sand overlying what originally had been a marine abrasional platform, and we're not seeing any evidence that there's been significant vertical deformation or evidence for faulting across the site, based on those analyses.

MR. STEPHENSON: Okay, thank you Kathryn. Hey Kathryn, are you on a land line or are you on a cell phone?

MS. HANSON: I'm on a cell phone. Is that problematic?

MR. STEPHENSON: Yes. Breaking up quite a bit here. I think there's some background noise also. Is it possible for you to get to a land line?

MS. HANSON: Yes. I'll try to switch over.

DR. RIZZO: Yes. We can't make a transcript out of the reception that we're getting now. But with that having been said, I think that as far as the effort to address some hypothetical faulting is concerned, let's stipulate that that's fine just for sake of discussion.

The real question is what, since all of this seems to be based on what I, anyway, consider to be quite recent data and debates, why available technology wasn't thought to be necessary, to establish in fact what the subsurface conditions are relative to the potential for existing, for faults to exist. But again, I defer to Bill here to pursue that.

DR. HINZE: Can I ask a question of Kathryn? Kathryn, Vernon's work on those faults, what kind of movement did he postulate, and how much movement? Was it strike slip? Was it dip slip, and what kind of relief. I don't recall reading that in the report. It may be there, but I don't recall.

MS. HANSON: It was dip slip, and I would have to check back. We did discuss, I believe, and I'll check on that and get back to you.

DR. HINZE: Could you get back to us on that, or where we can find it in the FSAR?

MS. HANSON: Yes. I'll switch over to my other phone and look that up.

DR. HINZE: My thought in reading this whole thing is that there was very little vertical displacement, and this would thwart the use of seismic reflection work, unfortunately. That's, I guess, a conclusion that I came to as I read through the report. But give us that information, if you would please.

MS. HANSON: Certainly.

MR. STEPHENSON: We'll take that as a follow-up.

CHAIRMAN RAY: Yes, let's do that, and we'll let Paul continue here for a little bit. But we will want, at some point, to revisit this.

DR. RIZZO: I want to make sure you said "thwart" and not "support."

CHAIRMAN RAY: No. I said thwart, with a T.

DR. RIZZO: Right, with a T. Right, got you. We agree. Okay. Back up one more slide there, Bob. Based on this interpretation of the faulting at the site, we dismissed faulting as a design consideration for foundations.

We did not, we now move to the other hazards, that we thought, we think could affect the foundation design or the behavior of the plant, and that is karst-related deformation.

We spent a fair amount of time assessing that issue, and that's the basis of our foundation design. We want to point out that regardless of what I say regarding karst deformation or what's on the slide regarding faulting or deformation, we will be mapping the excavations as we conduct the work, to be sure we don't have any evidence of offset, or faulting beneath the units.

Okay, next slide. This is a repeat of the slide that Vann showed earlier. This is summarizing our site investigation. We had well over 100 borings, more than half of which, about half of which were under the safety-related structures. We did the PS suspension logging and we did downhole velocity measurements for shear wave velocity.

We did acoustic televiewer down our boreholes, as well as caliper surveys. Caliper surveys were done to measure the diameter of the borehole with depth, to check to see if it's varying at all. We did the normal geophysical logging, including gamma-gamma, natural gamma, neutron-neutron and so forth.

The summary of that effort, the next slide, in the original investigation where we did 116 borings, from our perspective, indicated a series of low recovery zones. Let me explain what a low recovery zone is. When we are coring rock, we usually do that in runs of five foot or ten foot at a time.

When we pull up the sample, the recovery is the percentage of sample in the sampler. For example, if I have a five foot sampler, but I only have four foot of core, then my recovery is 80 percent. We noticed that the recoveries in many of our borings were very low.

We had to figure out why this was occurring. We did a very detailed assessment of the logs, and then we followed that up with a series of offset borings, six borings adjacent to previous borings that had been drilled, where the recovery was low, and we changed our drilling technique with the offset program.

We also conducted a grout take test program. A grout take test program is a program whereby you drill holes into a zone, a number of holes, and you pump cement grout, cement water mixture into that formation, to see if you can get take.

In other words, will the rock absorb grout in the program, and if so, at what rate and how fast and how much.

The profile that we used for foundation engineering at the site. Existing ground surface is at elevation 43, as shown on the right side of the figure in front of me. We interpreted -- at 43 feet above mean sea level. We interpreted at elevation minus 24, 75 feet below final grade, 67 feet below existing grade, 43 and 24 yielding 67.

At minus 24, we interpreted the Avon Park to be sufficiently competent at that elevation to support a nuclear reactor. The Avon Park exists higher, and you can find evidence of it higher in the stratigraphy.

But it's weather, and it's mixed in with undifferentiated quaternary deposits. We chose elevation minus 24. Below elevation minus 24 is the

Avon Park, much better quality rock, very minimal weathering.

Now so our interpretation of the condition for design, first from a structure point of view. The local dip is very shallow, meaning that we should be able to show uniformity of conditions underneath the site relatively easily. We have local fractures closely spaced, meaning that 19 feet, as close as 19 feet. There's an orthogonal set that runs north, east and southwest, I mean northwest, and there's no faults existing on the site. This is our interpretation for the geologic foundation.

The nuclear island foundation, we wanted a concrete mat, bearing on adequate or competent Avon Park. We can support our non-safety structures like the turbine building, the annex building and the rad waste building, on drilled shafts, if that's the economical solution.

From a geologic hazard point of view, we correlate those with groundwater moving through the vertical fractures, and we postulate that they coalesce with horizontal bedding structures, bedding planes, for karst feature, often called plus sign morphology.

In other words, a vertical fracture

coalesces with a horizontal bedding plane, and this zone here where they overlap, there's a potential for a karst feature to develop. The plus sign is when you have a vertical fracture intersecting a horizontal.

DR. HINZE: Let's talk about, for a moment, about those plus sign morphology that you're talking of. As I recall in your report, you have a conservative value of ten feet for the bedding planes.

DR. RIZZO: Yes.

DR. HINZE: I failed to find any vertical dimension on that, and it seems to me that the critical dimension is the vertical dimension.

DR. RIZZO: Well, okay, two comments. First off, the vertical is much easier to find from the boring logs, because that's the zone of low recovery, five foot, four foot, ten foot.

DR. HINZE: If you've hit it right.

DR. RIZZO: Correct. In that particular borings, that's the -- okay.

DR. HINZE: So what is the vertical? What would be the uncertainty, the mean and the uncertainty of the bedding plane solution zones?

DR. RIZZO: First off, okay. Let me tactfully answer this way. From a vertical point of view, we looked at all our borings and we found the vertical dimension of these low recovery zones to be essentially less than five feet across the site.

The average is closer to two or three feet. Effectively, they're all less than about five feet, vertical, all right. Then we studied the quantity of --

DR. HINZE: Are those associated with bedding planes? Can you --

DR. RIZZO: No, no, no. Those are associated with vertical, vertical.

DR. HINZE: Okay, all right. Now one or the other, vertical or bedding planes.

DR. RIZZO: Vertical, all right. Now I then had, when I finished the borings, this is the original investigation now, not the offset borings. When I finished the investigation, I filled those borings with grout, all right. I fill them up, all right. Normal practice is to backfill a boring with grout.

I measured the quantity of that grout that I took, and I should have a nice, uniform diameter-filled borehole with grout. But in some cases, the grout it would take was three, four times what I should normally have. So the net increase in grout is moved horizontally along the bedding plane.

That gave me my first indication of the size of the lateral dimension at a bedding plane, okay. Now I'm able to tie bedding planes from boring or boring, but I'm unable to -- there was no evidence that they moved from one boring to the other. So my evidence for a horizontal dimension, a lateral dimension or a width of a plus sign feature, is sets off knowing what my grout take was in that area.

DR. HINZE: So basically you determined the width of the bedding plane, the ten feet, by the amount of grout?

DR. RIZZO: Actually --

DR. HINZE: This also depends upon how vertical it is and how much it's filled with weathered material, because you're just pushing the weathering material off to the side with the grout?

DR. RIZZO: Yes, you're correct. Now the number turned out to be three feet, not ten feet. Ten feet's a design parameter. The three feet is what I measure. When I did that, I also multiply my grout take by a factor of three.

So I had a large quantity of grout. I assume it went into that level of that bedding plane. That gave me a dimension that I could work with, that was conservatively calculated.

I took that three foot and later, I said all right, I'm going to design for ten feet. Not only this way, but this way. A spherical or a cylinder, and more importantly, I'm going to assume it's void, it's empty, it's air. Whereas my offset borings clearly showed they're always filled.

DR. HINZE: There are certain karst features in the area that have up through a diameter of 50 meters.

DR. RIZZO: More than that in some cases, yes.

DR. HINZE: And you know, but 50 meters is a pretty good size there. How does that relate your ten feet, you know?

DR. RIZZO: How does that track? The features you're referring to are locally called cypress domes. You can walk out on a site, or you can look at an aerial photograph, and you can see these pockets, the pockmarks on that figure I showed before in the Ocala. But in our site, there are features that are pocking water, and there are cypress trees growing there. Hence the name cypress domes.

Those features are dissolution features of the upper-most surface of the bedrock that had filled in with clay, and now they contain water. A totally different feature from down below of karst development. There's not a continuation of --

DR. HINZE: Are they collapsed features?

DR. RIZZO: No, they're not collapsed features. They are erosion. They are dissolution features on the top of the limestone.

DR. HINZE: Well, okay. But is there collapse into that? Could they be -- certainly those could have been within the bedrock itself?

DR. RIZZO: They are within the bedrock.

DR. HINZE: And have covers over them?

DR. RIZZO: Yes.

DR. HINZE: In the collapse-in, right?

DR. RIZZO: Right. The origin --

DR. HINZE: So how do you know that ten feet is a good number here, rather than 50 meters?

DR. RIZZO: Based on my borings, and the fact that those features you're referring to and the features I'm referring to are different in time scale and different means of formation, okay.

DR. HINZE: One of the things that confused me in reading the report is this term "paleokarst." Why are they termed paleo? This term is used rather consistently in the report. Where does the paleo come from, because the dissolutioning is still going on?

DR. RIZZO: The interpretation that we made is that the surface features you're referring to are paleo in origin and has ceased. They were formed when the surface water level was much higher covering the site, causing the dissolution to occur. We have said, we are arguing now that the dissolution activity in the Avon Park beneath our site could be continuing, and we accounted for that. We assume that it's still active.

DR. HINZE: While I'm asking a question, let me ask, could you describe for us how you reached your conclusions from the offset filling program? I didn't find that very clear in the report, and if you could clarify that for us.

DR. RIZZO: I'm going to -- let me, I have a couple of slides here on this issue.

DR. HINZE: All right, good.

CHAIRMAN RAY: Let me just interrupt you for a second and say I'm looking for a spot at which we will take a morning break, as shown in the agenda here. This topic continues until lunch. So if you've got something you'd like to present now, go right ahead and do it. That's fine. But at some point, here shortly, I want to be able to take a break as we

--

DR. RIZZO: This would be a convenient time.

CHAIRMAN RAY: All right, then. We'll take a break from now until 20 minutes after 10:00.

(Whereupon the above-entitled matter went off the record at at 10:04 a.m. and resumed at 10:19 p.m.)

CHAIRMAN RAY: We're back on the record, and Dr. Rizzo has the floor.

DR. RIZZO: Yes. I'm going to advance the talk a little bit faster here, and now I'm going to speak about what we did to investigate these low recovery zones. As I mentioned, low recovery zones are a consequence of -- well, they're calculated by looking at the percentage of the core you actually recover in a core barrel, as opposed to the ideal lengths. A five foot barrel should yield five foot of core. But if it leaves four foot of core, then you have 80 percent recovery.

RQD is a qualitative definition that we use in the coreway of the core, our relative quality designation. RQD is a measure of the core samples that are at least four inches long in a barrel. So if you had nothing, for instance, your RQD would be zero, which you could have a very high core recovery.

Then we use an acoustic televiewer and caliper surveys to look at the size of the borehole, and then measure the diameter of the borehole. We follow that up by drilling six borings adjacent to borings that had exceptionally low recovery, and we changed the technique with the offset boring program.

For example, we carefully monitored the dome pressure on the drill rig as you're advancing the hole. We kept very careful control of the water pressure that was used to recirculate the recoveries from the drill hole. We turned the sample at a very slow rate, to prevent excessive vibration of the core barrel.

We used an enlarged core barrel and increased the diameter of the core, excuse me, and we used that triple barrel whenever we could. Triple barrel meaning you had three sleeves inside the sampler to retain the core.

We measured the grout takes from the initial borings, and I explained that earlier to Professor Hinze, and then I looked at -- then I did a special program, we did, of measuring grout take in a measured grout test program, to measure how much take we could actually get of grout into the rock.

Then we did a site vicinity fracture investigation, to see if we could nail down the fracture pattern that had been suggested in the literature. The next slide here is an example of offset boring 1, which was drilled next to A21. In A21, this zone was marked as having a 40 percent recovery.

Well, when you looked at 01 core sample, which is actually shown here, you can see 100 percent recovery simply by changing our drilling technique, and this is drilled five feet away from A21, where the recovery was only 40 percent. So clearly, the drilling technique, the drilling procedure has a great deal to do with the core recovery.

The next slide is another offset boring, so graphically you next see regular boring, A14-A. The yellow line is the recovery in that boring versus depth, and across the top you go from zero to 100 percent or one, and down this left, down the ordinate the depth down to about 200 feet, a little more.

So the yellow line indicated radical changes in core recovery, is with depth, getting as low as, for example, zero recovery at 60 feet, and zero again at about 210 feet. Whereas when we drilled the offset boring with better techniques, we had very good core recovery, between 80 and 100 percent for the full depth.

Okay. That gave us a higher level of confidence that what we were interpreting from a geology point of view, with respect to the confidence of the Avon Park, versus what the borings were showing. We felt very good about what we were getting at.

MEMBER RYAN: Dr. Rizzo, how many of those cores did you repeat in that second technique?

DR. RIZZO: We drilled six offset borings adjacent to six borings that were relatively poor.

DR. HINZE: And they were five feet away from them?

DR. RIZZO: About five feet. Of course, you don't know exactly, but you start off that close.

DR. HINZE: Is there any chance that you just missed the cavity with the offset? You know, how do you know? How do you know within five feet that those cavities could change considerably.

DR. RIZZO: That's correct. But if you had, this, I think, is Dr. Ryan's question. If you drill here and you had very low recovery, and you drilled here and you had very high recovery, then the chances are your drill technique here is not nearly the same as that here.

You're suggesting at the beginning that those low recovery zones are voids, and that's exactly what I set to prove, that they weren't.

DR. HINZE: You investigate them, right. Did you do gamma-gamma in the offsets?

DR. RIZZO: Yes, we did.

DR. HINZE: And was there any indication --

DR. RIZZO: We didn't do them in the offsets. we did in the originals, and the gamma gamma showed no pattern of low consistency between borings, as far as the recovery zones are concerned. The gamma-gamma was a little bit random, in fact.

DR. HINZE: Did you consider bore hole gravimetry to look to see whether there was any cavities off to the side?

DR. RIZZO: We did calipers.

DR. HINZE: That just tells you what's happening in the hole. I'm talking about reaching out, about remote sensing out from the holes.

DR. RIZZO: The televiewer, acoustic televiewer.

DR. HINZE: Well, that tells you what's happening at the side. I'm talking about beyond.

DR. RIZZO: No. If we didn't pick it up in the caliper or the televiewer in a bedding plane, we didn't see it.

DR. HINZE: You didn't consider using a borehole gravimeter to sense out --

DR. RIZZO: No sir, we did not. The next slide is also a technique used to assess the competency of the rock, so to speak. In the upper left-hand corner you'll see a hexagonal pattern of boreholes. The outer hex is about 16 foot out of center. Then we split space those at eight feet, and we split space some of those down to four feet.

What we're doing with those is we're pumping grout in at first a 16 foot spacing, measuring the take, of course, very carefully. Then we come back and split space the borings, and pump grout in the in between holes. Again measure the take, and normally you see a diminishment in the take, because you've grouted up part of the hole, part of the rock formation.

You do it again at four feet, and you should get very little take, which is what happened in our case. You see down in the corner there with site location, this is the location of a boring that we drilled at an incline and an angle, back to the grouter zone, so we could capture the grout in vertical fractures by drilling across them, as opposed to vertical.

The results of this program indicated to us that we could grout the Avon Park with a reasonable amount of takes, economically and technically feasible, and most importantly, we should grout, if we're going to grout, in angled borings, not vertical borings.

Because we're looking for vertical features, vertical fractures, we want to intersect like this, a series of them. Okay.

MEMBER RYAN: I'm sorry. Which hole did you decide on that vertical test? Was that the one way down here or --

DR. RIZZO: No. The one down in the lower is the boring we drilled at an angle.

MEMBER RYAN: Yes, that vertical angle.

DR. RIZZO: Through that hexagonal zone that we brought up.

MEMBER RYAN: That's okay. I just want to make sure I understood the picture, thank you.

DR. RIZZO: And they're always showing in the photograph there's the location of it, which was just north of Unit 2. Okay. We did do some work on this fracture issue, in addition to what Kathryn pointed out earlier. We, most importantly, I think the aspect of that is we went to some quarries and went to the river banks, where we could find exposures of the Avon Park. You might remember a early slide I showed an area was dark blue, where the Avon Park outcrops, basically the quarries, and they were banked in those areas.

We could get there and we did and we mapped fractures, the pattern, the spacing, the character of the fracture. Okay.

DR. HINZE: How about cavities?

DR. RIZZO: No cavities. We didn't find any cavities per se. What we found was fractures that did this sort of thing. I'm sorry, I'm talking with my hands. I should be talking verbally.

But anyway, we saw them open at the top, sometimes as much as two or three feet where the weathering had occurred, and then whereby we reached maybe five feet, sometimes as much as ten feet, where we could see it, and the thing tapered down to -- the fracture tapered down to inches.

So it clearly is a feature that, in the quarries anyway, the vertical fractures were on a spacing of about 19 feet in one direction and 23 in the other direction.

DR. HINZE: Are these the limestones or dolomites?

DR. RIZZO: This was in the Avon Park.

DR. HINZE: My question.

DR. RIZZO: Dolomitic. The quarry's known for dolomitic limestone at that area. Okay. This is the Hammock, Gulf Hammock Quarry. They're selling what they call dolomitic limestone or dolomite. It's really dolomitic limestone. It's really dolomitic limestone, not dolomite.

Okay. Now the overall results of that led to a series of design considerations for the foundation. We postulate that an ungrouted, and I'll point that out in a moment what that means, and ungrouted vertical fracture coalesces with a horizontal bedding plane to form a karst feature, always described in the literature as plus sign morphology.

Vertical fracture intersecting a horizontal bedding plane, and here you develop a karst feature for the two intersects. We postulate that that happens. We postulate that it's ten feet wide, based on our analysis of the grout takes, based on our analysis of the core filings of the borings and our observations at th coring.

We postulate that it develops over the life of the plant, and it goes undetected, and it's open. We found no evidence in the offset boring program that the features where we had low recovery were not filled. The original boring logs, done from very early on, indicate infill. We found this not to be a true characterization of the material in those zones. They're more aptly characterized as weather limestone, not infill.

So we postulated then that these towers, ten feet in diameter, either spherical or cylindrical, could occur over the life of the plant first off, in Case A, below the 75 foot thick grouted zone, which is the light gray in Case A, and we postulated that it could occur in the grouted limestone directly beneath our 35 foot thick RCC bridging mat.

We did four cases, many more cases, but it's summarized on these four slides. Case 1 is there's no cavities, so what's the conditions? What's the stress in the bridging mat? Then we postulated multiple caverns, spherical in nature beneath our mat. By the way, the gray outline there is a shape of the Westinghouse AP 1000 base mat. To square it off, and it's usually you've got some circular features, but we squared it off. That's what that -- that is the nuclear island shown in plan view.

So in Case 2 to the upper right is where we had multiple cavities underneath the foundation. Case 3, we said A, maybe it's one long cylindrical cavity along a vertical fracture, ten feet diameter, open, develops over some time in the life of the plant and goes undetected.

Case 4 is put the cavity in the other direction, in the long direction. It's again ten feet diameter and so forth, and that served as the basis of the design of the RCC mat. Let me just diverge for a moment on the next slide. This is our configuration for our foundation.

I keep referring to RCC bridging mat. RCC stands for roller compacted concrete. It's concrete placed with a roller, and compacted with heavy rollers. Some people have called it really cheap concrete. It's not really cheap. I've also heard this morning where somebody called it Royal Crown Cola, but it's not. It's roller compacted concrete.

We knew what thickness we wanted. How do I know what thickness I want it? Ground surface is going to be elevation 51 when we're finished, for reasons other than geotechnical. We chose elevation minus 24 as an elevation within the Avon Park that we think we have a line of demarcation, a reasonably competent Avon Park. There's Avon Park higher than that, and there's certainly 500 feet below that of Avon Park.

At that layer, at that elevation, as shear wave velocity tends to increase, the core recovery tends to increase. So we chose elevation minus 24 as the media, the natural media where we wanted to found the nuclear island. Well, elevation minus 24 to plus 51 is 75 feet.

The Westinghouse plant is designed to be embedded 40 feet. That leaves a 35 foot gap between the rock, the Avon Park, and the base of the Westinghouse AP 1000 foundation. That is the basis for the 35-foot thickness of the RCC mat.

The next parameter, well, if it's 35 feet thick, what's its strength have to be? That was determined from the analysis that I just pointed out, postulating a 10 feet cavity. Either it's spherical or cylindrical, east-west or north-south. That gave me the strength of the RCC that we needed. I had the thickness, I have a design. Now let me explain how we build this, keeping in mind --

DR. HINZE: Can I ask you a question about design before you get into building?

DR. RIZZO: Yes.

DR. HINZE: This mat is designed to bridge over any solution cavities that you haven't filled with grout for some reason or other, have not filled with grout, or that developed during the lifetime of the unit. Is that right?

DR. RIZZO: Yes, with two qualifiers. We analyzed it not only in the grouted limestone, but beneath the grouted limestone, okay, and any is not fair, because it's only ten feet diameter, not any. Ten foot diameter, either spherical or longitudinal.

DR. HINZE: A maximum of ten feet?

DR. RIZZO: Yes sir.

DR. HINZE: If that's the case, why don't -- why isn't there some structural steel in this, to help with the bridging?

DR. RIZZO: We can design it, that RCC mat, as a deep beam and not require any reinforcing steel. We have no chance of stresses for that, those conditions.

DR. HINZE: You calculated the shear stresses that would develop in the mat --

DR. RIZZO: Yes, shear stresses and tensile stresses.

DR. HINZE: Over, if there's any collapse of these unknown cavities, below or within the grouting zone?

DR. RIZZO: That's right.

DR. HINZE: Okay, and those are less than the shear characteristics of the mat?

DR. RIZZO: That's correct. Now let me clarify one more detail. I'm getting into some details now. When you build an RCC foundation mat like this or a dam or whatever, the practice is to build that in 12 inch layers, one on top of the other.

When you do that, you have a lift joint between layers. That's where you really have to design it. That's where your critical design parameter comes, is the lift joint. So we focus our attention on the design of the lift joint, because that's theoretically the weak link. Now we collar that weak link by using a mortar mix, a cement gravel mix, high strength cement gravel mix, that bonds one layer to the other, sort of bedding mixture of mortar layer. Okay, the next --

MEMBER BLEY: Could I follow that up with a question?

DR. RIZZO: Yes sir.

MEMBER BLEY: What is it that gives us

confidence that the three models you hypothesized are bounding for this site, in your ten foot --

DR. RIZZO: Well, the diameter, I think, is the question you're driving at. Why ten feet, which is --

MEMBER BLEY: What gives us confidence that the strength to cover that will cover anything that might be there?

DR. RIZZO: The ten foot is derived from an analysis of the boring logs and the grout takes, both the offset and the filling of the bores. That ten foot diameter is derived from a three foot, which we actually believe is the average number, multiplied by three, to basically give us ten feet diameter.

MEMBER BLEY: Okay, that's the spacing between those?

DR. RIZZO: No. That's the width of the karst feature I'm talking about. I assess it to be three feet, as the average of all the data I have, and I said okay, I'm going to design for ten, looking at a margin on three.

MEMBER BLEY: Okay.

DR. HINZE: Is there any evidence from outcrops at the quarries, etcetera, that would suggest that the heighth of these bedding planes? I understand where you're coming up with the ten feet for the grout, etcetera, but what about the heighth? The heighth is the critical aspect there. How much could it drop down?

DR. RIZZO: Well, actually when you design the bridging mat, it doesn't matter how much it drops down. It matters how wide it is. I mean if it's zero to one inch it's the same as one foot or ten foot. If it drops out, it drops out.

DR. HINZE: Well, okay. Having said that, what is the -- what kind of uncertainty do we have in the heighth of these bedding plane solution cavities?

DR. RIZZO: The heighth. The heighth of the --

DR. HINZE: Vertical dimension, right.

DR. RIZZO: The heighth comes from the low recovery zones in the bores.

DR. HINZE: And what is that number?

DR. RIZZO: The number, it averages about five -- no. Essentially less than five feet, averaging maybe two or three.

MR. STEPHENSON: Where you have them.

DR. RIZZO: Where you have them. The overwhelming majority of all our low recovery zones are less than five feet, and they're averaging closer to two. A lot of them are just one foot.

DR. HINZE: You have no drops in the --

DR. RIZZO: We had tool drops.

DR. HINZE: Tool drops you counted?

DR. RIZZO: We counted tool drops, yes sir, and loss of fluid.

DR. HINZE: How much was the maximum tool drop?

DR. RIZZO: I can't recall, but it's on the order of feet, a couple of feet.

MR. STEPHENSON: It was only in a couple of holes also.

DR. HINZE: Are they in the nuclear islands?

DR. RIZZO: Probably there's some in the nuclear island, I suspect, yes.

DR. HINZE: Okay, thank you.

DR. RIZZO: Okay, now. I want to discuss how we plan to build this foundation. Normally, you wouldn't get involved with this detail, but it's important for this site because of the particular conditions.

The first thing I do when I go out on the site is to create the bottom of the bathtub, so to speak. I grout up 75 feet of Avon Park beneath elevation minus 24. In other words, I drill a series of angled holes derived from my grout take test program, and I grout up 75 foot thick zone underneath that entire nuclear island.

That essentially forms the bottom of the bathtub, and minimizes the movement of, horizontal movement of water and vertical movement of water when I'm pumping into that zone. It also tends to inhibit dissolution activity, because I've minimized the flow of water now, as opposed to the natural limestone, where there's water flowing through the vertical fractures. So I'm intersecting vertical fractures with angled holes, and I'm grouting. Next slide.

DR. HINZE: Excuse me. What's the, is there vertical exaggeration on these diagrams? What's the horizontal scale?

DR. RIZZO: That, oh, I don't know what the horizontal is. No, it's not. That width there is about 150 feet.

DR. HINZE: This total width?

DR. RIZZO: Yes. I mentioned that the nuclear island for Westinghouse is about 250 feet. That's the 150 foot direction.

DR. HINZE: Okay.

CHAIRMAN RAY: Where does that excavation got a reverse slope showing?

DR. RIZZO: No, that's not an excavation. I'm sorry. This is the ground surface here. This is the grouted zone. From here, elevation minus 24, down here. Before I do any excavation, I grout this rock.

CHAIRMAN RAY: Okay. Then why has the grouted portion got that slope on it?

DR. RIZZO: Because I've been drilling my borings at an inclined angle.

CHAIRMAN RAY: I see, okay.

DR. RIZZO: So I intersect the vertical fractures. Okay. Now I have a tight bottom, so to speak. I now install a vertical wall, shown in bright red, around the entire perimeter of the nuclear island excavation. This is a concrete wall, we call it a diaphragm wall. It's reinforced. It's excavated in a vertical slot under slurry, so it stands open.

So when I'm finished now, I have a circular wall around the excavation, not quite circular but it's elliptical, more elliptical than anything, tied into the grouted zone. So now I have an excavation that I can pump dry, with pumps and the internal, internal to the diaphragm.

I install the pumps; I begin pumping down. The groundwater drops inside the bathtub, so to speak.

I'm draining the bathtub. As I go down in the excavation, you see those red angled lines. Those are anchors. It will allow me to make the inside of the excavation vertical, and I tie back the sides of the excavation with those anchors into the rock.

The next slide, now I'm excavating, and I'm installing anchors as I go down. As I'm going down in the excavation, I map the size of the excavation. I'm looking for the offsets that Professor Hinze and Kathryn was talking about before. As I go down on all the sides, I'm mapping the bottom when I get to the bottom, where I have encountered the Avon Park limestone.

Okay. The next slide, I'm down to the bottom. I have a dry hole. I've got to clean off the top of the rock. I'm going to map it, use some dental concrete. I may have to clean off some seeps coming in through the wall. These are called windows in a wall, where they leak sometimes, so you've got to clean those up.

You've got them all cleaned up. I'm ready to place the RCC mat shown in bright red. The RCC mat is 35 feet thick. I'm going to show you a couple of pictures of how this is built in the field. When I get the RCC mat finished, I install my waterproofing membrane, and I can come up with the Westinghouse AP 100 concrete mat, the standard design for AP 1000.

The adjacent structure shown on the next slide, we're going to install those on drilled shafts. Those are non-safety classed structures. We're confident we can support those structures on drilled shafts. We don't need to go in quite that deep.

You see on the right side of that figure the depth in the turbine building. This happens to be number two, where the rock drops off on that one side of the turbine building, and the shafts are much deeper over there.

An opening eventually bears on the Avon Park, either grouted Avon Park, or in this case, the drilled shafts are just drilled into the Avon Park at an adequate depth.

MEMBER RYAN: Quickly, is that determined for each one? I know these are shown in a nice, smooth slope, but they're determined on what basis as you go from the shorter ones to the longer ones?

DR. RIZZO: We are going to pre-drill each one of those at the design location.

MEMBER RYAN: How do you know when you're deep enough? How much of the rock to drill in before you're done?

DR. RIZZO: These are designed as what we call rock sockets. That's what that white box is.

MEMBER RYAN: Right.

DR. RIZZO: We drill from up here, down here, below that, three diameters, you know, to get what we need. Then we look at that core and we look at that log and we decide if that's deep enough.

MEMBER RYAN: Okay. So you're doing that core by core?

DR. RIZZO: Every one. Yes, every one.

MEMBER RYAN: Inspecting the core, okay, great. Thank you, all right.

DR. RIZZO: And that's on the rad waste building, the annex building, the turbine building.

MEMBER RYAN: They look nice and neat in an orderly row there, but --

DR. RIZZO: No, it's not that way at all. It's not that way, yes.

MEMBER BROWN: Yes, a simple-minded question. If I look at Slide 39 and then I look at this slide, I see there's a gap between the nuclear island and the diaphragm wall and then the other one that looks cross-hatched, like it's filled in. You didn't say anything about filling in --

DR. RIZZO: Oh, this gap here, yes.

MEMBER BROWN: Well, it looks like it's not a gap, but back here on 43, it looks like it is. Is that --

DR. RIZZO: There is a gap. There is about a six foot gap, at least a six foot gap all the way around, to allow Westinghouse to form this and build it.

MEMBER BROWN: Yes, okay.

DR. RIZZO: Then we can back in and fill it --

MEMBER BROWN: Okay, you backfill it?

DR. RIZZO: Yes.

MEMBER BROWN: What's it filled with?

DR. RIZZO: It's a flowable filling of low strength cement, low strength concrete.

(Off mic comment.)

MEMBER BLEY: I don't think you told us. As you excavate and start dropping those anchors, what kind of anchors are those? How are those constructed?

DR. RIZZO: Those were drilled from inside the excavation, with a drill rig that sits at an angle, and drills into the rock.

MEMBER BLEY: Again, until you hit deep enough in the rock and then you fill them with concrete?

DR. RIZZO: Yes, and cables.

MEMBER BLEY: And cables?

DR. RIZZO: Yes sir.

MEMBER BLEY: Okay. So the cables are anchored.

DR. RIZZO: Anchored in the rock, yes.

MEMBER BLEY: Okay.

DR. RIZZO: There's a test program, of course, up front, to determine if how long the generic length is, versus the actual length required.

MEMBER BROWN: So you have to map the cables, to make sure you don't chop the cables up when you put in the shaft?

DR. RIZZO: That's exactly right. We have to locate those cables so we don't interfere with them. That's right. That's a key issue.

MEMBER BROWN: Do you have a few spares in case?

DR. RIZZO: No, that's a key. We've got to lay them out so we don't do that. That's right.

DR. HINZE: Is the depth of those sockets going to be controlled by the velocity, the shear velocity?

DR. RIZZO: The depth of the socket is controlled by the load that the shaft has to take, and the perceived strength of Avon Park, verified by the core borings.

DR. HINZE: You're going to do tests on the core borings, not any velocities --

DR. RIZZO: Not a velocity, no, no. By looking at the actual core coming out of the --

DR. HINZE: And so how are you going to do it? Are you going to have real, essentially real time? You're going to leave the rig up there until you've satisfied that --

DR. RIZZO: We're drilling a pilot hole through each shaft before we put the main hole down. We design on the basis of the pilot hole, adjust the design.

DR. HINZE: So you're assuming that the bedrock is -- the unit that you're going into for the stable bedrock is going to be the same over the entire rad waste building and so forth.

DR. RIZZO: No. I could have variable depths on those sockets.

DR. HINZE: Well, that's what I'm worried about.

DR. RIZZO: Yes, they will be variable depths.

DR. HINZE: Okay.

DR. RIZZO: I mean the picture I showed is ideal, but these could be up and gone.

DR. HINZE: Yes.

DR. RIZZO: Sure. They will be, yes sir. That's why we're drilling a pilot hole under each one, through each one.

DR. HINZE: Okay, and the pilot hole then will, if you're ten feet with one of the -- ten feet lower with one of the other holes in the island, then you're still going to go to the same depth that you --

DR. RIZZO: After. I can't have them -- these are, these shafts are as much as six foot diameter. So I can't have one up here and one linked to it over here. It would not function. It would tend to shear. So I've got to get some reasonable degree of uniformity on those shafts. That's why it's important to drill a pilot hole, so I understand actual conditions in that shaft.

DR. HINZE: Okay, and -- okay. All right, thank you.

MEMBER REMPE: What materials are used for the waterproof membrane?

DR. RIZZO: It's a geomembrane material. Yes sir.

MEMBER BROWN: Type of cables, are those

steel cables and how do you anchor them, once you -- you drill the hole, then you run the cables down? How do you, do you have a low explosive in the bottom that splits out?

DR. RIZZO: No. There's various types of anchors on the market, all right. These are medium capacity. They are -- you drill them in. You push the cable down and then you grout it, fill it with grout.

MEMBER BROWN: So you're depending on a cement?

DR. RIZZO: Cement bonding to the cable.

MEMBER BROWN: And to the soil, and to the --

DR. RIZZO: Rock.

MEMBER BROWN: The rock that's underneath.

DR. RIZZO: Yes. There are tests that, a series of tests that are run before you start, of course, to prove that that design length is adequate.

MEMBER BROWN: How long are they supposed to last?

DR. RIZZO: We only need them to last a good three or four years, because we're going to cut as we come back up again.

MR. STEPHENSON: Yes, they're not

structures, not long-term structures?

DR. RIZZO: No, they're temporary anchors.

MEMBER BROWN: When you say "come back up again," what do you mean?

DR. RIZZO: Come back up with the backfill.

MEMBER BROWN: Oh, okay. So those are cut later?

DR. RIZZO: We cut them as we come up back up.

MEMBER BROWN: Okay, the anchor cables?

DR. RIZZO: Yes. Actually, what we do is release the head and then we'll --

MEMBER BROWN: Okay. So they're only temporary structural members, to hold everything in place while you do the rest?

DR. RIZZO: Yes sir.

MEMBER BROWN: Okay, thank you.

DR. RIZZO: There are permanent anchors on the market, but we don't use permanent for this. We use temporary.

CHAIRMAN RAY: These effectively -- the columns are supported laterally, so buckling isn't an issue, right?

DR. RIZZO: That's correct.

CHAIRMAN RAY: Okay.

DR. RIZZO: It's designed for that under seismic conditions. All right. Now let's see, where am I here?

MR. STEPHENSON: 45, raise the sight grade.

DR. RIZZO: The last line, I think, is where we're raising the site grade to elevation 51. Remember we started at 43. We're adding eight feet on top.

The next slide, if I can quickly run through this one, simply shows the plan layout of the vertical shafts that we're using for the non-nuclear island facilities. They're basically on column centers, one under each column and so forth.

The only issue from a design perspective is that there is a zone here where the turbine building is up against the reactor building, and we have to design this situation to accommodate what we call two over one situation, between this and this, so that this does not impact on that during seismic events.

Okay. This is a few slides on what lower compacted concrete is all about. It has never been used for a nuclear plant, but it's used around the world and including the U.S. on very large dams. I'm going to show you examples of a large dam that we completed last year in Missouri.

We designed on the basis of a mixed design program, much more elaborate than conventional concrete quick frankly. We look at compressive strength, tensile strength and shear strength, and we follow building code allowables for that, both the ACI 318 and U.S. Army Corps of Engineers.

A key issue with RCC is that you're placing it very rapidly. So temperature is an issue with your design mix. You've got to be very careful you don't place it too fast, because if you do, you'll cause cracking in the RCC. So you have to do a very careful analysis of your thermal conditions and the properties of your mix from a thermal perspective.

The next slide shows an example of a dam in southeastern Missouri that we completed last year. It's all RCC. There's three million yards of roller compacted concrete in this dam. It's on top of a mountain in Reynolds County, Missouri.

Just by comparison, each one of our RCC bridging mats is about 50,000 cubic yards. This is about three million cubic yards. So there's a great deal of experience with this kind of material. This is one we've built in in Missouri. There's another one in, there's two in California, and there's one in South Carolina. These are large-scale structures.

Now this is an example, a photograph of how you place RCC. You see it's placed with bulldozers and you spread it into one foot thick layers. You see it being compacted in the background with a large roller, like you build earth fill or asphalt paving. You'll see it's being placed with conveyors and that's what we call an elephant front that we drop the RCC down.

You see some testing here in the foreground of the material. It's a large-scale production operation. This picture here represents the size of our mats, our bridging mat at Levy. It's only one, maybe 1/20th of the entire width of that dam in Missouri.

By the way, you'll notice in this case the color is brown. That's only because the aggregate we use for the RCC is a rhyolite, which has a brawny structure to it. It normally would be a gray conventional concrete color. The next slide --

MEMBER BROWN: What's the longest time this stuff has been in service?

DR. RIZZO: Under RCC dams, probably as

old as 45, 50 years now in the U.S. At Levy, we will have a prototype pad, 40 feet by 40 feet by 60 foot by six feet, for a number of reasons. To measure and obtain samples of the RCC as-built. We committed this as a licensing condition to do this. We will have RCC testing, large-scale testing program for QAQC during construction of the actual bridging mat, and that's the subject of the ITAAC that we've committed to.

On the next slide is an example of what a test pad looks like. This happens to be the one for the same dam. When it went out on this figure is that this pad is maybe 60 feet long and about 40 feet wide. What you see here are these layers, are the individual RCC layers. They're separated in this case by a three quarter inch to one inch thick bedding mix, to assure the bond of one 12 inch layer out of the lower 12 inch layer as you go out.

The white is conventional concrete facing for a dam. Our concern here was on the upstream site for leach control, and on the downstream side for durability. This is exposed on the top of a mountain, so we were concerned with the durability in the long term. So we used a high strength conventional concrete on the face.

MEMBER RYAN: By durability, you mean just weather protection?

DR. RIZZO: Yes, weather protection, that's right. The RCC here is, you can see it reasonably well placed in 30 centimeter 12 inch lifts, here where it's simply tying one end to the other so we get a good bond between the conventional and concrete in the RCC. We'll have one of these in LNP, but it won't be brown. It will all be all conventional concrete color, limestone color. Thank you.

CHAIRMAN RAY: Okay. You've got one action item identified already, or one feedback item, I believe.

MR. STEPHENSON: Right, that's correct.

CHAIRMAN RAY: Bill, did you want to say anything more about the bedrock topography, and do we want to have any further discussion of why that isn't something that could be explored further?

DR. HINZE: Well, I'd like to see a bedrock topography map. I think that in the analysis, that it would be helpful to have that. I understand why you didn't do it, because you had a hard time contouring it.

DR. RIZZO: Yes.

DR. HINZE: But maybe some dashed lines

would help too. I really think we should see that.

CHAIRMAN RAY: Well, you can respond to that further later too, if you'd like to think about it and tell us what problems you would anticipate if such a map were to be called for. Okay. Then with that, I believe we'll turn to the staff, unless you have something more you want to say.

MR. STEPHENSON: And we do. We have one more section in this presentation.

CHAIRMAN RAY: Oh sorry.

MR. STEPHENSON: Yes, the seismic response development for the Levy site, with Dr. A.K. Singh. I know we're running a little bit behind.

CHAIRMAN RAY: Well, that's time well spent, I think, here and not to worry about that. I'll tell you when it's going too slow.

MR. STEPHENSON: Okay, all right. Thank you.

DR. SINGH: Okay, thanks Vann. My name is A.K. Singh, and I'm project director for Sargent & Lundy, also the JV project manager on this project for Progress Energy.

CHAIRMAN RAY: Could you speak as loudly as you can, Dr. Singh please, because we have to make a record.

DR. SINGH: My name is A.K. Singh. I'm the project director at Sargent & Lundy, and the JV project manager for this project on the Levy project. For that, we performed site-specific laboratory ground motion evaluations for the Levy site, and what I would present is the methods we used and the conclusions we have reached. This is documented in FSAR Section 2.5.2.

For the laboratory ground motion evaluations, we followed guidance provided in Reg Guide 1.208. As part of that evaluation, we started with the EPRI seismic owners group or EPRI SOG earthquake catalogue, which was dated 1985. We updated that through December of 2006. That's when we had started, initiated the COLA work.

In addition, the EPRI SOG seismic source model in the vicinity of Charleston was updated as part of the Vogtle ESP, and we used the Vogtle updated Charleston source model for our analysis.

DR. HINZE: Did you consider using the USGS 2008 seismic hazard analysis and their updating of the Charleston, which includes the Helena Banks, which were previously done?

DR. SINGH: Yes. For the analysis, we did not -- we did use the 2002 USGS Charleston information available, because we started our work in early 2007, and the 2008 work was not published.

However, Bob Youngs, who has done the detailed analyses, has looked at the 2008 update, and he has evaluated to -- it would not change our results. But that is not documented, because that came after we had submitted our COLA.

DR. HINZE: I think it would be very helpful if Bob's work were documented in the report, because as we've looked at it in the Summer plant, the use of 2008 was important to bring in.

MR. STEPHENSON: Okay. Yes, we'll take an action on it.

DR. SINGH: We'll take an action item. But as said, Bob Youngs has looked at it, and his conclusion is that it would not affect our analysis, and especially Charleston is about 300 miles from our site.

DR. HINZE: And he did take into account the Helena Banks faulting?

DR. SINGH: Yes, he did, and Bob is on the phone. Bob, would you want to quick update?

MR. YOUNGS: Yes. This is Bob Youngs. Am I coming through clearly?

CHAIRMAN RAY: Yes, you are.

MR. YOUNGS: Yes. We did look at the, recently at the 2008 report. I should mention that the Vogtle seismic, updated Charleston seismic source model that was used for the Levy site calculation, does include an alternative as it extends out into the Helen Bank area, as a possible source geometry for the Charleston source.

Whether or not it extends out into that area doesn't affect the distance to the Levy site in any appreciable way. So we used the updated Charleston seismic source from the local model, and that source actually extends closer to the Levy site in the USGS 2008 model.

DR. SINGH: In addition to the Charleston seismic source, we also included the two 2006 earthquakes which occurred in the Gulf of Mexico. They were added to the catalogue, and the maximum magnitude distribution for background source zones, then, were updated to account for these Gulf of Mexico earthquakes.

The probabilistic seismic hazard analysis for Levy site was performed using the EPRI SOG seismic sources, together with the ground motion models from EPRI 2004, as well as ground motion variability models from EPRI 2006. The probabilistic seismic hazard calculations were performed for a response spectra exploration at seven structural frequency, consistent with the EPRI 2004 model.

Based on the surface uniform hazards spectra was calculated from the probabilistic seismic hazard analysis. We used the cumulative absolute velocity to filtering or cath filtering in place of the fixed minimum magnitude, as permitted by Reg Guide 1.208. These uniform hazard spectra was used to generate the ground motion response spectra at the site.

DR. HINZE: You included the February '06 earthquake to be conservative?

DR. SINGH: Yes.

DR. HINZE: There's quite a bit of evidence that that really was not a earthquake, a tectonic earthquake.

DR. SINGH: Yes, correct. Yes.

DR. HINZE: So you erred on the side of conservatism; is that right?

DR. SINGH: Yes, correct. When we did it, there were still doubts. So we have included it. Bob, next slide. What you see here is the updated catalogue, some key features. What you see on the slide is the circles with the yellow infills are the original EPRI SOG data, which is through 1985. The circles which are with the pink infill are added historical record since '85.

So these are old records, but they were identified between 1985 and December 2006, and then the green infills are the post-EPRI SOG actual earthquakes, which are recorded. As you could see, we have the two earthquakes at magnitude 6, the biggest green circle in Gulf of Mexico, and the 4.9, which are located, those three circles in the Louisiana area.

Of significance on this chart is that only 15 earthquakes. What you see here is we have the 200 mile and the 50 mile radius. Within the 200 mile radius, there have been only 15 earthquakes which have been reported, which have a magnitude of 3 or higher. So this is, the site is located in a very low seismic area.

Next slide. Relative to conclusions of what we found through our ground motion evaluation is we did not identify any new seismic sources based on the updates we did, which basically said EPRI SOG seismic source characteristic is still good. We did not find that the seismic source geometry needs revision, based on these updated records.

We confirmed that the earthquakes in the site regions are random and not associated with any capable tectonic sources that we could identify, and at the site, what we found is the Charleston source produces comparable hazard or somewhat larger hazards than obtained from the updated EPRI SOG local source for 10 hertz, and dominates the hazard at one hertz.

So as you go to the high frequency, the background seismicity plays a role. But by and large, our site ground motions are controlled by the Charleston earthquake source zone, which is about 300 miles from our site.

Relative to -- next slide. Relative to the ultimate product of our seismic evaluation is the ground motion response spectra, and you've seen similar, the same curve, which Vann has shown. What we have is the horizontal G level is about .08, which as Vann said, we have scaled it up to .1 for all of our evaluations.

But both the vertical and the horizontal GMRS for our site is enveloped by a large margin by the AP 1000 CSDRS, which is accurate to .32. That's all I had for the 2.5.2, unless there's any questions.

CHAIRMAN RAY: Well, that's fine. I think the 2000, there was one item we wanted to -- I just want to get it on the record, so that we're not just saying well, we did something, but it's not documented. We can do it at the full committee meeting, if it's just a matter of reflecting the use of the 2008 USGS.

DR. SINGH: As Bob Youngs said and I had said too, he has done an evaluation. However, that evaluation is post-submittal of the FSAR. So it's not included.

CHAIRMAN RAY: Yes. We haven't heard from the staff yet. Maybe that will address it. But for now anyway, we can deal with that if it's simply a matter of having it be reflected in the record. We can do that at the full Committee meeting. Okay. Anything more you want?

MR. STEPHENSON: I think that's pretty much it. Unless there are any questions, we'll turn it over to the staff and let them present their --

CHAIRMAN RAY: Yes, okay. Let's do that then. We'll send the staff up. Being a greenfield site, we can expect this part of the discussion to go more slowly than other parts. Other parts, I'm depending on going more rapidly than the schedule shows. So let's swap out and get the staff up here then.

MR. STEPHENSON: Okay.

(Off mic comments.)

CHAIRMAN RAY: Okay, let me just -- Brian, you're going to introduce this?

MR. ANDERSON: Yes sir, I am.

CHAIRMAN RAY: Okay. We are late compared to the schedule. As I say, I'm not concerned about that right now. This is important stuff we're going over. But we may break before you're done for lunch, depending on how it goes. We'll just see, all right.

MR. ANDERSON: Good morning. This is the NRC staff's presentation of the geology, seismology and geotechnical review areas, covering many of the same topics that Progress Energy just presented.

My name is Brian Anderson. I'm the project manager for this portion of the staff's safety review. Presenters on the NRC staff today are Dr. Gerry Stirewalt, Dr. Vladimir Graizier, and Zuhan Xi. I also want to acknowledge other very key members of the NRC technical staff that participated in this review.

Meralis Plaza-Toledo, Dr. Stephanie Devlin, Wayne Bieganousky and Ricardo Rodriguez were all important members of the NRC staff review team here.

I'll also point out that Wayne Bieganousky retired from the agency at the end of the fiscal year, so he's enjoying, I guess, his third week in retirement, but we were happy to have his experience and expertise. He was a senior geotechnical engineer for the NRC staff. With those introductions, I'll turn it over to Dr. Stirewalt.

DR. STIREWALT: Thank you, Brian. I am Gerry Stirewalt, NRO senior geologist. Let's roll up our sleeves and wade right into the geology, since there were some good questions that Dr. Hinze posed, certainly relative to well, pure geology, I must say.

The primary topic of interest for FSAR Section 2.5 is development of karst and associated dissolution. In fact, that's also a key topic for 2.5.3, because well, dissolution and dissolution collapse could in fact induce non-tectonic surface deformation. So certainly then it is appropriate to focus on the development of karst, which was in fact identified by the applicant as the primary potential geologic hazard in the site area.

Now what about tectonics? We talked about that a bit this morning. Well again, Dr. Hinze's questions were really good ones. I noticed that by the way, Kathryn did not, Bill, provide the information on the max displacement that Vernon determined. I don't know if it's appropriate for her to weigh in and give Bill that number, Dr. Hinze that number or not. But she can, I guess, if need be.

But let's just talk about the fact that the preponderance of published data, we did well document that the Florida platform has been quiet tectonically since start of cretaceous. That's about 145 million years ago. Okay. Well, that's an important fact. So the concept, then, is that a capable tectonic structure and surface faulting are mostly likely of negligible concern at the Levy site.

Let me remind you what I mean by "capable tectonic structure." What I mean is the tectonic structure that's quaternary in age, that is to say, 2.6 million years of age to the present.

If I could have the next slide. Well, since this is the Florida peninsula, outcrops were sparse, good ones. So in this case, careful examination of core was really important for assessment of the karst and the associated dissolution features. I'm going to have break precedent and not show you a hand sample, because I don't have one right now.

So I'm going to wave slides of core at all. Hopefully that --

DR. HINZE: Don't let him get by with that, Brian.

DR. STIREWALT: That's my style a little, but I think I can perhaps manage. The next slide, let's again. Certainly these kinds of features are common in the region that includes the Levy site. The applicant qualified that pretty darn well.

One thing that you think of maybe initially is this concept of the intersection of fractures and bedding planes as being something that would in fact, because of induced groundwater flow, enhance development of karst. But that really isn't the only feature that we have to be concerned about. So I'm going to, I'll talk more about fractures and bedding planes a little bit later. But I want to also address the other geologic factors that can be brought to bear on why we believe that, you know, we don't have the large cavities in the subsurface at the site.

We're talking again about the Avon Park. That is the foundation unit. Age is Middle Eocene, about 48.6 to 40.4 million years old. Well okay. How did we go about doing this? Well, in September, I think we did multiple site visits and I know multiple rounds of some pretty stiff RAIs that we tossed at the applicant.

In September 2009, we directly examined the core from that slanted grout test program that Dr. Rizzo spoke about. Certainly, that helped us confirm a paucity of subsurface dissolution voids and extensive fractures in the Avon Park at the site, based on two factors: grout uptake results and visual examination of core.

DR. HINZE: By the way, what was the --

DR. STIREWALT: You have a question.

DR. HINZE: What was the direction of that slant hole? What was the azimuth of it?

DR. STIREWALT: I will, for exact azimuth, I'll refer that to those who drilled the hole.

DR. HINZE: From the fracture standpoint.

DR. STIREWALT: Well, the point is, I mean certainly they need to be -- I mean everybody understands the geometry of the vertical fracture. If you have a vertical hole, you're going to miss it. The slant hole certainly is going to intersect more, and that's the logic.

(Off mic comment.)

DR. RIZZO: Let me just comment, Gerry, a minute. We've oriented that slanted boring normal to one of the fracture patterns.

DR. HINZE: In other words, it was

northeasterly directed?

DR. RIZZO: It looked exactly on the figure, but it was --

CHAIRMAN RAY: You know, we can't pick you up unless you use the microphone.

DR. RIZZO: You have to look exactly on the figure of the precise azimuth. I know how we laid it out. So we intersected the fractures.

DR. STIREWALT: Yes. Well, the point is that what you're saying is that you laid it out to intersect the primary fracture directions that you knew existed?

DR. RIZZO: Yes, that's right.

DR. HINZE: That's the key, and that's northwest.

DR. STIREWALT: I'm sorry?

DR. HINZE: Isn't that northwest?

DR. STIREWALT: There's a orthogonal shear. There's a northwest and a northeast.

DR. HINZE: There always -- right. There always is.

DR. STIREWALT: Okay. And oh by the way, Vlad will discuss, when he starts his discussion regarding potential grouting effects on the shear wave velocity. That's another important issue. Okay. I promised you some core pictures. Well, this one illustrates a real live grouted fracture in the Avon Park.

You can see that this fracture was not very extensive, and I think if you look sort of in the edge of this, you might see another fracture, in fact, that was tight enough to not take any grout at all. So this is one example of a vertical fracture in the Avon Park.

If you look at the next slide, in this one pretty much we see no fractures and obviously we see some small dissolution involvement. So no fractures. So there's some variability. This means we have both dissolution features and fractures that are illustrated in the core, and what we also saw in the field in these sparse outcrops that we were able to examine.

If we could take a look at the next slide then, let's sort of start to think about really what geologic characteristics do we really need to consider, when we're assessing Cox dissolution. Let's think about several of these, because there are several from the geologic point of view.

Let's talk first again, something that the applicant spoke about a great deal, but let's talk about these soft weathered zones and the low core recovery areas. Okay. In February 2010, we examined the boring logs, the core photos, the written log descriptions for those six offset borings that Dr. Rizzo described.

They were again drilled adjacent to the locations of the original site characterization holes, and they were bored using some very much improved techniques, and again, as Dr. Rizzo spoke, recovery went from 40 percent to 95 plus.

We also examined the core from the original site characterization boreholes in an April 2009 site audit, so we had some means of comparing the two. Okay. Based on the borehole data then, we really documented that the low recovery zones in those original site characterization boreholes were in fact soft weathered zones in the normal stratigraphic sequence of the Avon Park, not dissolutions.

How did we do that? You looked at something in a piece of core and you think oh, so we could consolidate it. Is this part of the stratigraphy, or is it in fact infilling? Well, you had primary layering, not chaotic pieces of rock. So in fact, it was bedded, layered Avon Park and not infill. That's the sort of a little geologic trick you might use to do that.

Using that same series of boreholes, we also documented that the low recovery zones were not continuous between the boreholes -- again, I just fell off the disk, based on the borehole data.

Let's take a look at this slide, that actually shows one of those soft zones. Again, this is what they look like. Let me point out one thing in this slide, however. There's a disking in this slide that's sort of perpendicular to the trend of the borehole.

Well, that disking -- I just spoke about bedding -- that disking actually happened, even though it was exacerbated by the spinning core nodge, it still parts where the bedding is. So these are bedded units, and that's what the disking illustrates in this case.

Okay, so that's the concept of the low recovery zones, the evidence that they are a part of the stratigraphy, not simply washouts because of the drilling techniques that were used initially.

What about the thickness of quaternary sediments? What might this tell us about potential dissolution at depth? Well, the thickness of those quaternary sediments, and again, I'm reaching the age of that already, that overlie the Avon Park, varied from less than three meters in the site area to 24 or so meters near LNP Units 1 and 2.

Well, okay. The thickness of those sediments could be related to deposition in collapsed dissolution cavities. They could be. That's a possibility, and Dr. Hinze was picking on that earlier, and rightly so. Well okay. Geared to the paucity of dissolution voids that were really not noted in the site borings, and an important part, the documented erosional and depositional history of the site region.

The increased thickness of those deposits that was observed in the borings is most likely due to deposition in sediments and paleochannels, and Dr. Rizzo alluded to that earlier also.

DR. HINZE: But wouldn't those paleochannels be largely controlled by dissolutioning of the bedrock beneath them?

DR. STIREWALT: Okay. I'm glad to have that question, Bill, because I'd like to address that thought. The fact that you have a stream channel does not mean you have to have major dissolution at depth. In fact, if you had large dissolution cavities at depth interconnected to that stream, most likely become a disappearing river. So certainly you can get surficial dissolution that's going to control entrenchment and widening of the stream, but it really does not require at depth large dissolution cavities to produce a surficial stream flowing across limestone terrain.

DR. HINZE: Do you think surficial dissolutioning gives you any clue to deeper dissolutioning?

DR. STIREWALT: Well, it may, but in the situation where you picked up on the concept of the paleokarst, and again, that was addressed, those particular --

DR. HINZE: I think that's a different issue.

DR. STIREWALT: Well, actually it's not a different issue. It's a related issue, because, and your question was, are those features really paleokarst, or do they reflect something deeper? Do they reflect subsurface dissolution and collapse?

Well, in fact they don't. We actually looked at those, had the same questions you had. Those things are really surficial features, very convincingly so. It's mostly from surficial processes and in fact, as you get that surficial dissolution, you get a clay lining in that dissolution area actually seals it. So that's why they end up being older and not associated with the deep dissolution.

As I recall, the applicant actually drilled one or two of those, and did not find collapsed fractures at depth beneath them. So that's a pretty important factor.

DR. HINZE: It's just that most of our fracturing here is vertical, right?

DR. STIREWALT: That's correct.

DR. HINZE: And I would assume that where the movement of water is the most rapid and carries the right chemistry, that's where you're going to get the dissolutioning. That will happen at the surface first of all, and then it will reach the greater depths, and it's going to be greater depths beneath it and therefore it just seems reasonable to me that paleochannels, I mean the gravity is on the water side. The gravity is going to drive it to the lower areas, and that's where you're going to get the paleochannels that may be erosion.

But the erosion is a reflection of the strength of the rock as a result of weathering, the greater weathering, and the dissolutioning in these more highly fractured zones. Do you understand where

I'm going to?

DR. STIREWALT: Yes, I do, and I'm going to agree with what you're saying, in the sense that you can certainly enlarge those fractures, just as you said, by surficial dissolution, and that becomes your stream channel. That's certainly true. That's certainly true.

DR. HINZE: That's why I think paleochannels, and that's why I think the bedrock relief is important to this, because it may reflect then where do have more highly fractured zones, and more dissolution.

DR. STIREWALT: And in fact, those numbers are actually in the FSAR. I know that they had commented that they don't think they're good, because of the difficulty in picking that boundary. But there are numbers where a map could be produced. The numbers are already in there, as I think you know. Okay.

Yes, yes. Those depositional and erosional episodes really are related to sea level fluctuations, as we've spoken about earlier, and not to Cenozoic, that is to say, relatively recent, from 65 million years or so to the present. So it wasn't uplift or down-dropping due to tectonism. It really was in fact the sea level varying, and not the land surface moving up and down.

Well okay, what about dissolution rates? I mean that's a pretty important factor here too. The upper 150 meters or so of the Avon Park, again as was qualified earlier, does consist primarily of dolomitized limestone, and there's a lot of evidence in the published record, stuff that's been done, even laboratory testing, that indicates that dolomites, because of the calcium magnesium carbonate, simply are less susceptible to dissolution in pure limestone.

The estimate of dissolution rates, and again Dr. Hinze alluded to earlier, for these less dolomitized Ocala at the Crystal River plant, Unit CR-3 specifically, gave a rate of 1 times 10 to the minus 4 percent per year for that site, and a calculated rate over the 60 year life of the plant, 6 times 10 to the minus 3 percent.

Now as Dr. Rizzo admitted, there's certainly some uncertainty in that, but still, the point is that the dissolution rates in the Avon Park are going to be less than those values, because it's dolomitized. So the potential for dissolution of the Avon Park at the site itself is most likely negligible during the life of the plant. Bill, you look like you've got a question.

DR. HINZE: I'm wondering whether you followed up and did a check on this 10 to the minus 4th number. Do you have any feeling regarding the confidence that one should place in that number, and the Crystal River site?

DR. STIREWALT: I do not know what the uncertainty on those values are.

DR. HINZE: It seems to me that that came out of a master's thesis, if I recall correctly, and I'm just wondering how much quality control there was, and we're bantering that number around as if it's gotten gospel. If I recall, that came from a master's thesis and somebody ought to do a little QC on that.

DR. STIREWALT: Yes. Well, I defer to the applicant, if they can address whether or not there's any -- I mean I think Dr. Rizzo indicated he didn't have a definitive number on the uncertainty for that value.

DR. RIZZO: That's right.

DR. STIREWALT: It's a good thing to pursue.

CHAIRMAN RAY: Applicant indicated agreement with that statement.

DR. STIREWALT: Okay. Let's take one more factor. What about springs, and what do the springs tell us about the lateral extent of voids? Well, point of fact, there's an absence of springs in the Avon Park in the site vicinity, indicating that there's no major subsurface conduits that exist for rapid groundwater flow.

Again, the borehole data that we've talked about show evidence, no evidence of interconnected subsurface voids or extensive and large fractures in the subsurface at the site location, that plus sign morphology notwithstanding.

Now let me talk a little bit more about what the numbers were for the measured voids. The maximum lateral extended voids, again addressed by Dr. Rizzo in the Avon Park, was calculated, we believe conservatively, to be about three meters, based on two things.

They looked at what the grout volumes were, and they increased for vertical fractures, that grout volume by 50 percent, and the horizontal uptake they increased by 100 percent. The actual maximum lateral extent of the voids that were calculated from the grout uptake was 1.6 meters.

So there's quite a factor that's placed into that, seemingly being a conservative value. By the way Zuhan, when he speaks, will address a bit more how that void size was used in the calculations. Let's look at one more piece of core. We keep talking about the fact these dissolution vugs aren't large. This particular core box shows some intriguing variation.

In the central part, there's clearly a very well indurated piece of the Avon Park that has relatively small dissolution vug in it. No fractures in that. In that same core box, there's that softer, more friable zone, obviously collected in the same core run, and that little fine spacer is actually a zone in no core recovery.

Remember we've talked about because of the initial relatively lack of controlled drilling techniques, you got washouts of the zones that were not refriable, that were loose. Clearly, they do exist in the Avon Park.

Okay. Let's talk about one more thing. Everybody's spoken about this concept of the fracture embedding intersections that really sort of, what the applicant referred to as their plus sign morphology. You have to sort of think about how do you get a plus sign if you're developing a horizontal plane, not a vertical. But I won't go into that.

But the concept is that that intersection line, those intersection lines are zones of increased ground water flow. So provides great potential for increased enhanced dissolution. Well, we know that we've got fractures in the Avon Park. We know we've got bedding the Avon Park.

However, the borehole data didn't show any evidence of that extensive dissolution of large fractures or bedding plains in the subsurface at the site location. We did also direct examination of a few sparse outcrops, a couple of different site visits, April 2009, September 2010, and documented that primary orthogonal set, north 39 west, north 51 east, and that outcrop scale fracture said the fractures were spaced six to eight meters apart. They certainly parallel regional fracture trends.

It's certainly true that in some of the borehole information, you got a finer scale fracturing as well. That was what in part contributed to those more friable zones. It was really a combination based on what the logs report, of more friable and more fractured material, okay.

So the fractures do occur more locally on a finer spacing than that, and again, those do parallel regional fracture trends and, as Dr. Hinze is alluding to, the regional fracture systems certainly control stream drainage and alignment of sink holes.

Well, let's think of one more catch we've got, one more hook we've got. You know, I talk about five or so geologic criteria for assessing dissolution cavities at depth. Well, we've got one more final check that we will apply at the Levy site, for working to detect potentially detrimental features in the excavation.

Let me address specifically the geologic mapping license condition 2.5.3-1. What that numbering system means that it's located in Section 2.5.3 on surface faulting.

Let me, and I know you can read, but let me go over this, to make sure you understand all that's built into this. This says that the licensee will perform detailed mapping of the excavations for the nuclear island structures, number one. The applicant will examine and evaluate geologic features other than those for the nuclear islands where needed, and they will notify the NRC once those excavations are open for NRC examination.

Now that license condition hopefully clearly relates to both tectonic and non-tectonic deformation features. There's good evidence that there is no quaternary faulting at the site, but everyone recognizes after today's presentations that certainly the concept of collapse and subsidence due to dissolution and karst development is a potential issue at the site.

So the license condition then is important, because the potential for detrimental features at this site, and in fact every other site, in every geologic setting, is really important when you consider both tectonic and non-tectonic features.

This license condition really will be used as a means of confirming that no detrimental features occur in the safety-related excavations. I have no other slides to show and no rock samples to show, alas. Are there other questions?

MEMBER BLEY: Yes. Are you going to be around when they get to Chapter 3 and the PRA --

DR. STIREWALT: Yes.

MEMBER BLEY: Okay. I'll hold my questions until then, two related questions.

DR. STIREWALT: Dr. Hinze, anything else from you?

DR. HINZE: No thank you. Excellent presentation.

DR. STIREWALT: Okay. Well then if that's it from me, I'm going to pass it to Vlad, who's going to talk about 2.5.2. Thank you very much.

DR. GRAIZIER: Okay. We switch to seismic part of our presentation. This slide basically shows you the location of site relative to seismic zones, and relative to seismicity. Basically, what it says, that the main source or the closest to source is Charleston. It's about 500 kilometers away from the site.

Next closest is East Tennessee seismic source zone, which is about 650 kilometers away. Another one, which is farther away, it's New Madrid Seismic Zone. It's about 900 kilometers away. Basically, this give you the picture of seismicity of the area and seismicity around the area.

As it was mentioned before in previous presentation, EPRI SOG catalogue, historical catalogue was done from 1627 until 1984. It was complete, and the applicant updated this catalogue through 2006.

These abbreviations at the bottom shows the sources of this update. It's National Seismic System catalogue, United States Geological Survey catalogue, Virginia Tech Seismic Center catalogue, International Seismic Center catalogue.

Okay, next slide. Thank you. The issue

that we had at some point is that the effect of New Madrid seismic source zone was not considered. Basically, the assumption was that it's too far away from Levy site, and it's not important. We asked RAI on this issue, and we got response from the applicant, basically showing that the effect of New Madrid seismic source zone is minor.

Specifically, this curve shows almost worst case scenario, because it's low frequency ground motion, and as you can see, for example for exceedance frequency of 10 minus 4, the effect of New Madrid seismic zone is less than one percent from the effect of Charleston seismic source zone. Basically, this closed this issue, again showing that Charleston is the main source, and to the effect of New Madrid is minor.

CHAIRMAN RAY: The effect of New Madrid --

DR. GRAIZIER: Is minor.

CHAIRMAN RAY: Is minor.

DR. GRAIZIER: Minor, I'm sorry.

CHAIRMAN RAY: Okay.

DR. GRAIZIER: It's about less than one percent on seismic curve. Now let's step a little bit closer to the site, and as it was mentioned before, within 200 miles area or site region, there was only

15 earthquakes which was magnitude MB higher than three. None of this event exceeded magnitude 4.3.

This is very important, again showing that it's a low seismicity area. You can also see a couple of events. One of them is shown as magnitude 6.1, and it's an event of September of 2006. Another was mentioned before, but it's farther away. Sometimes it's called Green Canyon event, which is supposedly according to current knowledge, is landslide type event. Okay. That shows the local seismicity.

Next slide. Okay. Gulf Coast source zone. Actually, as I mentioned before --

MEMBER BLEY: Can I ask a question?

DR. GRAIZIER: Yes, sure.

MEMBER BLEY: Could you back up a slide?

DR. GRAIZIER: Sure.

MEMBER BLEY: This earthquake you pointed out in 2006.

DR. GRAIZIER: Correct, two of them. One is September 2006, with magnitude shown of 6.1.

MEMBER BLEY: Right, and the closest one is roughly the same distance away from the site as the Charleston?

DR. GRAIZIER: Right.

MEMBER BLEY: I don't know what the

features are down here in the Gulf that are causing that, if that one's not -- those aren't figured in this basis. Is that a significant issue?

DR. GRAIZIER: That's actually explained on the next slide.

MEMBER BLEY: Even better.

DR. GRAIZIER: There are similarities, yes. Okay. As I mentioned, the catalogue was updated with those events, and the applicant updated -- sorry. It's actually came from South Texas study. South Texas study, the applicant updated this seismicity and recurrence rate for this area.

We kind of saw some kind of issue, if I might say. The issue was that at South Texas, it used SSHAC II level process. In this process, there was some kind of disagreement about maximum magnitude for this area. TI team suggested one set of magnitudes, magnitude distribution, and review panel rejected this.

Kind of from our point of view, we were still concerned about this. We asked the applicant to consider basically the worst case scenario, reported before by TI team. The applicant showed that yes, it produced some results. It produced some difference, but this difference is less than eight percent in seismic cause of assessment. Now usually --

MEMBER BLEY: That must be at some particular frequency.

DR. GRAIZIER: Okay. I have the table, which I was not planning to show. But anyway, I can tell you it's exactly -- at 100 hertz it's seven percent. At 25 hertz it's close to seven percent.

MEMBER BLEY: So it's pretty constant across the range we care about?

DR. GRAIZIER: At high frequencies. Now at low frequency of .5, it's only two percent.

MEMBER BLEY: Oh, so it drops off?

DR. GRAIZIER: Basically drops, yes. Actually, it's highest at high frequencies and drop down. Anyway, the applicant did this sensitivity study and showed that we can kind of live with what was done before.

MEMBER BLEY: Okay. I haven't seen the details, but you were convinced that that's pretty reasonable?

DR. GRAIZIER: Correct, yes, because whatever is less than 15 percent change, we consider not important. Next slide, please. T his slide is kind of show deaggregation results, deaggregation of seismic hazard for two frequencies of exceedance, 10 minus 4 and 10 minus 5.

What basically this slide shows, that there are two deaggregation earthquakes. One is local source, with magnitude 5.5, at about 20 kilometers from the site, and the second, and actually the main, is Charleston type event, at the distance of 460 kilometers away.

Next slide, please. Okay. With that, the applicant calculated uniform hazard response spectra. Just to remind you, Uniform hazard response spectra of course points to bedrock. Bedrock in our definition is 92 or 93 hundred feet per second or 2.8 kilometers a second.

As you can see, it's pretty low level of ground motion at generic rock conditions.

MEMBER BLEY: I'm sorry. I don't think I understand that.

DR. GRAIZIER: Okay.

MEMBER BLEY: Each of the colored codes as stated on here, mean 10 to the minus 3, mean -- I don't know quite what I'm looking at in those four curves.

DR. GRAIZIER: Okay. These are spectral acceleration, calculated using 10 minus 3, 10 minus 4, 10 minus 5 and 10 minus 6 frequency of exceedance.

MEMBER BLEY: Ahh, okay. Okay. Thank you.

DR. GRAIZIER: Basically, the more time you have, the higher you can expect ground motion.

MEMBER BLEY: I get it.

DR. GRAIZIER: Okay. Next slide shows -- okay. A little bit of introduction. So far, we go to the response spectra at generic rock conditions. Now we have to propagate this from generic rock conditions to the surface of, or to the level of ground motion response there.

As Gerry mentioned before, we had a concern, and this concern was that okay, grouting program. It's very interesting, it's very exciting from a geotechnical point of view. But our concern was how it influenced shear wave velocity, because shear wave velocity measurements were performed before grouting.

We would like to make sure that grouting will not change our site response, basically will not change shear wave velocity profile. In response to our RAI, the applicant performed studies after grouting, studies, suspension logging measurements after grouting was performed.

And this is not the best figure, because okay. What you see, you see four curves, and two of them in response to S waves, and two of them in response to P waves. Unfortunately for S waves, they are same color. But basically, what this slide shows, that there are practically no differences between suspension logging measurements before grouting and after grouting.

This is very important issue. This gave us confidence that site response analysis performed based on before grouting measurements is reliable.

DR. HINZE: How do you explain the equality here? Why would you expect that, from developing that issue, that there might be a change, and yet there wasn't a change? So I'm asking, do you have any physical concept of why there is no change?

DR. GRAIZIER: I would not say there is no change. There are changes, but they are not important.

DR. HINZE: You know, are we looking here at the amount of grouting? Are we looking at the way the grouting is connected to the rock itself? I mean if you raise an issue, I'd like to understand why it isn't an issue. It's not an issue because you're measured it, but what is the reason for it?

DR. GRAIZIER: Part of the reason, I

believe, is that actually voids were not large enough.

DR. HINZE: There wasn't sufficient grouting, and they were really disconnected. The grouting wasn't connected in any way.

DR. GRAIZIER: The grouting. Okay, that relates to the questions that you asked Dr. Rizzo, and basically what are the size of the voids? It was shown that basically the size of the voids should be less than five feet, according to their estimates.

Clearly, in those cases, I would expect that voids were much lower, maybe one foot only. yes, and another point of interest is that basically the grouting project was targeting just filling the voids. They were not claiming to strengthen the whole area. In a way, grouting was of the similar density, whatever, is the question to ask, to the rock surrounding these voids.

But basically, I believe in short the answer is that most likely, those voids were not large enough.

DR. STIREWALT: Can I embellish on that just a bit? Dr. Hinze, you're exactly right. That's a good question. I think there are two factors that tells us they really weren't large voids. It really does shout that at us very loudly. It also suggests that whatever parameters they used to build that grout were pretty close to what the rock was.

So I think it reflects both of those aspects, but it certainly reflects the fact that they don't have large cavities full of grout.

DR. HINZE: Did you get this evidence from other holes as well?

DR. GRAIZIER: No.

DR. HINZE: Because a single hole that the log was run on?

DR. GRAIZIER: Right. Okay. After report, as I mentioned that we got confidence in shear wave velocity measurements, we go to site response analysis. Basically, our goal is to propagate from generic rock to the surface.

In this case, GMRS was defined at the elevation of 36 feet. It's in so-called hypothetical outcrop, because it corresponds to the top level of weathered limestone.

Now how site response was performed. We had information from a lot of borehole, boreholes, surface boreholes, at the depths of 450 feet, approximately, and this information was combined with a deep boreholes measurements. Basically, site response was done using 29 layers with different properties, and it's approximately 4,300 feet thickness from the bedrock.

There are two profiles on the right side of this slide. One is average profile for site 1, LNP 1, and another one is for LNP 2. The applicant took very conservative approach. They calculated site amplification function using both profiles and they enveloped them.

Next slide, please, and this is shown with open circles. Open circles show site amplification, final site amplification function produced by the applicant, and as I mentioned before, it is an envelope of the worst case scenario of these two site response measurements.

Now we did confirmatory analysis, and we used a SSHAC program with large number of interground motions, which were different from what applicant used. We also did similar thing. We calculated two site amplification functions.

One is shown in green, and another is in red, as far as I see. We also enveloped those site amplification functions, and we got actually similar results to the applicant, up to the frequencies of about 30 hertz.

We got slightly different results in the frequency range of 30 to 75 hertz. But this is not important because of limitations of SSHAC program. Original SSHAC program was designed to calculate up to 25 hertz, and in the previous years, if you recall maybe, the ZPA or PGA was located at 33 hertz.

This basically in this version of the program SSHAC, this plot is -- this exceedance is not critical. But even, yes, is not critical. Basically, what this slide shows, that our confirmatory analysis confirmed what the applicant did.

DR. HINZE: Vladimir, are you satisfied with this subsequent shear wave velocity at 4,300 feet? That was from a petroleum hole, a petroleum log?

DR. GRAIZIER: Yes.

DR. HINZE: Did you people check that out, or is there any need to do that? Or do you feel confident to go with the type of lithology that was encountered? Is it consistent?

DR. GRAIZIER: It is consistent. Kind of you can press me more, but yes, it is consistent. It seems to be reliable. Now we know how it happens. When you combine different measurements you always have some potential for disagreement. But speaking about this, don't forget that when we perform site amplification runs, we actually calculate 60 randomized profiles, and we vary shear wave velocity.

This is why kind of in a way, we have a way to estimate uncertainties and in short, yes. I feel confident with what was done.

DR. HINZE: Okay, thank you.

DR. GRAIZIER: Okay. The next slide shows in details the two ground motion response spectra. One is vertical, another is horizontal, and as always it is done, horizontal was calculated using site amplification function from uniform hazard response spectra.

Vertical was calculated using G over H ratios, which is pretty typical. We do this because basically not much knowledge we have, not much detailed knowledge is available for vertical component. That's a typical wave, and the last slide that I wanted to show, you already saw it. It shows that ground motion response spectra are very well enveloped by design of Westinghouse.

CHAIRMAN RAY: Okay. Bill, did you have any question you want to direct to staff on this issue of the 2008 data?

DR. HINZE: No.

CHAIRMAN RAY: Okay, and how about the --

I think Gerry already commented on the -- he thought that the bedrock topography data were there, but just hadn't been provided on a map.

DR. HINZE: But I also thought that one of Gerry's points was that the paleochannels could well be controlled by fracturing in the bedrock. That was one of his points.

CHAIRMAN RAY: And therefore what?

DR. HINZE: Well, therefore this is an important consideration.

CHAIRMAN RAY: So we still have a craving to see the topographical profile on the bedrocks.

DR. HINZE: In one word, yes.

CHAIRMAN RAY: Yes, Vladimir.

DR. GRAIZIER: One more point, if I can make, as probably relates to this. The shear wave velocity profile that I show you on one of the slides is based on many, many measurements, and of course, I didn't show this here, but the applicant provided all these measurements of shear wave velocity, and they are kind of consistent.

We actually asked one RAI about how, what's the dipping, the maximum dipping of layers based on shear wave velocity measurements and other measurements. We were satisfied. Basically, we didn't see significant dipping using shear wave velocity measurements at least. They are pretty consistent from one borehole to another.

DR. HINZE: How far away is that borehole, that petroleum borehole? Gerry, is the geology going to change much from that? Can you reliably transfer from the position of the borehole to the Levy site in question?

DR. STIREWALT: I think it's a little hard, but mostly because the petroleum borehole, they were searching deeper. That's where the detail is in their holes. They had very little solid information on stuff where there was no petroleum, and there certainly isn't any in the Avon Park. So I think it would be hard to tie those to.

DR. HINZE: I wasn't tying it to the Avon Park, but the deeper formations, because you're doing this from 4,300 feet up.

DR. STIREWALT: Correct, yes. Correct, that's true.

DR. HINZE: Could we have a word of wisdom on the reliability of the projection from the position of that hole to the site for the shear wave velocities, or the deeper, deeper materials remaining specifically? Deeper, because you've got 29 layers there you're working with.

DR. GRAIZIER: Yes, but the 29 layers, some of them are top layers, which are kind of more, I mean just --

CHAIRMAN RAY: Vladimir, rather than try to answer Bill's question right at the moment, I'm going to break for lunch and see if you guys want to say anything more after we come back. I know we've still got another presentation to go here, but I don't want to delay too long breaking for lunch.

I don't want to take a longer time for lunch than we have on the agenda either. So therefore, we'll resume at ten minutes after 1:00.

MEMBER BLEY: Before you hit the gavel, I wanted to put a question on the table, to get to later today.

CHAIRMAN RAY: Okay.

MEMBER BLEY: But instead of asking it later, I'll just put it on the table now. We've seen a lot of information on what we can expect for ground motion at the site. When we get to Chapter 3 and when we get to the PRA, we're going to understand applying that ground motion to the facility built there.

The question I have with this stuff on the karst features and the voids, do any of this ground motion, can it affect the structural stability of the underlying supporting material, or could we have problems because of those karsts, that would undermine the structure when we have a seismic event?

DR. HINZE: You're talking about collapse of the cavities?

MEMBER BLEY: Yes, yes.

DR. HINZE: That's what you're talking about.

DR. GRAIZIER: Because if you are asking about effect on ground motion, karst will actually lower ground motion. I mean --

MEMBER BLEY: Well, it will have that effect, but also if you have collapses, can that affect something else? You know, is that factored into the PRA, into the structural analysis? If not, shouldn't it be?

(Simultaneous speaking.)

CHAIRMAN RAY: That's fine. It's on the table. I thought I did hear that being addressed by the applicant, but maybe we'll revisit it. In any case, 1:10.

(Whereupon the above-entitled matter went off the record at 12:07 p.m. and resumed at 1:07 p.m.)

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

1:07 p.m.

CHAIRMAN RAY: I think we're ready to go. I'm recording attendance here. So we're back on the record, and ready for the next staff presentation.

MR. ANDERSON: The next staff presentation is the last of the staff's 2.5 presentations. Zuhan Xi will provide this presentation.

DR. GRAIZIER: You probably may object. I dug out some information that --

CHAIRMAN RAY: We'll come to you at the end. Thank you.

DR. GRAIZIER: Sorry.

CHAIRMAN RAY: That's all right. We look forward to hearing from you.

MR. XI: Good afternoon. I'm Zuhan Xi, the geotechnical engineer of NRO. The first slide is this figure shows the conceptual plan view for the excavation, diaphragm wall, excavation limits, and seismic category 2 in a non-safety related structure surrounding the nuclear island.

The basic line is to represent the diaphragm walls, which enclose the nuclear island. In order to support the excavation of the nuclear island. Reinforce the concrete diaphragm walls will be constructed as the boundary of the excavation limits.

These diaphragm walls will be installed prior to excavation around the existing ground surface.

The diaphragm walls will serve as a temporary excavation support and vertical seepage barrier to facilitate the excavation from the existing ground surface back to elevation of minus 24 feet. Next slide.

CHAIRMAN RAY: Why do we care about these, other than as a construction aid? What's the point of the walls?

MR. XI: The walls, this is a varying point to the engineering judgment, because this wall, it's to provide a function of water, to prevent the water seepage, and also create the limits of the excavation.

CHAIRMAN RAY: Well, I understood how it worked during construction. What I'm trying to get you to address, I don't really care about that. What I'm really interested in is what I think you just said, which is we rely on them during the life of the plant as a water barrier, from what the amount --

MR. XI: To negate the seepage from the --

CHAIRMAN RAY: All right, and therefore

the integrity of the walls is an important assumption in the design of the foundation?

MR. XI: Yes, yes, yes.

CHAIRMAN RAY: The long-term, life time integrity?

MR. XI: Yes. That's the wall will be designed as a reinforced concrete wall, 3.5 feet for --

CHAIRMAN RAY: Yes, yes, and to perform that function, they don't rely on these tiebacks, which are just temporary during construction?

MR. XI: This is after the backfill place, that these will be balanced. It's --

CHAIRMAN RAY: I understand. But the way we look at it is forget about the tiebacks. These things are there and will remain an important part of the foundation design throughout the life of the plant. That answered my question, then.

MR. XI: Yes.

CHAIRMAN RAY: Thank you.

MR. XI: Okay. This figure is actually it's very similar to what the applicant this morning they provided, which indicated that, you know, both the applicant and the staff think this is very important to explain that. Let me quickly go through these cross-sections again, and the figure shows the conceptual cross-section of the LNP site.

Existing ground surface at elevation of about 40 to 44 will be excavated down to the elevation of minus 22 feet, within the nuclear island footprint. The bottom surface of the excavation will receive a 35 foot thick RCC bridging mat, which will replace and satisfactorily weather the limestone between an elevation of positive 11 and a minus 24 feet, which his totally is 35 feet.

Diaphragm wall, approximately 30 feet cleared into rock. This wall will be tied back by rows of pre-stressed anchors, spaced ten feet and centered. The pull of resistance will be developed by grouting the anchor into the Avon Park limestone.

CHAIRMAN RAY: Okay. But that's what I'm saying. We don't care about that. That's just during construction, right?

MR. XI: Yes, right.

CHAIRMAN RAY: So let's not worry about that.

MR. XI: Okay. Let's talk about in order to degrade the permeability of the upmost layers of Avon Park limestone, the applicant plans to use injected grout from an elevation of minus 22, or minus

24 to minus 99. The total is 75 feet within the limits of the diaphragm wall, to fill voids associated with in the bedding planes.

The applicant plans to use inclined grout holes based on 16 feet centers as primary grout point, and then follow the space the grout holes on eight foot center, before an excavation. The applicant also committed to perform a certain stage of grouting of four foot centers during excavation activity, if the first and the second stage grout does not in seepage cutoff.

Acting together, the diaphragm and grout limestone will form a bathtub and slow the groundwater seepage into the excavation for the foundation. The grouted section will also reduce the potential for further solution activity by cutting off flow path. Adjacent to non-safety related structure will be founded on deep foundation that are into the Avon Park formation. Next slide.

DR. HINZE: How will the grouting be checked? Will it have to be recorded?

MR. XI: The grout for the tieback?

(Simultaneous speaking.)

DR. HINZE: --to 1.4. Will that be tested?

MR. XI: No, it will not be tested. It will be judged from the seepage during the excavation. Now if the seepage is not as in the design, they will provide it at a certain stage of the grouting.

DR. HINZE: If their feet are getting wet when they're working down there, I guess then?

MR. XI: Yes, right. You can visually inspect it, if it's during that excavation process.

MEMBER BROWN: During the fill or during the excavation?

MR. XI: During the excavation.

CHAIRMAN RAY: Well actually, or afterward, when it's done. Then their water will rise or it won't.

MR. XI: Right.

CHAIRMAN RAY: Having done one of these below sea level, I can tell you --

MEMBER BROWN: I was going to ask if we'd done this before --

CHAIRMAN RAY: Yes, but I don't want to tell you all the travails you go through to do it. This isn't the time or place.

MR. XI: So as mentioned in previous slide, foundation improvements are summarized as follows. Reinforcing tieback concrete diaphragms were surrounded nuclear island. Grout injection from elevation minus 22 to minus 99, and also I want to emphasize there is -- at first, there is two stages of the grouting program, and possible the third stage of the grouting program.

And a certified RCC bridging mat will sit under grouted tub supported a Category 2 in a non-safety related structure. Vertical drains to relieve excessive pore water pressure during SSE, to prevent the liquefaction of sand soil underlaying Category 2 structures.

Next slide, please. The staff's review concentrated, focus on the four in five important aspect of foundation design, which includes karst topography, grouting, bearing capacity of Avon Park limestone, sediment and liquefaction.

The slide is to present the safety evaluation karst features and grouting. Extensive dissolution in karst development may be strongly enhanced when a vertical joints and horizontal bearing planes intersect, as mentioned this morning by the applicant, that they refer to as plus sign morphology.

The intersection geometry has not produced large dissolution cavities at the site location, based on borehole data. The staff concludes that this conclusion is based on as follows. The staff reviewed individual borings that are the test results, such as neutron-neutron logging. Neutron-neutron logging is a type of a test to identify the porosity of the rock, shear wave velocity, rock recovery rates, and the rock quality designation, which is RQD.

The staff also reviewed the procedure that applicant used to determine the vertical and the lateral dimension of the karst features. The staff found the method the applicants used to estimate voids is acceptable and conservative. The vertical drops were very small, typically less than one foot in height.

The vertical dimension of these possible karst feature is typically limited to less than five feet. The maximum lateral dimension calculate from the actual borehole was 5.3 feet. I think this morning Gerry mentioned that. Okay.

MEMBER BLEY: Can I ask you a question about that first bullet?

MR. XI: Yes.

MEMBER BLEY: Because I just haven't got a real feel for this yet. Are there sufficient boreholes that, I'm not sure how to say this right, to get the answer I'm looking for. You have some number of boreholes, and I'm not sure exactly how many, that are simply sampling from this whole area.

Is that, and I think you're saying by what you stated, that you're saying that that sample has been sufficient, that you think there's essentially no chance that there could be a larger void than 5.3, which you said was a very conservative estimate.

Am I reading that right, and if so, I wonder how we get to that conclusion. Is it some statistical analysis? Is it some just engineering judgment looking at the set. Is it that we've pulled out sufficiently that really there can't be anything that big, bigger than that?

DR. STIREWALT: May I comment, Zuhan?

MR. XI: Yes, please do. Gerry will answer this question.

DR. STIREWALT: You know, the way to make absolutely certain, of course, if you turn the site into Swiss cheese, which you cannot do.

MEMBER BLEY: And you don't want to.

DR. STIREWALT: But that gets it to your boreholes. You know, it's a pretty darn good, reliable conclusion that these sorts of features combine the borehole information with the geophysical data, a very, very strong indication that we don't have major dissolution cavities, either along joints or bedding surfaces at the site location.

DR. HINZE: And probably grouting as well, right?

DR. STIREWALT: Oh yes, and the grouting.

MEMBER BLEY: And the grouting, which are really the most important.

DR. STIREWALT: So that combined information said that's about as good as you can get until you dig it up, and it's good and sound, I believe, as a geologist.

MEMBER BLEY: Okay, thanks.

CHAIRMAN RAY: Well, let's go back to the grouting for a minute. We were making some comments here about how do you know that the grouting, that you might not need this third phase of grouting? Well, it seems to me a more fundamental question is whether or not --

You're basically creating a long-term leak path by embedding this structure in the ground, so that over 40 years or 60 years, whatever it is, there's a flow of water assumed to occur, into this embedded structure, and then presumably there's sumps or something that pump it out, right? Am correct so far?

DR. STIREWALT: The rate at which that flow takes place, that it references up here, for example, to vertical joints and horizontal bedding planes intersection, there are locations in the remaining structure that are weaker than others, and the water will tend to flow there, I would think. I stipulate to begin with that I'm merely an engineer. I'm not a --

DR. STIREWALT: Nature tends to do it that way, that's right.

CHAIRMAN RAY: So why would one conclude that the erosion that has been observed but is limited, to the extent that it is so far, won't increase or grow or become quite large over some period of time, based on the leak rate that is going to occur, or is considered to be comparable?

In other words, what's the long-term effect of this on a karst development, I guess it would be, of a continual flow that's created by embedding the structure as it's described?

DR. STIREWALT: Well, you're certainly edging into hydrology as well with that question. Maybe that's something you could bring up there.

CHAIRMAN RAY: Well, no, no. I'm just assuming that you've got a water table. You're not going to change where the water table is. The ocean is where it is. Like I said, I've done this before, so I have some experience with it. I don't understand why over time a continual flow, particularly if it's channeled down into a weak zone, won't be sufficient or I shouldn't why it won't be sufficient?

Have we satisfied ourselves that it won't be sufficient to cause that erosion, a void to develop, okay? Bill, I've said all I can.

DR. HINZE: To me, the water aspect is secondary. The primary aspect of all of the grouting is stability, and along with that comes the prevention of a flow of water, because you've grouted up the voids and the vugs. So the water is not the central point of the grouting, in my understanding of it. The grouting is stability.

CHAIRMAN RAY: I wasn't arguing that it was the central point. I'm just asking whether a long-term flow, that will result from the, embedding this structure as we're doing, why it won't erode the formation and create larger voids than we presently understand or believe exist?

MEMBER BLEY: Is 60 years too short a time maybe is another way to say it?

DR. HINZE: I asked Paul at lunch what the viscosity of the grout is, and that's a very important parameter, because that really depends then on how well the grout can go through the vugs and get to all of them and fill them up?

CHAIRMAN RAY: If there's no leakage, then my hypothesis doesn't apply. But I'm assuming that there's some level or rate of the water flow into this, I don't want to call it a hole in the ground, but that's basically what it is, that what's the effect of that flow over a long period of time? We'll let the applicant talk later. We're talking to the staff now.

DR. HINZE: Excuse me, but we brought that up this morning, when this 10 to the minus 4th number, and my question as to the validity of that number, the uncertainty of it, QC'ing on it. You know, we've bandied this about, and that gets to your point of 10 the minus 4th per nth.

The question is, if it's going to be a lot more than that, then somebody has to start getting concerned. So I think there's a need to look at that 10 to the minus 4th number, and just make certain that that is a valid number.

DR. STIREWALT: But you're talking about the rock beneath the grouted area.

DR. HINZE: Yes, yes, yes.

DR. STIREWALT: Well remember, one geologic factor is we know that's dolomitic stuff. So it is simply going to dissolve more slowly, and the --

CHAIRMAN RAY: Slowly than what?

DR. STIREWALT: More slowly than a pure limestone, than a pure limestone like that in the Ocala formation for the Crystal River.

DR. HINZE: Gerry, I mean I came away from this morning not relying on that at all, because there's so much variability in the dolomitic and we know there are some members of the Avon Park that have, that are more dolomitic at depth.

But I think the mat is put there to prevent relying on the dolostones. Maybe the applicant can answer that further, but that's what I took away from it this morning.

CHAIRMAN RAY: Well, I think we're talking about several different things here, and I'm not so much focused on the integrity of the grouting, and its affect on the stability of the structure, as I am that whatever it is, there's going to be some leakage, and have we thought about what the long-term effects are, in terms of creating voids that we were talking about. That's all I'm saying.

And you know, if the grout prevented any leakage, then the question would not be relevant. But if there's some allowable leak rate, which I understood that there was, the design provides for that, then what's the effect of that over the long-term? That's the only question really, and we can just -- we've talked about it enough now, I think, unless somebody wants to say something more.

DR. STIREWALT: I do.

CHAIRMAN RAY: Please, go ahead.

DR. STIREWALT: If we talk about long term, the Avon Park is Eocene in age. It's been sitting there for 40 million years.

CHAIRMAN RAY: Well, but it's sitting there presumably in an environment in which the water flow, at least for some recent period, has been negligible. Now we institute, we provide for some flow of water to occur. So I'm just wondering what the effect of that was.

DR. STIREWALT: Doing that grouting is not going to produce pathways in subsurface material beneath the grout --

CHAIRMAN RAY: Absolutely not.

DR. STIREWALT: It really isn't. So whatever's there or not --

CHAIRMAN RAY: Can I read what's on the screen up there. "Dissolution and karst development may be strongly enhanced where vertical joints and horizontal bedding planes intersect." Now all I'm asking is have we thought about the effect of water flow on creating voids over the long term?

That's my only question. I'm not asking about how the drifting -- I mean like I said, if the grouting were such for there not to be any water flow, then it's not even a relevant question that I'm asking.

But we all see pictures of these karst. I mean my God, they can be quite large, as water flow over time occurs, and I'm just asking that question.

MR. ANDERSON: But Mr. Chairman, it might help. Carl Constantino is at the microphone. He supported the NRC staff in this review area.

CHAIRMAN RAY: Yes, sure, fine. Absolutely.

MR. CONSTANTINO: Could you hear me?

CHAIRMAN RAY: Yes.

MR. CONSTANTINO: There are really several answers. No one would ever say that there will not be any leakage through the slurry walls on the outside, concrete fill on the surrounding facility and the material underneath. But the idea, I think, is that rate of inflow of water, immediately in the vicinity of the plant, will be expected to be much less than the water rate down through the karst material, or the potential karst material as it currently exists.

In and around the plant, we have a grouted zone, which doesn't eliminate karst formation, but certainly would slow it down. But the big thing is the bridging mat is 35 feet thick.

The whole point of the design of the bridging mat, which is not susceptible to karst formation, was to bridge over any potential voids that will develop from now over the life of the plant. The safety in that design is very much bigger so than when we say that the design is ten feet. That bridging mat could really bridge over a very much larger void.

So I think we did consider that in the design of the bridging mat, and that's an issue, I think, which is very much lower level concern to us.

CHAIRMAN RAY: I think that's fine, and that, by the way, is the solution that we used in this other application as well. But to imagine that you're not going to do what that says can happen, you know, I think could be a mistake.

Anyway, the idea is that the bridging mat is sufficient to deal with any long term development of voids as a result of any water flow that occurs, is what I take away from that, and that satisfies the question, as far as I'm concerned. Okay.

MR. XI: Okay. We already discuss a lot about grout fills. Grout fills fill the joints, accomplish the two stage grouting program, will inhibit percolation of rainfall runoff.

Next slide, please. This slide is to present the safety evaluation on the other three aspects, which are bearing capacity, sediment and the liquefaction potential. First, the bearing capacity of Avon Park is adequate for stacked and the dynamic loads.

Actually, the staff reproduced the applicant's results in its confirmatory analysis, for stacked bearing capacity, using the USACE, U.S. Army Corps of Engineer bearing capacity computer program. The staff also reviewed 3D final element analysis, including safety analysis associated with a large 10 by 10 feet cavity directly below the RCC bridging mat.

Safety analysis also assumed a large 20 feet cube-shaped void located below the grouted zone under the reactor building. Also, the sensitive analysis presumed ten foot wide voids across the entire footprint of nuclear power plant, and immediately beneath the RCC bridging mat.

The sensitive study, by varying location of cavity, indicate no negative effects on stability.

For sediment, and the differential sediment, they are way below the AP 1000 DCD limits. AP 1000 DCD Rev 19 allows maximum six inch total sediment for nuclear island foundation, and half inch in 50 feet differential sediment across nuclear island foundation mat.

The staff performed the confirmatory analysis, indicating sediments and the differential sediments are very minor. Sensitive analysis by the applicant determined that under most conservative assumptions, that the maximum sediment will be less than .5 feet, which compared to the DCD's value limit is six inch. .5 inch, I'm sorry. It should be less than .5 inch, compared with 6 inch.

Also, liquefaction is not possible for the nuclear island, because we know that nuclear island is firmly on RCC, and RCC is sitting on the top of the Avon Park limestone. Both Avon Park limestone and RCC is, they are not liquefiable. Therefore, liquefaction cannot occur below the nuclear island.

For outside, for liquefiable ground

outside the nuclear island, those ground will either be removed or replaced with engineered backfill or stabilized with drains to prevent liquefaction, by relieving the buildup of power water pressure. Now I think that's the end of my presentation.

CHAIRMAN RAY: Okay, fine. Now we had some items we want to cover, if possible, from before lunch, unless there's any questions for Zuhan. If not, Vladimir.

DR. GRAIZIER: Okay. I'm actually very glad that we had a break, because I went back and looked at the application. Okay. The question that Bill asked is about how reliable is the information from deep borehole relative to shallow boreholes.

Okay. There are total of four deep boreholes. One of them is actually only 500 meters away from the site. But this hole, unfortunately have only metallurgical description, and it reached generic rock basically at 4,300 feet below the ground.

Now the three other boreholes have velocity measurements, and some of them, just one of them, has upper level also. Basically, there is overlapping between deep and shallow borehole information, and this overlapping shows that those boreholes which have measures of velocity, have same, approximately same velocity as shallow at this level.

This give us confidence that there is no basically big metallurgical and velocity changes from deep borehole location to the shallow borehole locations.

DR. HINZE: Thank you, thank you.

DR. GRAIZIER: And the second issue that you raised actually before, about comparison of USGS 2008 map, and what was done in the application. We actually just looked at this, but we didn't put this into ACR. But V.C. Summer specifically looked at the situation, and did comparison of 2008 USGS map results with what was done before in Vogtle.

Okay. There are some differences, of course. Main difference is actually the area covered by USGS is not bigger than the area covered in the application, but the applicant. But the maximum magnitude is high, and this is a typical situation with USGS, and anyway. That's the answer to -- the comparison was done, but was not included in the ACR.

DR. HINZE: So the question is whether that should be included, right?

DR. GRAIZIER: I agree. It should be. It should be. It's actually not much, but it should be included. But again, you have consider that we will always have differences between what we do and USGS. I don't want, because it's a long story.

DR. HINZE: I've been in thick of that. I understand.

DR. GRAIZIER: Right, okay.

CHAIRMAN RAY: If I understood what you were just talking about, I'm suggesting that at the full Committee meeting, the issue can be addressed by the applicant.

DR. HINZE: Or you could handle it the same way that it was handled for the Summer. You brought this up for the Summer plant, if you recall.

CHAIRMAN RAY: Yes. I didn't think we resolved it there.

DR. HINZE: Yes. The staff presented some results, and ended up with a paragraph that they said would be included.

DR. GRAIZIER: Correct. I don't have this paragraph.

(Simultaneous speaking.)

CHAIRMAN RAY: All right. Well, that's fine, Bill. If I'm trying to think while you're saying that. I must be thinking of Vogtle, then, or something, where it was not -- we didn't get closure on the issue. But you say we did at Summer?

DR. HINZE: Yes, because the staff came in and reported to your Subcommittee.

CHAIRMAN RAY: Okay. Well, we probably don't want, unless they want to do it tomorrow, we don't want to ask for another subcommittee meeting, if that's the only reason we would hold it. But it does seem like it's something, I'll put this in the form of a question.

Do you think it's something that we can, for the record, address at the full Committee meeting. Whether it's just the applicant or the applicant and staff, it doesn't matter to me. It's just something that we can get on the record, because I don't perceive that there's an issue.

DR. HINZE: No, there's not. It's just that it should be brought up to date.

CHAIRMAN RAY: Yes, all right. Anything else, Brian, for this group?

MR. ANDERSON: There's nothing left for the staff presentation of this section.

CHAIRMAN RAY: All right. Any other questions for staff, before we go on to the next item?

(No response.)

CHAIRMAN RAY: Okay. With that, we'll now

-- thank you, everyone. We're behind schedule, but I'm not surprised by that, and given the topic, we're going to catch up. But first, we've got to get to what Dennis Bley has been anxiously waiting for, and that is Chapters 3 and 19. Right Dennis?

MEMBER BLEY: Can't wait.

CHAIRMAN RAY: Okay. I'm going to be very interested in how it goes.

(Off mic comments.)

CHAIRMAN RAY: Okay, you're on, Bob.

MR. KITCHEN: Okay, thank you. As you mentioned, we're going to talk about Chapter 3, which is the Design of Structures, Components and Equipment Systems relative to Levy. We're also going to talk about Chapter 19 of the FSAR, which is probabilistic risk assessment, and of course, we'll be focusing on the site-specific features for both chapters.

Dr. A.K. Singh, who we introduced earlier, is going to prevent these two sections. So go ahead.

DR. SINGH: Next slide. I'll cover Chapter 3, and then follow up with Chapter 19. Chapter 3, which is Design of Structures, Components, Equipment and Systems. DCD is incorporated by reference.

We have taken no departures. The standard material from Vogtle has been added as standard supplement, and then we have performed certain site-specific evaluations, to satisfy the COLA items in Levy-specific supplements, which is what I would describe in this presentation.

Next slide. The Levy supplement 3.2-1 and 3.2-2 deal with the classification of structures, components and systems. The roller compacted concrete, the bridging mat, which has been discussed earlier, is the only safety-related structure, system or component outside the DCD. This is an additional component we have added with the site-specific.

CHAIRMAN RAY: Wisely.

DR. SINGH: I agree. Going through other site-specific items, COL Item 3.3-1 deals with wind and tornado loadings. High winds and hurricane are bounded by the DCD design winds, and so is the tornado wind speed, as well as the negative pressure. Both are bounded by what's in the DCD.

Ground water. The DCD basically has a criteria that the ground water be at least two feet below the finished grade, which is elevation 51. The measured ground water is anywhere from a foot to eight feet below the existing grade, which is at 43. So we easily meet that criteria.

Floods, under the same COLA Item 3.4-1, deals with maximum probable precipitation, maximum probable flood due to streams and rivers, maximum probable hurricane surge, and maximum probable tsunami. We've calculated all these, as will be presented in discussion with Section 2.4, and all these are bounded by the finished grade elevation 51.

COLA Item 3.5.1 deals with missile effect. The turbine missile is a standard supplement which we have here, where we have a P-4 probability of 10 to the minus 7, which is the same as Vogtle and Summer. External missile from tornado damage on non-safety structures on the site are bounded by the AP 1000 tornado missiles.

MEMBER BLEY: I don't think we've talked about the building alignments and turbine alignments for turbine missiles. Does that come up some time later, or is that going to be --

DR. SINGH: No. This is the standard. What we have is what the DCD has the P-1 probability, which is the missile generation probability DCD has is 10 to the minus 5 number in it. That, coupled with the Reg Guide 1.15 P-2 times P-3 probability off 10 to the minus 4 for unfavorable orientation -- we do have an unfavorable orientation.

MEMBER BLEY: How unfavorable is it? Are they aimed right at each other?

DR. SINGH: No. The layout, if you look at th parallel layout, so there is an overlap when you have a turbine missile with a 35 degree ejection. It may hit. The units are 900 feet apart. So the probability of that being the first unit hitting the second one is small.

MALE PARTICIPANT: They're offset a little bit.

MEMBER BLEY: Yes, I see they're offset a little bit. So it's at least, it looks like ten degrees or more --

DR. SINGH: But what we have used, which is the same as the standard plant, that the Reg Guide says the P-2 and P-3 are very difficult probabilities to calculate. But conservatively, one could use 10 to the minus 2 for unfavorable orientation, and that's what we have used to give us the 10 to the minus 7, which is the acceptance criteria in the Reg Guide.

MEMBER BLEY: Given my look here at the picture, I think I'm convinced. So that's fine.

DR. SINGH: Like I said, this is a standard supplement, which we basically have adopted, even though our layout is somewhat better than the parallel standard one.

External missile, which deals with missiles generated by non-safety structures at the site, what we have, we are saying is that those missiles are bounded by the tornado missiles, which are part of the standard design.

Another item, which is COL Item 3.5.1, relates to aircraft impact and as shown on the slide, we considered both large and small aircraft impacts, and the craft's probabilities are bounded by the DCD, as noted on the slide. If we're looking at large aircraft, we're looking at event probability of crash. For small aircraft, we have a conditional core damage frequency, which is again bounded by what the DCD requires.

`MEMBER BLEY: I guess I'm not sure if that's all spelled out somewhere. I haven't read it if it is. Can you give me a quick summary of the basis for why you're bounded by the DCD probability?

DR. SINGH: The DCD --

MEMBER BLEY: I assume that has to do with where you are on flight paths and that kind of thing?

DR. SINGH: The DCD has an acceptance criteria relative to crash probabilities, what is acceptable, and for the first layer is so long as the event probability, which is the crash probability, is less than 10 to the minus 7, we are within the DCD calculations.

MEMBER BLEY: And how could you calculate your crash probability?

DR. SINGH: For the crash probability, we basically looked at, we used the method, DOE method relative to crash probabilities, the number of aircrafts in that airway.

MEMBER BLEY: Same kind of thing they did at Yucca Mountain?

DR. SINGH: Correct. Well, I don't know about Yucca Mountain, but that's what they have done for the DOE facilities, and there is a publication which is accepted to the NRC.

MEMBER BLEY: Is that somewhere in the FSAR? It's not anywhere I looked.

MR. LAUNI: Yes. This is Mike Launi at Sargent and Lundy. It's in our COLA, in 3.5.1.6.

MEMBER BLEY: 3.5.1.6?

MR. LAUNI: 3.5.1.6.

MEMBER BLEY: Okay, thanks. I'll take another look at that.

DR. SINGH: So we for large aircraft and did that for smaller aircrafts, because we have more of them, we did not meet that probability. But the DCD also has another level, because the smaller aircrafts are less likely to damage. They have the conditional core damage frequency, and we calculated that to be at .4, 10 to the minus 12, whereas the DCD acceptance criteria is 10 to the 8. So more events, but low likelihood of damage.

Going over to COLA 3.7.1, relates to dam failure. There are no dams upstream which -- there are no dams. So the dam failure of flooding is not an issue at the site. 3.7.2 deals with post-earthquake operating procedures and we comply with -- other procedures would comply with 1.1.6.6 and 1.1.6.7.

This is the same as Vogtle. The only reason it is cited as Levy-specific is because Vogtle procedures were different than Bellefonte's. So Vogtle has their site-specific; we have ours, but they're identical.

COL Item 3.7.3 deals with foundation input response spectra, FIRS, which is at elevation 11, which is the bottom of the AP 1000 foundation. What you see here is this morning, we presented the GMRS, which was at elevation 36, which is about eight feet below the ground surface.

What we're presenting here, and that, as

I mentioned, was unscaled. It had a G level of .08. What you see here is the FIRS, which is foundation input response spectra, at elevation plus 11, which is scaled to meet the .1 G Appendix S requirements. Here again, for both the vertical and the horizontal comparison, they should a significant margin when compared to the DCD.

The process we used to generate this FIRS, as well as the PBSRS, which I'll cover next, we comply with -- we basically use the methodology which is inherent in Reg Guide 1.208. So looking at the performance-based surface response spectra, which is at elevation 51, which is the finished grade, the reason we performed this analysis is our GMRS was generated at elevation 36; yet our finished grade is at 51.

So again, we used the methods of Reg Guide 208, as well as the ISG-017, which basically tells us if have to go to the surface and perform an SSI analysis. Here again, these are scaled PBSRS, and when I say "scaled," obviously the PBSRS is related to the FIRS, and because we scaled the FIRS, it's consistent with the scaled FIR, is what it meant, and again shows significant margin.

Using the PBSRS we just presented, we did look at Seismic Category 2 versus Seismic Category 1 interaction, which is Levy-specific because of our Category 2, our non-seismic turbine building, annex building and rad waste buildings supported on drilled shaft, and what we found -- what we determined is that both for the PBSRS, as well as the 10 the minus 5 uniform hazard spectra, our displacements to the foundation level are less than the two inch gap which is provided.

Which basically proves that we would not have any seismic two over one interaction, both for the design basis PBSRS, as well as the 10 to the minus 5 uniform hazard spectra, which then we use for in Chapter 19, as a means of establishing the high confidence, low probability of failure limits.

The staff, even though our PBSRS, the FIRS was enveloped by the CSDRS, the staff did point out that we are using the RCC bridging mat, and thereby it's not a generic site, which Westinghouse had originally analyzed. So we did perform a 3D SSI analysis, Westinghouse did, considering the best estimate, the lower bound and the upper bound soil properties.

The staff was also concerned about the construction activities further softening or deteriorating the soil conditions. So they also asked us to develop, and we did, a lower bound, which kind of in addition to the lower bound soil properties, account for some disturbance, which may further degrade the soil.

So we did that, and we performed this using the standard NI-20 model, as well as procedures in ISG-017 and SRB-370.

MEMBER BLEY: Can I take you back to your last statement on the previous viewgraph? You don't need the viewgraph for this. Both of you said that you used the 10 to the minus 5th per year spectra to show if you've met that, that you used that for your HCLPF.

DR. SINGH: Yes.

MEMBER BLEY: Now the traditional HCLPF, as I recall, is no more than a five percent chance that the 95th percentile curve would be exceeded. Does that come out to be the same thing for this plant, or it's just an alternative?

DR. SINGH: The guidance also gives us an alternative, that so long as we could show that our capacity is 1.67 times the design capacity, then it also qualifies. We could screen it out as a HCLPF.

MEMBER BLEY: As a HCLPF. But can you --

I hate to admit I don't know that. What guidance is that? I want to go back and look at it --

DR. SINGH: I would have to get back with the exact numbers, but --

MEMBER BLEY: If you can, I'd appreciate it. It's just something for me, because I didn't recall that. I assume they're almost equivalent statements, but I'm not sure of that. Okay.

DR. SINGH: In fact, using the simplified method is what I would call conservative, because the actual HCLPF probably would be higher. But relative to the screening, so long as we could say that the capacity is greater than 1.6 times what the design is, it could be screened out.

MEMBER BLEY: Okay.

DR. SINGH: I will provide you with a reference to that. So I was here. The SSI analysis we conformed to the staff, interim, Interim Staff Guidance-017, as well as SRP 3.7.2 provisions, and the SSI analysis results show that the flow response spectras at the six key locations of the AP 1000 which were required to be generated, are all enveloped by the generic CSGRS.

What I have here is -- Bob, next slide -- a comparison at node 2675 of the model, which happens to be the corner of the fuel building roof and the shield building, and it's fairly high up, at elevation 179 feet. We chose this node because this was the worst of all the comparisons, which means it showed the least amount of margin.

Here, what you see is the solid black line is the generic floor spectra at this node from the CSDRS. The dotted blue line is the Westinghouse DCD H, at a high frequency HRHF spectra. The red is what the Levy-specific SSI results, which is the envelope of the upper bound, lower bound and the lower lower bound results.

First, this was the worst case. Second, there are -- and if you notice here, we have a significant amount of margin, up to about 30 hertz or 35 hertz, and from 35 to about 40 hertz, we have a lesser amount of margin. If you blow up this figure, we're still enveloped, but we have less margin.

Now one thing which we do want to point out is, if you recall, we're doing all these analysis to a scaled FIRS. FIRS was .08, and we are doing all the analyses using a .1 G FIRS. So we have that 25 percent margin in all of our results, including this. So it appears close, but as a minimum, we have that 25 percent margin.

Looking at the same node, because you have three components, what you saw was the X component or the north-south, and then when you look at the east-west component, you could see a very significant margin throughout the frequency range. Then the last one is the Z direction, which is the vertical, and here again, you see a very significant margin throughout the full frequency event.

That's all I have. Those were the different supplements we had. We do have an additional supplement in Chapter 3, which deals with foundation design, and Dr. Rizzo covered that this morning, relative to the foundation design and what we are doing to account for voids which we could have. So that basically completes Chapter 3.

CHAIRMAN RAY: Just a minute.

(Off mic comments.)

CHAIRMAN RAY: Okay. Thank you very much, and rather than take a break now, which is scheduled -- it seems a little early to me -- let's press on with this. What do you have, Bob?

MR. KITCHEN: I was just going to say we have Chapter 19.

CHAIRMAN RAY: Oh, okay. I'm sorry. I was getting too anxious, I guess. Go ahead.

DR. SINGH: Okay, next slide.

CHAIRMAN RAY: Somebody says that's all I have, well you know, then I tend to think of what's next.

(Laughter.)

DR. SINGH: Chapter 19 deals with Probabilistic Risk Analysis, and we're doing 3 and 19 together, because as you will see, it essentially is a lot of overlap relative to the topics which I covered.

Like all other chapters in our COLA, the DCD is incorporated by reference. That is applicable to Chapter 19. Standard material --

MEMBER BLEY: Before you go on, I guess I still have a little discomfort with the stuff we discussed earlier. I think I'm pretty comfortable on the design basis, on this idea of the voids and the maximum size of them, or the most likely maximum size of them if that's reasonable.

When we get to seismic PRA, however, it seems to me one needs to think about the uncertainty in that process, and I guess two things. Can it be, from what you already know, is it possible to say that given the uncertainty in those voids and given what you know about the strength of the bridging mat, is there essentially no chance that the tails of our uncertainty distribution for a seismic event, we could undermine that structure for the kinds of excitation we're looking at in the seismic PRA?

Or should there be some allowance for that maybe the lack of knowledge about the details there could have an impact during earthquakes?

DR. SINGH: Well, there are two basic questions you're raising. One is the size of the cavity, which is ten feet, and you did say that you feel relatively comfortable with overestimates, and the fact that it's conservative, if I heard you right.

MEMBER BLEY: Conservative on a best estimate kind of basis. But when we're talking risk, we're talking about, you know, unlikely situations where the consequence could be high.

DR. SINGH: And what we -- our approach to this is that we're designing two codes, in this case the ACI code and guidance from the U.S. Army Corps of Engineers on the bridging mat. So our inherent margins is the same as any other structural component. So am I making myself clear, because the margin inherent in the code is what we have in our RCC mat design, because we're using code allowables.

Given a ten feet void, we are building in margins which are inherent in the code, because --

MEMBER BLEY: We put it in terms of not of a whole PRA, but in terms of the HCLPF kind of thing. Is the HCLPF for some problem in those void areas, as something hotter than --

DR. SINGH: From a structural design point of view, the voids are no different than any other load, whether it be wind load, cycling load. Even though it's a void, it causes the mat to span a certain distance and to introduce the stresses.

MEMBER BLEY: Yes.

DR. SINGH: So, and the loads also introduce stresses into the mat. So from a structural point of view, the void is not treated any different than any other load, and we're using the same codes, same allowable, and that is where we get the margin. Just like -- so that's where we're coming from, that we have -- you know, we're not using mean response, median responses. We're basically using conservative allowables.

MEMBER BLEY: So let me try to paraphrase what you're saying, based on other things you've said earlier, and based on your pointing to the 10 to the minus 5th for your spectra. Would it be a fair statement that the results of what you've done, you'd say the chance of this becoming a problem under all the earthquakes we can envision would be less than 10 to the minus 5th per year?

I think that's where the rest of the facility seems to fall.

DR. SINGH: Right, correct. The only hesitation I have is we did it for PBSRS, and as you know, it's a performance-based spectra we're using, and the Staff Guidance 1.208 uses the AISC standard 4305. That has a probability of somewhere between 10 to the minus 4, 10 to the minus 5.

When you account for the margin between design and capacity, you get back to 10 to the minus 5. So the answer is if you use the same logic we're at, 10 to the minus 5, but all the calculation which are deterministic, if you have done, are to the performance base, which is approximately about to 10 to the minus 4 or in that range.

MEMBER BLEY: Okay. I think I'm following that. Then I have one more related question. In the beginning, in Chapter 19, you said you've adopted the DCD seismic PRA. But then back further, when you get into statements about PRA results and insights, there's a statement that I wonder how I'm to interpret, and we hear of the differences, and you're about to get to this in another bullet or two, but I want to get it out there.

When you deal with the differences between the as-built plant and the design used as the basis for AP 1000, seismic margin analysis will be completed prior to fuel load. I thought seismic PRA was supposed to be completed before fuel load, that the seismic margins was adequate for the DCD and for the COL PRA, but before fuel load it was supposed to be a full seismic PRA. Am I mistaken in that?

DR. SINGH: What you're saying is what's in the DCD. What we're saying is the standard supplement is that if, once the Levy plant is built, if there are variants between the Levy as- designed, as opposed to as-built, we would basically reconcile that.

MEMBER BLEY: Okay, and that's what I'm reading here.

(Simultaneous speaking.)

DR. SINGH: --is that I would defer it to Mr. Cummins. But the DCD has a commitment to have completed the PRA, and this is not the same. The standard supplement, all it says is if the as-built is different than as-designed, we would reconcile that.

MEMBER BLEY: And you would modify the

seismic margins analysis --

DR. SINGH: At that point.

MEMBER BLEY: I might be, and maybe I'll put this to the staff later. I might be misinterpreting the words here. But this seems to have written into the combined license, via the safety and FSAR, that you will not have to do a seismic PRA.

I'm wondering if that's just a misinterpretation, that what this is saying if you find problems, you'll fix the seismic margins analysis. But that has nothing to do with the seismic -- well, first for the PRA that's supposed to be done before fuel load.

DR. SINGH: But the first bullet is very clear, that we are adopting or we are taking no exception to the DCD.

MEMBER BLEY: Yes, you have, and at this point, this story you told me kind of holds together, that that's a reasonable thing, even with the void issue. The second thing I raised had to do with a later section in the FSAR on PRA results and insights, which seem to me to be closing off something we've been expecting. Maybe I'll save that for staff later, because it doesn't seem to be resonating.

DR. SINGH: Yes, because what we have as

standard supplements, which make these commitments, like 19.59.10-1, "Evaluate as-built plant to confirm seismic margin remains adequate." That to me is that any deviations we take from the standard plant, as-built as opposed to as-designed, we need to reconcile that with the standard. This is how I am interpreting that.

MEMBER BLEY: Okay. I understand what you're saying there, and this is a question I'm going to put to staff, and also to the owners, in that the requirement for the complete PRA before fuel load is not a DCD or a COL issue. It's a prior to fuel load issue, and --

DR. SINGH: Yes. It should be a DCD issues.

MR. KITCHEN: I'm sorry. I had number block. Where were you reading from earlier that was --

MEMBER BLEY: I'm reading from the final safety analysis report, 19.59.10.5, and maybe that fixes my problem, because it says "combined license information," and maybe that restricts it just to getting your license, but not to fuel load. But it had some words about prior to fuel load, which made me nervous.

DR. SINGH: Again, getting back to the third bullet, we did perform additional site-specs, we generally did additional site-specific information, which essentially compared our seismic margins to what's in the DCD. We also looked at initiating events, winds, floods and other external events.

Under the "other external events," we're looking, we looked at aviation accidents as we just talked, the marine, which there are none which affects the site, pipeline explosion, rail and truck accidents on nearby transportation routes. The other events also included external fire, toxic, chemical releases and major depots and storage area.

Again, there are none, no manufacturing facilities near the site, and the only major depot which has chemicals would be the Inglis water treatment facility, which is over three miles away. 19.55 deals with site-specific supplemental --

MEMBER BLEY: I'm just thinking out loud here. It's three miles away. It's pretty flat country down there. Is three miles far enough you don't need to --

DR. SINGH: What we're saying is both the quantities as well as the distance is what made us rule that out. The quantities of chemicals, as was said, it's a fairly small town, the town of Inglis. So quantities coupled with the distance is what screens it out.

MEMBER BLEY: Okay.

DR. SINGH: 19.55 deals with seismic margins analysis. As we had presented in Chapter 3, the GMRS, which the ground motion response spectra, and the performance-based surface response spectra, PBSRS, they're both bounded by the AP 1000 CSCRS.

In addition, the 3D LNP site-specific SSI analysis shows that our flow response spectra through a detailed analysis are bounded by the DCD. Thus, we have concluded that the Levy unique site conditions do not lower the HCLPF values, which is calculated for the DCD.

For soils under the adjacent turbine, annex and rad waste buildings, I'm sorry, the second, the soils under the adjacent turbine, annex and rad waste building, we have incorporated in our design these vertical and horizontal drains, which would prevent the build up of core water pressure, and what we have checked is both for the PBSRS, that that design is sufficient to prevent liquefaction, as well as the 10 to the minus 5 uniform hazard spectra.

Again, the same statement, that the

uniform hazard spectra at 10 to the minus 5 is greater than 1.67 times PBSRS. So liquefaction, again Levy-unique conditions do not lower the HCLPF values calculated in the CSDRS.

The third item in seismic relates to the Seismic Category 2, only one interaction as we presented in Chapter 3. We did do that evaluation, both the PBSRS and 10 to the minus 5 uniform hazard spectra, and again we showed that there are no interactions, and there again we conclude that the Levy site conditions do not lower the HCLPF capacity, which was calculated using CSCRS.

So for all these three areas which are susceptible to seismic excitation, we have established that we are not lowering the capacity, which is already documented in the DCD.

Other events we looked at deals with wind, flood and other external events. Again, here our basic conclusion is that the Levy site is bounded by the DCD evaluation, and some of these numbers I had presented as part of Chapter 3. If there are no questions, that's all I had, relative to Chapter 9, the site-specific portions of it.

CHAIRMAN RAY: You said Chapter 9?

DR. SINGH: 19, I'm sorry, I'm sorry.

CHAIRMAN RAY: Anything else, Dennis?

MEMBER BLEY: No.

CHAIRMAN RAY: Well now I'll change what I started to say before. We will take our break now, but I'd like to limit it to ten minutes. So we'll start at 2:32.

(Whereupon the above-entitled matter went off the record at 2:19 p.m. and resumed at 2:29 p.m.)

CHAIRMAN RAY: Okay. We're back on the record, and Brian, it's over to you.

MR. ANDERSON: Thank you, Mr. Chairman. This will be the staff's presentation of Chapter 3, primarily focusing on the foundation design and associated seismic analyses. I'm Brian Anderson. I'm the project manager for this portion of the staff's review.

Presenting today will be Pravin Patel and Vaughn Thomas. They're both members of the Structural Engineering Branch. Also seated up front here with me is Carl Constantino, and in the first row of the audience, Tom Houston is here as well. Carl and Tom were both consultants that assisted the NRC staff in this part of the Levy County review.

I'd also like to acknowledge Terri Spicher. Terri was the project manager for the vast majority of this review, but she recently moved on to another job within the agency. So she deserves a lot of the project management credit for what got this chapter to where it is. Actually, before I continue with the rest of this presentation, if you'll indulge me, I'd like to make a correction to a statement that was made during the previous staff discussion.

A question was asked about the function of the diaphragm wall, and for the -- I'd like the record to correctly reflect that the diaphragm wall serves as a dewatering aid during construction. It does not serve any function, structural function or safety function. It's not considered in any analysis as part of the Levy County design. So it exists only to aid during construction.

MEMBER BLEY: The pumps that have gone after construction.

MR. ANDERSON: Correct, and if there are no follow-up questions to that correction of the record, the next couple of slides just provide an overview of Chapter 3 of the FSAR. Like I said, the staff has prepared presentations specifically for foundation design and associated seismic analysis.

There are several other site-specific evaluations that the staff does not have presentations prepared for, but were discussed in the Progress Energy presentation. Some of the site-specific evaluations you see on the screen are all enveloped by DCD requirements.

The next slide highlighted in yellow reflect the topics that the staff will provide presentations on. The remainder of the items there are incorporated by reference as standard content items. With that, I will turn it over to Pravin Patel.

MR. PRAVIN: Good afternoon. My name is Pravin Patel, Office of New Reactor, Division of Engineering. I will cover three seismic analysis-related issues of Section 3.7.

Issue No. 1, design ground motion response spectra. Issue No. 2, site-specific soil structural analysis. Issue No. 3, maximum related displacement within the nuclear island and the existing building foundation. I will start with Issue No. 1. Engineering backfill required to raise the plant to be consistent with DCD soil profiles.

The applicant developed the site amplification functions for the calculations for both PBSRS, performance-basis surface response spectra, and GMRS, following the guidance of the subsection of

5.2.1 of ISG-017.

The primary difference between the PBSRS and GMRS is that PBSRS is developed at the plant finished grade, and includes the engineering backfill effect, while the GMRS depends on ground motions at LNP Unit 1 and Unit 2.

So without considering the building or field characteristics. The GMRS developed at 36 feet, and PBSRS developed at 51 feet. That means it's a 15 feet fill.

Next slide, please. This figure shows the GMRS versus PBSRS. The slide shows the staff confirmatory analysis results, as previously presented by Vladimir. Composition of FIRS, foundation input response spectra, is on the left-hand site, and PBSRS is on right-hand side. Horizontal axis is frequency in hertz, and vertical is accelerations. AP 1000 certified response spectra in red, and envelopes Levy and the staff in different analyses.

Next slide, please. Resolution. Staff performed the confirmatory analysis using the estimated value of the stiffness and damping coefficients for the proposed filling material, to develop the surface PBSRS for the site profiles. The staff developed the FIRS spectra at the foundation elevation 11 feet, to check the minimum required peak acceleration of .1 G in horizontal direction for 10 C.F.R. Part 50, Appendix S.

There are no significant difference between the staff's and applicant's calculated PBSRS for the 10 to the minus 4 and 120 the minus 5. In conclusion, staff concludes that applicant's analysis for the design basis force are enveloped by the AP 1000 CRDS and HRHF, are considered to be non-damaging.

Next slide, please. Now in the supplement 3.7-6, Issue No. 2. Site-specific soil structural analysis. Levy greenfield response spectra analysis shows that the AP 1000 CRDS for the vertical seismic excitation does not envelope the design grade deterministic surface spectra in the high frequency range.

The size-specific horizontal and vertical SSI input, soil structure interaction input spectra developed by the applicant from three soil column, lower bound, upper bound and best estimate soil columns for SRB Guidance 3.7.2.

The CRDS vertical design input spectra, as well as the horizontal input spectra, but not the vertical SSI input spectra.

Next, please. This slide shows the

horizontal on the left and vertical on the right SSI input spectra, the vertical SSI input spectra for the best estimate and upper bound soil column, clearly the high frequency range greater than 30 approximately.

Next slide, please. Due to the foundation geometry such as RCC bridging mat, the applicant performed the SSI analysis using the 3D and 2D models considering the simultaneous occurrence of the two horizontal and one vertical component of the time history using five percent dampening. The time history was applied as the in-column motion at minus 24, which is the bottom of the RCC bridging mat.

From the three time histories, in structure for response spectra, are generated at the NI key locations. These key locations are the same as the AP 1000 and are key locations. The AP key locations are high stress locations, which are located on the nuclear island and defined by the DCD.

The DCD requirement, the COLA applicant helped to envelope site-specific in-structure response spectra with the DCD in-structure response spectra at the key locations. In conclusion, the Levy 3D design basis in-structure response spectra are enveloped by the AP 1000 3D, three-dimensional, and HRHF high frequency range of 20 to 30 hertz in-structure response spectra with a sufficient margin to account for the site variation in modeling and material properties.

Next slide, please. Issue No. 3. Maximum relative displacement between the nuclear island and the adjacent buildings, which is the turbine building, annex building, rad waste building. Those are the buildings we're talking about here.

The seismically induced deformation of the soils surrounding the drill shaft needed to be incorporated into the analysis, in addition to the shaft deformation. In fact, the loss of soil support on the shaft needed to be incorporated into the analysis.

Next slide, please. This slide shows proposed drill shaft layout figure legend that was previously presented by the presenters from the applicant, as well as the staff. That shows that to prevent the inflection of other buildings with the nuclear island, the drill shafts have closer spacing adjacent to nuclear island.

The closer spacing of the drill shafts provides the adequate lateral supports and stiffness to the foundations.

Next slide, please. Resolution. The

buildings on the nuclear island are supported on drill shafts. Proposed distance of diameters are four feet and six feet, shown on previous slides. The seismically induced deformation of the soil containing the drill shaft needed to be incorporated into the design, in addition deformation caused by the lateral seismic loads. Applicant provided supplements --

DR. HINZE: Does the diesel generator building also have these shafts for seismic structure?

MR. PRAVIN: Diesel generators, I think -- yes.

DR. HINZE: So but does it have the shafts?

MR. PRAVIN: Yes, but it's away from the nuclear island.

DR. HINZE: It's not shown on this.

MR. PRAVIN: Yes, it's not shown on this, because it's away from -- it's not adjacent. It's much more farther than the nuclear island.

DR. HINZE: Thank you.

MR. PRAVIN: The seismic-induced deformation of the soil containing the drill shafts needed to be incorporated into the design, in addition to the deformation caused by the lateral seismic load. The applicant provides supplemental seismic analysis for the seismic displacement between the nuclear island and adjacent structures.

Calculated maximum displacement by the applicant is .70, which is less than two inch gap required by the DCD. The applicant also stated that the lateral stiffness of the drill shafts is primarily governed by the soil properties in the top ten feet of the drill shaft, up to four feet diameter shaft and the 16 feet for the six feet diameter of the shaft.

The applicant is using 16 feet of engineering fill material to provide lateral support to the shaft. The construction of the drill shaft and ITAACs will be discussed later in the 3.8 presentation. In conclusion, staff concludes that the interaction within the nuclear island and the adjacent buildings is not a concern. This concludes my presentations and any questions.

DR. HINZE: I have a quick question, if I might. It's not a terribly urgent issue, but regarding the foundations, with density an integrated density value was used, and that's determined from the compressional seismic wave velocities.

It's stated in the FSAR, I believe it is, that this is the turbine from what is called Gardener's equation. But Gardener's equation can't be used or should not be used directly with carbonate rocks like we have in the Florida peninsula.

I'd just urge someone to check that, because a value of two of 2,400 kilograms per cubic meter is used, and it probably should be less than that, by at least 100 kilograms per cubic meter.

MR. PRAVIN: I think I'm on the structure side.

(Simultaneous speaking.)

DR. GRAIZIER: Well yes, we looked at this situation. As you pointed, there is some differences, 2.4 grams per cubic centimeters and 2.27. I looked at this issue and basically, the difference is 5.7 percent. Now let me --

DR. HINZE: Is that frequency-dependent at all?

DR. GRAIZIER: It should be frequency-dependent. But generally speaking, for all frequency of interest, it's considered to be constant. Now to answer this question in a kind of different way, I can say for site amplification, what is important is the multiplication of RAW and V, density multiplied by shear wave velocity.

Basically, we don't worry in our analysis density, but we worry shear wave velocity much more.

This means that the difference of six percent is clearly encountered in variation of shear wave velocity.

DR. HINZE: Shear wave velocities.

DR. GRAIZIER: And to make long story short, there will be no effect in site response calculations.

DR. HINZE: Okay. But that doesn't mean we shouldn't have it right.

MR. PRAVIN: Now I'm turning it over to Mr. Vaughn Thomas for issue related to 3.8.

MR. THOMAS: Thanks, Pravin. Good afternoon. Once again, my name is Vaughn Thomas, and I'm a structural engineer in the Office of New Reactors. In the next few slides, I'm going to present the staff's issues for Section 3.8 of the Levy application.

The key safety issues associated with the design installation of the drill shaft foundation, which we talked about earlier this morning, the design of the roller-compacted concrete bridging mat, which is known as RCC, and the construction processing quality aspects for the RCC bridging mat.

Section 3.8 of the reference AP 1000 DCD is incorporated by reference by the applicant, with the supplement 3.8-2, on drill shaft foundation design and installation, of which I talk about in the next few slides, and 3.8-3, which is RCC strength and constructibility verification program, of which I'll talk about a little bit later.

Seismic Category 2 are non-safety related adjacent buildings, the motor turbine building, the rad waste and the annex buildings, they're all shown on this figure, and they're all supported on drill shafts.

The diameters for the drill shaft varies anywhere from four feet in diameter to six feet, and as we talked about this morning, and we saw in the applicant's presentation, the length of the drill shafts varies from approximately 75 feet to 150 feet in length.

In reviewing the applicant's supplemental information, the staff noticed that the design methodology of the drill shaft, the drill shaft supporting the structures adjacent to the nuclear island was needed. As a result, the staff requested additional information in order to adequately review the safety of the design and installation of the drill shaft foundation.

Next slide, please. To resolve this issue though, the applicant demonstrated that the backfill provides literal support to the drill shafts, as Pravin previously mentioned. The backfill will be controlled engineering fill under the footprint of the turbine building, annex building and the rad waste building.

The applicant also provided a detailed description of the construction sequence and practices to be used for construction of the drill shafts. In addition, the applicant proposed an ITAAC to ensure that an as-built design provides adequate vertical and horizontal capacity and stiffness.

As Pravin noted in his presentation also by the applicant this morning, the applicant demonstrated that a seismic separation between the building supported on drill shaft is adequate to prevent interaction with the NI structure.

As was resolved, the staff concludes that the information provided by the applicant demonstrates that the design and installation of the drill shaft is adequate. Therefore, this issue is resolved and is being tracked as a confirmatory item.

CHAIRMAN RAY: Okay. Now adequacy here is measured by the absence of any threat to safety, structure, systems or components; correct?

MR. THOMAS: Right.

CHAIRMAN RAY: Okay, because you know, the ITAAC, I guess, is directed just at that as well?

MR. THOMAS: Right. The ITAAC is more or less for inspection of the rock socket and for the drill shafts, in addition to making sure the as-built drill shaft condition, that we're checking the physical regimen of the drill shaft foundation in addition to that.

CHAIRMAN RAY: Okay. But I guess I'm trying to, I would have a lot more interest in the ITAAC, and how it was actually going to be one, if it was, I guess, if I thought that there was a significant risk of the failure of these drill shafts to create a hazard. What is the threat that is created in the event of a failure of the drill shaft foundations, a column failure, which is the only thing you're really worried about, I think.

MR. THOMAS: Yes, right. The lateral movement.

CHAIRMAN RAY: Well, a couple things.

MR. THOMAS: Right.

CHAIRMAN RAY: It's attached at each end, and somewhere along the way, it doesn't have lateral support, so you get a failure. What is the threat that we're worried about?

MR. THOMAS: I think the major threat is the socket.

CHAIRMAN RAY: Is what?

MR. THOMAS: The rock socket is the major threat to --

CHAIRMAN RAY: The rock site.

MR. THOMAS: Rock socket.

MR. CONSTANTINO: Okay. It's pinned for analysis, and we have lateral fill which is well-compacted at the top. So that prevents -- at worst, you have a column failure. But the major problem with any socket in real life is the failure of the socket at the bottom.

CHAIRMAN RAY: What if it does fail? I mean what's the --

MR. CONSTANTINO: Well, the only thing that really could happen is you'll get some settlement of that particular foundation element. But there is a potential. If you're not careful, and I think Dr. Rizzo mentioned it previously, of damaging the adjacent socket and if that was much deeper.

So that's one of the issues that I think needs to reviewed during the design of the sockets, to make sure that that potential interaction is not a problem. But the rest of that is straightforward.

CHAIRMAN RAY: I'm still mystified. What happens when that fails, and affects safety-related?

MR. CONSTANTINO: I mean you think the socket is really a steel shell filled with --

CHAIRMAN RAY: No, no, no. You're missing my point. Assume it fails. So what?

MR. CONSTANTINO: If I get a single failure, settlement, for example, at 1, then the issue is what is the impact on the design of the building? Now I get differential displacement of the building --

CHAIRMAN RAY: Yes, I understand.

MR. CONSTANTINO: Right, and that's the major concern for the structural design, just to make sure that's not going to be a problem.

CHAIRMAN RAY: Thank you.

MR. SHAMS: My name is Mohamed Shams. Just for the record, I'm the acting branch chief of the Structural Engineering Branch. I agree with Carl, that the point being is if the drill shaft fails, depends on which one it is, we don't know. So we would assume the worst case condition would be the one that's adjacent to the nuclear island.

So now you have the first bang now. It can fail. You don't know the extent of that failure, and in its failure, it can actually harm the nuclear island next to it.

CHAIRMAN RAY: All right. So you're talking about an impact from the turbine building, let's say, on the safety structures is what you're talking about?

MR. SHAMS: Correct.

CHAIRMAN RAY: Okay. It just seemed like an ITAAC was something I wouldn't have expected, I guess, for a foundation of a non-safety building like this.

MR. SHAMS: Yes, and the reason for the ITAAC, it goes to the two over one aspect, is that the failure of that building has an impact, negative impact. It may have a negative impact, so --

CHAIRMAN RAY: Yes, okay. But --

MR. PRAVIN: One more thing that we, the impact on the safety-related building. If you look at the grid of the piles, it's closer to the nuclear and it's much closer spacing, compared to the other safety --

CHAIRMAN RAY: Yes, no. I understand. There's some possibility of a building failure that could impact on the nuclear island. But I was just trying to figure is there something in the turbine building that we're trying to ensure isn't affected, and I guess the answer is no.

MR. SHAMS: Not necessarily, and it's non-safety. It's what, Category 2?

MR. THOMAS: Yes, Category 2.

MR. SHAMS: So it's --

CHAIRMAN RAY: Huh?

MR. SHAMS: The turbine building itself is not a Category 1 building.

CHAIRMAN RAY: Exactly. I was surprised that we put an ITAAC on it, but if it's a two over one issue --

MR. THOMAS: It's a two over one issue, so and 14.3.2 says that.

CHAIRMAN RAY: Okay, well --

MR. THOMAS: Provide an ITAAC to show that there's no impact to the Seismic Category 1 and Seismic Category 2.

CHAIRMAN RAY: I do understand two over one, but it seemed to me like this was a little more than I would expect for that reason. But okay. Oh, we're back to this picture again.

MR. THOMAS: Next slide, thanks. Again, I'm not going to elaborate on that one, since they went through that this morning.

CHAIRMAN RAY: Well, I've got a question about it, when you're done saying whatever you want to say.

MR. THOMAS: Okay. I'll just go over it, with a small introduction. I just want to say this is supplementary 3.8.3, which describes the RCC strength and constructibility verification program for the Levy site. Like I said, on the next two slides, I'll present the key technical issues identified in terms of the design aspect and the construction process for the RCC bridging mat.

This really shows a cross-section of the RCC bridging mat, characterized as a safety-related, that will be used to transmit the NI loads under static and dynamic conditions to the karst foundation.

As we talked about, it will be 35 feet thick and it will have over about 50,000 cubic feet of -- cubic yards of unreinforced concrete. I want to point out that neither the AP 1000 DCD nor ACR 349 addresses the requirements for unreinforced concrete, and a shown in the previous presentation, the upper 79 feet of the Avon Park limestone, as you can see, will be grouted to provide additional stability. Do you have any questions?

CHAIRMAN RAY: Yes, I do. I now

understand that we don't rely on the watertight integrity or the water leakage-limiting integrity of this wall over the plant life; correct?

MR. THOMAS: That's correct.

CHAIRMAN RAY: So you know, that changes what I said earlier, which I assume then we believe that this whole area will be permeated by in-leakage eventually, and the water table will be back to where it was before. In other words, there's no -- this isn't kept dewatered after the bridge foundation is in or the --

MR. PRAVIN: Can I say something? The water barrier is also one vertical wall also. So that is a Tier 1 requirement also, that water barrier goes up to the vertical. It's a waterproof barrier, I'm sorry.

CHAIRMAN RAY: It is kept dewatered by the water barrier?

MR. PRAVIN: That is correct.

CHAIRMAN RAY: All right. The water barrier is supported by the wall, isn't it?

MR. PRAVIN: It's attached to the wall.

CHAIRMAN RAY: Okay. What was the point of the clarification before then? Maybe I missed it.

MR. PRAVIN: During the construction that dewatering is required, while they're constructing this at the foundation level.

CHAIRMAN RAY: Yes, I understand.

MR. PRAVIN: Yes. So that's why any watering due to the rain on any other seepage, that's in order to pump it out. So --

CHAIRMAN RAY: Okay. But there's no active system to -- assume the barrier leaks for a moment, okay. There's no drain in there to keep the area inside the wall dewatered. So if the water barrier leaks, it will fill up with water and just sit there, right?

MR. PRAVIN: Correct.

MR. ANDERSON: We might be talking about two different components here. The clarification that I looked to make was the diaphragm wall, which is the vertical section here in black, which serves as a dewatering aid during excavation.

Once construction is complete, that diaphragm wall does not perform any additional function, either a structural function or a safety function. It's not considered in the design of a plant.

CHAIRMAN RAY: How about the support of the water barrier that he just referred to?

MR. PRAVIN: Water barrier is just when they used it on the bottom of the foundation.

CHAIRMAN RAY: No, but I'm talking about the nuclear island. It's got a standard waterproofing idea.

(Simultaneous speaking.)

MR. CONSTANTINO: Yes.

CHAIRMAN RAY: Yes, I understand.

MR. CONSTANTINO: But that's just on the nuclear island itself, not on anything -- it's not intended to keep dry --

CHAIRMAN RAY: Outside the nuclear island itself, the water level will come up to whatever it naturally -- water seeks its own level, right?

MR. CONSTANTINO: Right, right.

CHAIRMAN RAY: So the wall hasn't got anything to do -- so there's no active system to maintain a lower water level inside this excavation?

MR. CONSTANTINO: Beyond the construction phase. I assume they have some --

CHAIRMAN RAY: Okay. Then that eliminates the issue that I was concerned about. I had understood the comment to have been made that there was a drainage system inside this excavation. They kept the water level down.

MR. CONSTANTINO: Well, during the construction you always have something --

CHAIRMAN RAY: Oh during construction, I don't care about that.

MR. CONSTANTINO: But that's the only time.

CHAIRMAN RAY: I made some big holes in the ground during construction with dewatering. Believe me, it can be done. But I had to fill them back up with concrete again. But that's a construction activity.

MR. CONSTANTINO: We do that all the time.

CHAIRMAN RAY: But during the operation, you just have the usual moisture barrier around the nuclear island, and everything else fills up with water. Okay, I got it. Thanks.

MR. ANDERSON: Are we sure that we're done with this picture?

CHAIRMAN RAY: Now we are, from my standpoint.

MR. THOMAS: Again, in reviewing the applicant's supplemental information, the staff noticed that the applicant did not provide enough details to demonstrate whether RCC bridging mat is capable of transferring the NI loads, while providing the design level performance.

As always, the staff requests additional information in order to adequately review the safety of the RCC bridging mat design. To resolve this issue, the applicant is committed to using RCC construction guidance in the United States Army Corps of Engineers manual 110-2-2006 entitled "Roller Compacted Concrete."

The RCC construction specification will also specify additional enhancements for nuclear safety quality assurance. These practices include guidance for deriving RCC mixes, procedures for RCC placements and compaction, lists of mix preparation, temperature control and placement of the entire RCC bridging mat, density control and lift thickness control.

For the conceptual design phase of the RCC, the applicant is committed to using ACI 349 load and strength reduction factors, ACI 318 equations for computing the tensile strength and modular self elasticity for structural unreinforced concrete, and Army Corps of Engineers' engineering manual guidance. Thus, the failure probability will be consistent with industry codes.

Additionally, the applicant provided and developed the finite element model of the RCC bridging mat, and confirmed the base capacities at which for the anticipated loading conditions. The applicant also demonstrated that the stresses in the RCC bridging mat will remain within code-allowable limits, and is therefore assured of performing its required function.

The staff concludes that the information provided by the applicant demonstrated that the RCC bridging mat is capable of transferring the NI loads, while providing the desired level of performance. Therefore, this issue is resolved and is being tracked as a confirmatory item.

Next slide, please. In reviewing the applicant's supplemental information, standard is that the applicant's construction verification program did not address the capability of the aspect material to transfer design forces across the bedding joints. As always, the staff requested additional information in order to adequately review the construction verification program for the RCC bridging mat.

To resolve this issue, the applicant is committed to follow either industrial standards that have been successful on large commercial RCC projects. This provides assurance that the RCC bridging mat will be successfully constructed and will have the desired strength.

In the applicant's response, the applicant included a detailed test plan that described the quality control and inspection to occur during construction. The implementation of the plan will ensure that mixing, placing and compaction complies with construction specification. The pre-COL and post-COL RCC testing will verify that specified compressive strength, tensile strength and shear strength across lift joints are achievable.

The applicant's RCC test results from commercial RCC projects confirm that the use of the design values from ACI 318 and Army Corps of Engineers engineering manual are appropriate. Post-COL RCC and bedding mix testing will be performed on a large test pad of the site prior to construction of the RCC bridging mat.

The RCC test pad will be approximately 40 feet long by 40 feet wide, and will consist of at least six feet and one foot vertical lifts, at least six one foot vertical lifts. At the staff's request, the applicant added a license condition for post-COL testing, which states that licensee will complete, 180 days prior to construction, the integrated test report of the strength verification and the construction variability testing, in accordance to the criteria outlined in the FSAR.

Staff concludes that the information provided by the applicants adequately address the capability of the aspect material to transfer design forces across the bedding joints. Therefore, this issue is resolved and is being tracked as a confirmatory item.

Next slide, please. In April 2011, the staff participated in a meeting with the applicant in two scenarios, in order to witness a pre-COL RCC mix design test. During the pre-COL mix design testing program, the concrete in the test panels did not obtain the desired compressive and tensile strength.

The applicant actually believed the low strength of the cored cylinders from the test panel that required the use of small mixing and compaction equipment. To resolve this issue, the applicant is committed to using mixing, placement and compaction equipment consistent with Army Corps of Engineers engineering manual, equipment comparable to that using large commercial projects.

In the applicant's biaxial shear test, biaxial test is that the three block shear sample that is required from the test panel, either shear strength at least 1.67 times the maximum design demand shear across the lift joints, even though the test panels did not achieve the desired compressive strength.

As previously stated, post-COL RCC bedding mixed testing will be performed on a large test pad on the site prior to production of the RCC bridging mat. The testing is being performed post-COL, but prior to construction of the bridging mat for two reasons.

One, due to limitation on mixing and compaction equipment sizes that can be used in the laboratory testing, the required compaction cannot be achieved in the laboratory. Thus, a large test bed in an open field setting is required.

Number two, because RCC design strength is specified as 365 day strength, it is not practical to perform constructive testing on RCC bridging mat during construction on the pure or block test specimens. Six inch cores from the RCC test pad will be used to verify that design compressive strength is achieved, and the split cylinder strength meets ACI 318 requirements.

In addition, one foot by one foot samples consisting of two adjacent lifts and the bedding joints will be cut from the test pad to perform direct shear testing. The blocks cut from the RCC test pad will be used to verify that shear strength achieved across lift joints, per Army Corps of Engineers engineering manual 110-2-2006.

The staff requests applicant add a license condition for post-COL testing, which states that licensee will complete, 180 days prior to construction, the 90-day test report for the strength verification and constructibility testing, in accordance with the criteria of adding the FSAR.

Also, the applicant proposed an ITAAC to ensure that the production of the RCC bridging mat constituents is consistent with the design requirements resulting from the testing program.

The staff concludes that the applicant assessment of attaining the desired compressive strength and tensile strength of the RCC test program is acceptable. Therefore, this issue is resolved and is being tracked as a confirmatory item. This concludes my presentation.

CHAIRMAN RAY: Okay, questions?

(No response.)

CHAIRMAN RAY: All right. What else, Brian?

MR. ANDERSON: That's the last of the staff's presentation for Chapter 3. We'll do a quick rotation of people and move on to staff's presentation for Chapter 19.

CHAIRMAN RAY: Okay.

MR. GALLETTA: Okay. For the record, this presentation to the ACRS Subcommittee pertains to the staff's review of Chapter 19, Probabilistic Risk Assessment for the Levy County COL application.

My name is Tom Galletta. I'm a project manager in the Division of New Reactor Licensing, AP 1000 branch. To my right is Malcolm Patterson from the PRA and Severe Accidents Branch, Office of New Reactors. The majority of Chapter 19 is incorporated by reference, that is, IBR or IBR standard content.

The two highlighted sections on the slide identify site-specific evaluations for Levy County. Section 19.55 describes Levy site-specific seismic margins analysis, and Section 1958 describes the external event frequencies. I'll turn it over to Malcolm.

MR. PATTERSON: Good afternoon.

CHAIRMAN RAY: Good afternoon.

MR. PATTERSON: I'm a reliability risk analyst in the Office of New Reactors, and for Levy

Units 1 and 2, I'm now the lead technical reviewer in the area of PRA and severe accidents. Chapter 19 is supposed to deal with total plant risk. We typically think of the PRA as internal events at power.

But this is where we discuss the other factors, things we have to consider like when the plant's shut down, fire, floods, high winds, seismic events and human activities. To be certified, a new reactor design has to cope with events at a hypothetical site.

External hazards, whether they're natural or man-made though, are going to differ from one site to another. So for each COL applicant, we have to look and see what the local conditions are.

Natural hazards specific to the Levy site were evaluated in Chapter 2 and 3. We rely heavily on those analyses. But for the most part, those are deterministic. For Chapter 19, same events, same location, but we look at it from a risk perspective.

Most of the risk comes from multiple failures that can and do occur. But less frequent events can also contribute to core damage, and it's important for AP 1000 to examine these carefully, because the internal plant risk has been reduced to such a low level. The total risk is about 3 times 10 to the minus 7. So a very small additional risk can create significant problem.

CHAIRMAN RAY: As we have discussed generically, yes.

MR. PATTERSON: Okay. I'll talk about earthquakes first. The seismic PRA requires a real plant, so it can't be done at the time of design certification or the COL application. So instead, we do a seismic margins analysis. Having ensured that the plant can safely shut down after a design basis earthquake, the designer has to show that there's high confident to low probability of failure, even when subjected to shaking that is more than two-thirds to a safe shutdown earthquake.

The easiest way for the COL to show that the seismic margins analysis of the DCD apply, will be to show that their GMRS is bounded by the CSDRS.

Next slide, please. For Levy, that's very clear. There's quite a lot of additional margin there, and as you've seen, other response spectra, the CSDRS also bounds them, with the possible exception of some high frequency components, and yet the DCD now has a hard rock, high frequency spectrum that completely bounds all the other cases that apply to Levy.

MR. TIRUNEH: Excuse me, but your papers are in the microphone. Yes.

CHAIRMAN RAY: I couldn't figure out who it was.

MR. PATTERSON: In addition to the seismic events and local geology, AP 1000 COLs have to address high winds, flooding, fire, transportation accidents and nearby facilities. We ask each COL applicant to provide a site-specific supplement describing the external events that might have an impact on their plant.

This way, we have the data to make an independent assessment of whether or not they were bounded by the DCD, and moreover, if these characteristics change in the future, say something new is built, the appropriate review will be triggered as the FSAR is updated. Next slide, please.

MEMBER BLEY: Malcolm, maybe this is the point. I don't see you have slides. I don't see another one. I agree that for the COL, you need a seismic margins analysis. My understanding is that prior to start-up, they need a complete PRA, including the seismic PRA.

MR. PATTERSON: That is correct.

MEMBER BLEY: I've been concerned with the way the FSAR Section 19.59 is written, in that it says if there's a problem, you know, if as-built plant they discover something, the seismic margins analysis will be modified prior to fuel load.

Now I'm worried that this is institutionalizing the idea that they won't need a seismic PRA in their license. So that's my concern.

MR. PATTERSON: I understand the concern. That's not what we're doing with this particular license condition that we've imposed. It was a COL information item and is a license condition for Levy County.

MEMBER BLEY: So writing those words into the FSAR does not set them up to come back later to say look, you've said here we don't need one.

MR. PATTERSON: What they need is to confirm that the seismic margins analysis remains valid.

MEMBER BLEY: I agree with that.

MR. PATTERSON: That's what the walk-down is used to do.

MEMBER BLEY: Okay, fair enough. So this has no relevance at all to that later PRA that we need before fueling?

MR. PATTERSON: That's correct.

MEMBER BLEY: Okay. That's what I wanted to hear. Thank you.

MR. PATTERSON: The ground rules for screening events from further evaluation are set forth in the DCD. If an external event is more frequent than 1 times 10 to the minus 6 per year, the plant must be designed to withstand it.

If the applicant shows that an event at Levy is bounded in both magnitude and frequency by the same type event at the generic site, then the associated risk has already been included in the DCD PRA. This is the way we deal with high winds. Yes, they're more frequent than 10 to the minus 6th by quite a large margin, but taken together, all the high winds, tornadoes, hurricanes, extra tropical cyclones, contribute less than one percent to the total CDF.

If event frequency is less than 10 to the minus 7 per year, it's so unlikely that it won't make a noticeable change to total risk. Accidental aircraft impact is usually analyzed this way.

If an event is more frequent than 1 times 10 to the minus 7 per year, then its contribution to CDF has to be assessed. If the change in CDF is less than 1 times ten to the minus 8th, its contribution to total CDF is going to be too small to make a difference. The uncertainty in the CDF figure that we typically bandy about is so large that a large number of such events are not going to have an impact on total plant risk.

If it's not screened out by one of these criteria, the contribution it makes has to be reported in Chapter 19. However, for Levy County, all of the events were screened. Let's see.

Next slide please. This shows how the different external events that Levy County looked at were screened out. Tornadoes, hurricane, external flood are all bounded by the DCD. The large aircraft impact, accidental impact, was screened out on the basis of low frequency, and small aircraft impacts on the basis of low consequence.

For Category 1 hurricanes, the actual frequency at Levy County is slightly higher than the frequency that was used for the DCD. It's 1 times 10 to the minus 6 versus 1.06 times 10 to the minus 6. But since the plant is designed, you know, the non-safety structures at the plant are designed to withstand a Category 1 hurricane, there's no consequence associated with it.

Transportation accidents, green, rail, truck. These were screened out on the basis that the closest point of approach of trucks, rail cars, is going to be further than the stand-off distance from the hazards that they could impose on the plant. What we look at is for explosive hazards, you're looking at a hypothetical truck or a hypothetical car that's loaded with TNT, and for -- you're looking for hazardous materials that might affect operators in the control room. Again, the hazards that exist are so far away that by the time any vapors get to the site, they're going to be below the immediately dangerous to life and health levels for any chemical.

MEMBER BROWN: How come the -- excuse me. A dumb question probably, but I'll ask it anyway. Category 1 hurricane, kind of small. Florida seems to have hurricanes all the time. I've sat through two Category 1's at Hatteras in a house on the beach. It was not fun, probably stupid.

But it just seems like that's an awful small hurricane, relative to the ones you seem to, we seem to read about. Is that -- statistically, is that they just never get anything on that western coast?

MR. PATTERSON: Well, they get them. They get them with a frequency of 1 times 10 to the minus -- the assumption was 1 times 10 to the minus 1 for Cat 1 hurricanes. In other words, you get them --

MEMBER BROWN: What about Category 2's?

MR. PATTERSON: Category 2's, 5 times 10 to the minus 2. These are the numbers that are used in the DCD, the limiting event. So it was 1.06 times 10 to the minus 1 for Levy County. They come fairly often.

MEMBER BROWN: Fairly often. Category 2 comes fairly often. So it's not designed for a Category 2? You just said it's Category 1.

MR. PATTERSON: I'm sorry. Category 2 will take you up to --

MEMBER BROWN: I misunderstood then, because I thought it was only designed -- I thought you said it was only designed to handle Category 1 hurricanes.

MR. PATTERSON: If that's what I said, I misspoke.

MEMBER BROWN: I'm old. I maybe not hearing correctly.

MR. PATTERSON: The safety-related structures are designed to withstand winds of 300 miles per hour, and the highest winds for hurricane expected at the Levy site would be on the order of 260 miles per hour. The highest tornado winds expected in that part of the country are around 200 miles per hour.

MEMBER BROWN: You've answered my question, I think. Thank you.

MR. PATTERSON: I guess the other useful piece of information would be that the non-safety related structures are designed, the DCD is designed for 145 miles per hour, and the expected site winds, the design for non-safety structures at Levy County would be 120. That's all I came prepared to present. If there are any other questions?

MEMBER BLEY: No, I don't have any, but I just wanted -- so if the non-safety structures during a 60 year life, it wouldn't be surprising if they failed?

MR. PATTERSON: It would not have any safety significance.

MEMBER BLEY: And it would not have any safety significance.

CHAIRMAN RAY: Anything else anyone?

(No response.)

CHAIRMAN RAY: Thank you. Now let's move on here folks. At this point, we're ten minutes behind on schedule, which isn't too bad, and I'll ask the staff if there's anything they can suggest to us, assuming we go through this section expeditiously, that we can bring forward from tomorrow's agenda, we'll consider that after we get done here.

MR. KITCHEN: We're going to continue. We're going to proceed into FSAR Section 2.4, which is hydrologic engineering. Paul Snead, who's our supervisor of Environmental Services, is going to present that. Paul.

MR. SNEAD: Good afternoon. I wanted to give you a Progress Energy overview of Section 2.4, Hydrologic Engineering. First slide, the DCD was incorporated by reference for this section, and the COL items that are addressed are as shown on this slide. The site grade is above the design basis flood level, determined by the maximum water levels due to extreme flooding events that we'll describe in more detail.

Just as a reminder, you saw this slide earlier. I just want to point out the major water bodies associated with the Levy site that potentially impact its hydrology, the Gulf of Mexico being the most significant water body and the source of our cooling water; Lake Rousseau, which is an impoundment on the Withlacoochee River.

The Withlacoochee River itself, which serves as the border between Levy County and Citrus

County, and the cross-water barge canal, which has been described to you previously, which comes in from the Gulf of Mexico up to the Inglis Lock, which is the boundary between the barge canal and the Lake Rousseau.

There's also the bypass channel that goes around the Lock, and continues the flow of the Withlacoochee River out of Lake Rousseau, different than the original flow, which was cut off by the creation of the Cross-Florida Barge Canal. We'll talk more about these features in the next couple of slides.

I'll point out that our site lies in two different drainage basins. It straddles the Waccasassa and the Withlacoochee drainage basin. Again, the site is about eight miles from the Gulf of Mexico. The southern-most part of the site is in the Withlacoochee drainage basin. Most of the site, though, is in the Waccasassa, which just have overland flow towards the Gulf of Mexico.

All of the safety-related structures are in the Waccasassa drainage basin. There are no main surface water features anywhere on the plant site.

This is a close-up view of the Cross-Florida Barge Canal and the Inglis Lock. If you'll notice, Lake Rousseau, in the lower right-hand side of the picture, it actually curves off the picture here and goes around to connect to the Inglis Lock. That body of water coming into Inglis Lock is also part of Lake Rousseau.

You see the original remnant run of the lower Withlacoochee, which was cut off by the creation of the Cross-Florida Barge Canal. As Bob mentioned to you earlier, the Cross-Florida Barge Canal serves as our source of circulating water for the site.

Next slide. The elevations across that property vary between a low down in the southwest portion of about 29 foot elevation, up to 59 foot elevation in the upper northeast side of the property. As it was mentioned previously, the average elevation currently at the location of the construction planned is about 43 feet.

The design plant grade elevation that will finish that for the safety-related structures is 51 foot. I do want to note that in the following slides, all of the elevations that I'm referring to are in a NAVD-88, the North American Vertical Data criteria. So when I refer to these elevations, they're all in that neighborhood.

So let's look at the design basis flood

considerations. You see at the top of this chart the design plant grade at 51 foot elevation, and then basically our local probable maximum precipitation that's calculated for the site is at 50.7 foot elevation. The probable maximum hurricane surge associated with that is projected at a maximum of 49.8.

The probable maximum flood on the Withlacoochee River and Lake Rousseau area would reach an elevation of 29.7 feet. Potential dam failure of the Inglis dam was evaluated and would reach a maximum elevation of 23.7 feet, and probable maximum tsunami was evaluated, which would reach a maximum elevation of 12.9 feet. So you can see in all cases, we're below the design plant grade for these flood considerations.

CHAIRMAN RAY: How is the probable maximum tsunami determined, and don't spend a lot of time on it, because it's not relevant.

MR. SNEAD: We're going to cover it in our --

CHAIRMAN RAY: You are indeed, okay.

MR. SNEAD: We thought you might be interested in that, so we have a few slides on it.

CHAIRMAN RAY: Well, no. I just since the guidance on how to do it in the future, so that's a work in progress. I just wondered how you --

MR. SNEAD: Let me know if the slides don't answer your question in a few minutes.

CHAIRMAN RAY: Okay.

MR. SNEAD: Probable maximum precipitation is basically during evaluating in accordance with the requirements, but the maximum elevation. The site actually drains off from the 51 foot or 50 foot down. So but the maximum location on site near the safety-related structures could be 50.7 during a PMP event, which as you know as PMP event is, you know, a tremendous amount of local precipitation over, you know, a prescribed number of hours before and after a major rain event.

DR. HINZE: This overland runoff that you talk about on page 2.4.3, the drainage system for storm water becomes blocked. The LNP site can be drained by rolling flow directly to the lower Withlacoochee River. What's the impact of that, overland runoff?

MR. SNEAD: The intention of that statement is that, you know, we have a storm water system design for the site. But without that storm water system, if it wasn't functional, the water flow would flow across the property --

DR. HINZE: It could become blocked by debris or something?

MR. SNEAD: Or actually as part of our PMP analysis, we assume it's not functional.

DR. HINZE: Okay. What's the environmental impact then, because you also say that you're not going to influence the river --

MR. SNEAD: That's correct.

DR. HINZE: --with anything that you do.

MR. SNEAD: Well, any storm water flow that currently occurs on this property flows overland toward the Gulf of Mexico or down toward the Withlacoochee River. There's no evidence that it ever really reaches the Withlacoochee River. It's just that's the direction of the overland flow.

It's more likely that all of that precipitation or all of that storm water is going to be absorbed into wetlands or into the ground. But that is the ultimate direction. So we would consider that as the ultimate receptor of any of that water.

MEMBER RYAN: Do you have any idea of the infiltration rate on your site, apart from the reconstructed areas?

MR. SNEAD: Yes. I don't have those

numbers in my mind right now.

MEMBER RYAN: I guess it's 10 to 15 inches per year is the normal infiltration of water --

MR. SNEAD: I believe so, and the probable maximum precipitation is like a 36 inch rain event.

MEMBER RYAN: Yes, that's not my question. But over the course of the year, I think the point you were making to Professor Hinze is that as the water flows over land, a large fraction of that is going to infiltrate as it goes.

MR. SNEAD: It's much more likely that that overflow or that water will ultimately make its way to groundwater. But it is flowing overland in the direction of the Gulf of Mexico and the Withlacoochee River. So in an extreme storm event, it's possible it could be carried. From an environmental standpoint, that's not --

You know, we designed the storm water controls for the site to meet the environmental considerations associated with operations.

MEMBER RYAN: I see that, and that's why I'm asking the question. Is there any effect upon the estuary, the salinity of the water in the estuary that would have an impact upon the vegetation or the --

MR. SNEAD: No more than what exists

currently for the operation of the -- I mean for that land.

MEMBER RYAN: Is there an overflow for the ponds?

MR. SNEAD: Yes.

MEMBER RYAN: There is, and where is that overflow going?

MR. SNEAD: It's basically going to just spill out and flood downgrade.

MEMBER RYAN: So it's just over the levy then, or is it specific?

MR. SNEAD: It would flow, normally flows down. But it would be flowing away from the safety-related structures. But it would be flowing across our property towards the southwest.

MEMBER RYAN: Is there a specific structure for the overflow? Is there a specific structure around the pond?

MR. SNEAD: Yes. There is a design overflow for the ponds, yes, which would not be expected to be impacted, unless we had an extreme weather event.

MEMBER RYAN: Sure, sure. That's what we're worried about.

MR. SNEAD: Sure. But to answer your

question originally, there is no planned impact, direct impact to the Withlacoochee River or Lake Rousseau. We're not planning to draw any water from them or discharge any water to those water ponds.

MEMBER RYAN: Thank you.

MR. SNEAD: Next slide, probable maximum flood. The flooding may occur in the lower elevations around Lake Rousseau and the Withlacoochee River. There's no safety-related structures that are adjacent to Lake Rousseau or the Withlacoochee. The maximum PMF in Lake Rousseau was calculated to be 29.7 feet.

As I mentioned before, the dam failure was evaluated to reach 23.7 feet, both of which are below the plant grade lower elevation of 51 feet.

For probable maximum hurricane, a combination of NWS 23 hurricane parameters were used or produced, that would produce the most conservative surge water level were used in the SLOSH model. The SLOSH model, created by NOAA, is sealand/overland surges from hurricanes.

Using that model, we determined the surge elevation and then we had a subsequent additional wind wave set up and run-up that was calculated for a total maximum flood elevation of 49.8 feet for the Levy site. Again, below 51 foot design plant grade elevation.

Now tsunamis. Probable maximum tsunami. The most severe of the natural phenomena have been historically recorded or determined from geological or physical data for the site were considered, to try to determine what credible source could create a tsunami that would affect the Levy site.

We had a tsunami analysis performed using a computer model known a FUNWAVE-TVD that was developed by the University of Delaware. FUNWAVE-TVD is a fully non-linear wave total variation diminishing model, which is what the acronym stands for, and it's a numerical simulation of tsunami generation, propagation and runoff and inundation, using a Boussineq-type model.

It assumed an initial water level due to a 10 percent exceedance high tide as a starting point, and also looking at long-term sea level rise associated with trending data available for NOAA and the National Weather Service.

Next slide. The sources we considered, there were a number of sources looked at. But the three that were looked at most closely was one seismic event, the Venezuela seismic source, and then two underwater land slides, a Mississippi Canyon landslide and a Florida Escarpment landslide.

If you'll look on the next slide, I just wanted to show you briefly. For the worst case of those that we evaluated was the Mississippi Canyon landslide, and what you see here in this figure, you'll see the sort of pink and blue area is a very large region of land underwater in the Gulf of Mexico, and this particular landslide presumes that that entire volume slides down to where you see the green and yellow and orange below it, and ends up down below that.

So consequently, that landslide event is the source of the energy that creates a wave, which could ultimately lead to what we consider to be the worst case we evaluated with regard to a tsunami that could affect the Levy site.

DR. HINZE: The Florida Escarpment is less than the Mississippi Delta?

MR. SNEAD: Yes. The Florida, if I could use this pointer, the Florida Escarpment, I think, is more over in this region, and in terms, I guess, of the total amount of area that's available for a potential landslide, it turns out it was about a third of potential wave impact that could be created by the Mississippi Canyon landslide that we monitored.

DR. HINZE: So it was the volume of the landslide?

MR. SNEAD: That's one contributor to it. Another would be the geometry of where that landslide exists from, you know, what the geometry would be in terms of what direction is the landslide.

DR. HINZE: But there's a large shallow area there which is going to prohibit an event.

MR. SNEAD: So most severe probable maximum tsunami event was the Mississippi Canyon landslide event, and it led to a runup elevation, maximum runup elevation of 12.94 feet, just under 13 feet. Again, relative to the 51 foot plant grade elevation, it came nowhere near that.

If you'll look on the next slide, you'll see sort of a cutaway. If you take one longitudinal cut or latitude, excuse me. If you come across that latitude in terms of all the disparate simulations that were done, you see mean sea level at the bottom, and we use the bathymetry in the Gulf, plus the topography of the land that we have.

You can see the red line represents the maximum water level during the simulation, which comes in, you know, hits ultimately the maximum plus 13 feet. You'll see the Levy site is off the scale over here at the right, up around, you know, over 50 feet.

So we were, of course working on this, you know, before Fukushima. But it certainly made it more interesting to evaluate the concerns associated with a tsunami.

CHAIRMAN RAY: How is probable defined? I mean it's a deterministic term I guess, is it? Or is it based on a probability of not exceeding, the way seismic hazard analysis is?

MR. SNEAD: A.K., could you help with that answer?

DR. SINGH: I think we have Dr. Kirby here, who actually did the analysis for us.

MR. SNEAD: Okay. Well, Dr. James Kirby, if you would like to --

CHAIRMAN RAY: The question is is probable the same probable that we use historically in a deterministic sense, or is it something that has a probabilistic curve associated with it, in terms of exceedance probability?

KK No. I would say it has a deterministic sense.

CHAIRMAN RAY: Okay.

MR. SNEAD: And as you'll notice, it's

used in all of the different types of flooding analysis we have. It's not just associated with tsunami. It's dealing with the fact that it doesn't --

CHAIRMAN RAY: Well, we used to call it maximum credible sometimes too, and you know, it looks like you identified a source there that you offer as the maximum credible source, and you just say well, that's therefore the probable maximum. But nowadays, there's a tendency for people to put everything out on some kind of curve, exceedance curve, and say the chances of exceedance are, you know, 10 to the minus 5th or less or something of that kind.

I just wondered if you had come to that. There's certainly going to be a lot more thinking about that subject now, and whether there is --

MR. SNEAD: Well, in developing a probable, you have to go back and look at credible sources. But we evaluated lots of different occurrences that could lead to a tsunami or whatever situation we'll look at, and in this case, we were just sharing with you which of those different evaluations produced the worst situation.

CHAIRMAN RAY: Well, and you don't have anything that would exceed your or be a threat to the site, let's put it this way. But for a site that does, then this probability of exceedance becomes an issue just like with an earthquake, and the same kind of approach can be thought about. It's just that nobody's done it before to my knowledge, and that's why I asked.

MEMBER BLEY: It is something that can -- this is really the worse you think could be generated from that particular source?

MR. SNEAD: Yes.

CHAIRMAN RAY: And that's the worse source they could find.

MEMBER BLEY: And that's the worse source they can find.

MR. SNEAD: So far.

CHAIRMAN RAY: Yes, I know. If Mexico splits off from --

(Simultaneous speaking.)

MR. SNEAD: Now you could be in a credible situation, which wouldn't probably not be probable.

CHAIRMAN RAY: Yes.

MEMBER BLEY: Okay. I do understand that.

MR. SNEAD: Any other questions about tsunami?

CHAIRMAN RAY: There must be, to the

extent that there are seismic sources here, you can always postulate bigger and bigger earthquake, with lesser and lesser frequencies, and eventually drive something.

MR. SNEAD: But as you've seen before, the Gulf is a fairly quiet seismic region.

CHAIRMAN RAY: Yes, okay.

MR. SNEAD: Okay. Let's talk about groundwater. The maximum groundwater elevations observed during our analysis were about, were greater than eight feet below the design plant grade elevation. The DCD criterias at the maximum groundwater elevation will be two feet below the design plant grade elevation.

So post-construction groundwater levels were evaluated. We did calculations and evaluations, looking at what the finished site would look like with regard to the plant structures and permeable surfaces and the various topographies that we would create post-construction, to evaluate what the maximum groundwater elevations could be at safety-related structures.

As you see in the last bullet here, those elevations were simulated to reach asymptotic conditions, approximately 30 days after the beginning of a probable maximum precipitation design storm, at approximately 54 feet. Again, below the DCD criterion, which would have been 49 foot, with our design plant grade at 51.

MEMBER RYAN: Are you going to talk a little bit about the groundwater initiative contamination and so forth that's been identified in other existing plants, and how you're going to address those issues? Single wall pipe, double wall pipe, I don't know.

MR. SNEAD: Well basically, we have committed in our application to NEI-08-08, just like our existing operating fleet is committed to, in terms of monitoring and reporting associated with any spills associated with radioactive waste leakage.

MEMBER RYAN: Are you going to take any measures to prevent spills at double wall piping or multiple wall piping or frequent inspection?

MR. KITCHEN: We're going to discuss it a little bit tomorrow, but briefly, we use double-walled pipes for the liquid rad waste.

MEMBER RYAN: You did what?

MR. KITCHEN: We used double-walled pipe for the liquid rad waste up to the connection to the blowdown. I didn't mean to get out of order, but so tomorrow's fine. We can talk about more of that.

MEMBER RYAN: All right.

MR. SNEAD: I did want to finish our hydrology discussion by talking about the accidental release of liquid effluence. It's not so much a pipe leakage but the assessment that basically we're all doing for the AP 1000. There is no potential for a direct release to surface water. We described those surface water bodies previously. There are no named water bodies on the site that would transmit that.

So when you looked at accidental release of an effluent holdup tank, which is the highest potential radioactive material inventory moving directly to groundwater, and we examined the radionuclide pathways from that postulated event, to both nearby wells and to that groundwater resurfacing at the nearby river, which would be the Withlacoochee River.

We used the methodology consistent with the guidance and the branch technical position 11-6, which is the same as what you have reviewed previously with what V.C. Summer did.

Next slide. We modeled the accident concentrations to show that they would meet the 10 C.F.R. 20, Appendix B drinking water effluent concentration limits. The contributions at a well receptor, the well receptor would be at our site boundary in the down gradient direction of the plant site at about two kilometers.

The total contribution from all radionuclides associated with that postulated maximum release would be .7 percent of the 10 C.F.R. 20 Appendix B limits. Then the contributions for that groundwater contamination reaching the lower Withlacoochee River were negligible after the transport and the dilution associated with going an additional three miles, three or four miles down to the Withlacoochee River.

MEMBER RYAN: Have you done -- I guess we'll talk about it tomorrow, but I'd be interested if you've done modeling at and beyond your boundary, because at the boundary, you're 10 C.F.R. 20. Just beyond your boundary, you're under EPA regulation, which is --

MR. SNEAD: Oh yes, I understand. Actually, the analysis we've done was with regard to the NRC criteria of the ECL. But again, there are really, you know, well water would be the only source of drinking water in the area.

MEMBER RYAN: But off the site, it's four millirems is the basis, not 10 C.F.R. 20 loads.

MR. SNEAD: Yes, you're correct, and that's the nature of the NEI-08-08, is to make sure that you're dealing with drinking water standards associated with the public, dealing with the groundwater contamination.

MEMBER RYAN: Okay. Well tomorrow.

MR. SNEAD: That concludes our discussion of 2.4. Are there any additional questions?

CHAIRMAN RAY: I don't think so. I appreciate the discussion on tsunami. I found it interesting. So we'll hear from the staff now on Section 2.4.

Brian, back to you.

MR. ANDERSON: Good afternoon. This is the staff's presentation of Section 2.4, Hydrologic Engineering. I'm still Brian Anderson. With me at the front table are Henry Jones, Nebiyu Tiruneh and Mark McBride. They're all members of the NRC's Hydrology Branch.

We've got a large supporting cast of folks that helped with this portion of the review, and I expect that several of these folks are on the phone. So as I introduce them, I just want to check and make sure that we can, they can hear us and we can hear them.

From the Pacific Northwest National Laboratory, Paul Thorne. Paul, are you on the line?

MR. THORNE: Yes, I am.

MR. ANDERSON: Rajiv Prasad. Rajiv, are you there?

MR. PRASAD: Yes, I am.

MR. ANDERSON: Lyle Hibler. Is Lyle on the line?

MR. HIBLER: Yes, he is.

MR. ANDERSON: Lance Vail. Is Lance joining us?

MR. PRASAD: Lance is not on the line, but we can have him if needed.

MR. ANDERSON: Okay. From USGS, Eric Geist. Is Eric on the phone?

MR. GEIST: Yes, I am.

MR. ANDERSON: Okay, and Pat Lynett is actually here in the audience. So Pat's in the front row back there. The staff's presentation is going to cover the topics that are listed on the screen. A lot of the same topic areas that the applicant just presented. So the emphasis for the staff's presentation are the bulleted items that you see in front of you. With that, I'll turn it over to Nebiyu

Tiruneh.

MR. TIRUNEH: Thank you, good afternoon.

CHAIRMAN RAY: Good afternoon.

MR. TIRUNEH: Staff's review of Section 2.4 included confirming whether the applicant has provided adequate and correct description of the site, whether the applicant has accounted for all plausible hydrologic hazards of the site, and whether the applicant has correctly addressed postulated accident scenarios and emergency procedures using the guidance provide in the applicable regulatory guides.

Staff conducted site audit and issued a number of RAIs, to obtain the information necessary to make conclusions for each specific subsection of the safety evaluation report.

In Section 2.4.1, staff's review included confirming the hydrologic description, conceptual site model and interaction of the plant with the hydrosphere. Section 2.4.2 and most of the subsequent subsections except 2.4.2-13 deal with various flood-causing mechanisms and consideration of appropriate combinations thereof.

Staff's analysis of hydrologic description of floods was performed with specific goals of determining whether the applicant has addressed all plausible flood-causing mechanisms at the site, including adequate description of historical flooding.

Although the applicant has considered appropriate combination of normal and accident conditions in the formulation of the design basis scenario, and whether the applicant has employed the scientifically acceptable and technically defensible methods in estimating flooding from plausible causes considered.

Staff reviewed information related to hydrologic description of the site and the surrounding watersheds, historical flooding records, flooding from dam breaches, flooding from storm surge and seiche, and flooding hazards from tsunami.

Staff also reviewed information related to the groundwater and accidental release of radioactive nuclear effluence.

Next slide. This is a brief hydrologic description of the site, which shows the hydrologic unit code, 12-digit boundary watershed description, which location of the Levy nuclear power plant site.

Next slide, please. In order to confirm the applicant's description of historical floods, staff independently obtained stream flow and stage data, and analyzed the data to obtain characteristics of floods.

CHAIRMAN RAY: Okay, stop. Somebody's already put us on mute. We're going to have to get -- Weidong, just go and terminate the line. So again, we're going to have to do without your brothers from Pacific Northwest and elsewhere.

(Laughter.)

MR. WANG: It's on mute now.

CHAIRMAN RAY: Thank you. They should be able to hear us, unless they can't, also having to listen to the Muzak. Okay, please. Back up about two sentences and start again.

MR. TIRUNEH: Okay. So in order to confirm the applicant's description of historical floods, the staff independently obtained stream flow and stage data, and analyzed the data to obtain characteristics of historical floods, and as part of the onsite flooding analysis, staff performed independent estimation of local intense precipitation using the National Oceanic and Atmospheric Administration's hydrometeorological report procedures.

In order to determine the flood discharge and stage estimates provided by the applicant appropriate, staff reviewed information submitted by the applicant, and checked whether the applicant used reasonable and conservative assumptions in plotting conservative, simplifying assumptions in the conceptual model, and submission of the conservative model parameter values.

Staff agrees with the applicant's use of the rational method, for example, and choice of the hydrologic engineering center's river analysis system as the hydraulic model, and choice of parameters such as Manning's roughness coefficients. Overall, after reviewing the information provided in Section 2.4.2, staff has determined the analysis to be conservative and acceptable.

Staff also confirmed the applicant's estimate of PMP and PMF by independently estimating the PMP in the Withlacoochee River Basin using the procedure described in the NOAA HMR guidance, and by performing independent confirmatory analysis, staff was able to confirm that the PMF analysis in Section 243 demonstrates acceptable level of conservatism, and in order to do that, staff confirmed the PMP values for the Withlacoochee River Basin are estimated correctly.

The same course model, including the rainfall runoff model, is appropriate, reasonable and conservative, and the applicant's PMF discharge estimates are appropriate and the applicant's water surface elevation estimates accounted for wind effects.

In order to confirm the applicant's description of dams and reservoirs, both upstream and downstream of the site, and analyze hazards from breach of dams, staff reviewed information provided by the applicant and performed independent confirmatory analysis.

The staff independently reviewed all upstream dams and reservoirs to postulate a conservative, cascading failure scenario upstream of Lake Rousseau, and the analysis included estimating the discharge resulting from individual dam failures, and combining the dam failure discharges with PMF discharges to maximize the water surface elevation in Lake Rousseau.

Staff estimated water surface elevations in Lake Rousseau and the Cross-Florida Barge Canal using two plausible scenarios, one where the Inglis dam would fail and the other without failure. Under conservative scenarios of dam failure, coincident with PMF, the staff estimated that the water surface elevation in Lake Rousseau or in the Cross-Florida

Barge Canal would remain below the LNP site grade by a reasonable margin.

Therefore, staff concluded that the upstream dam failures coincident with a PMF event in the Withlacoochee River Basin would not result in flooding of the LNP site grade. Staff finally confirmed that the design basis flood is the result of the probable maximum storm surge, combined with a wind-induced setup, with a flood elevation of 49.78 feet, NAVD-88.

MEMBER RYAN: I'm sorry. So that reasonable margin, you said, was what height, what elevation, what change?

MR. TIRUNEH: For the --

MEMBER RYAN: You said the staff found it was a reasonable margin. What was it?

MR. TIRUNEH: Okay. That was for the dam bridge analysis.

MEMBER RYAN: Yes.

MR. TIRUNEH: And there was about five point some feet margin between the plant grade elevation and the maximum water surface elevation at the site.

MEMBER RYAN: Okay, thanks.

MR. TIRUNEH: But the DCD requirement is

for maximum flood level to be at or below the plant grade level.

MEMBER RYAN: Right. Thank you.

MR. TIRUNEH: Having said that, I will request Henry Jones to proceed with 2.4.5 and 6 presentation.

MR. JONES: Good afternoon. For probable maximum storm flooding, the Gulf of Mexico, which is located about eight miles west of the site, is the major hydrologic feature and a source of the hurricane storm surge for the site. The applicant estimated the probable maximum storm surge at the site to be approximately 49.78 feet, using the current NRC and Corps of Engineers guidance, supplemented with more recently available data, and conservative assumptions.

The applicant stated that the nominal plant grade would be 51 feet, leaving a margin of approximately 1.22 feet. Staff examined the methods and determined that the applicant has adequately addressed the effects of probable maximum storm surge on the water surface elevation at the site.

MEMBER RYAN: Henry, can you give us some insight into what margin was created by the conservative assumptions you mentioned in your second bullet?

MR. JONES: Well, if you start with the initial storm surge at the coast, you can add about almost eight, nine feet more, ten extra margin of conservatism, on top of having a large storm that's --

MEMBER RYAN: That's a fairly significant conservative margin.

MR. JONES: It is, because we stack margin upon margin upon margin.

MEMBER RYAN: Okay. I just wanted to get kind of an analytical feel for that. Thank you.

MR. JONES: For seiche flooding, Lake Rousseau, which is about three miles southeast of the site, maintains an operating pool of approximately 20 feet below the plant grade elevation of 51 feet. Now as you know with storms, you have to have the intensity, fetch and duration.

For Lake Rousseau, not only do you have it located three miles from the site, but what happens due to, I guess, the geometry of the lake, you will never get anything higher than about six feet in wave height, using even the maximum winds there.

So the stage runup and the run induced by seismically generated tsunamis, since tsunamis do not even approach the site, will not affect the site, as far as inducing a stage. Therefore, the staff agrees with applicant's conclusion that meteorologically or seismically induced waves set up in the lake would not adversely affect the plant.

Now for the probable maximum tsunami. The staff and the applicant performed independent numerical modeling. So you have the applicant that actually used what you saw was FUNWAVE, and we had one of our experts actually run the other Boussineq model that's used, the state of the art. They looked at the distant earthquake scenario --

CHAIRMAN RAY: Well, what's the other model? I'm sorry?

MR. JONES: A COULWAVE. It's a --

CHAIRMAN RAY: COULWAVE?

MR. JONES: It's also a boost, it's also a boosting. It's the Cornell University Long Wave model.

CHAIRMAN RAY: It sounds great, thank you.

(Laughter.)

MR. JONES: What happened is that they looked at all the sources possible. They looked at the distant earthquake sources. This includes the Canary Islands, this includes the Puerto Rico Trench. They looked at the regional sources, they looked at the submarine land slide sources in the Gulf of

Mexico.

The conditions, the most conservative source parameter, as you have seen before by the applicant, was the Mississippi Canyon. So that became --

CHAIRMAN RAY: Okay. Now again, you're using the term here "most conservative source."

MR. JONES: What happens is to explain this is that all right, in the case of our analysis, not only did we look at everything. We ran simulations for every source possible, taking in historical record, taking in what we plausibly believe to be the maximum maybe submarine landslide volume, we ran multiple simulations for it.

And what it is, under the probable maximum, if you use it in hurricane sense, the probable maximum was defined as the storm that, the hurricane that possibly couldn't be exceeded for that region. If you try to use that same analogy here, it would be if you take the most severe, realistic, plausible source that you can get, and you run the simulations on it, that you should not, based on historical and what you looked at globally, what you looked at locally, you could not supposedly get a tsunami higher than this.

CHAIRMAN RAY: I understand that. That's why I said earlier that it's like the maximum credible approach. But Henry, you do know that nowadays, people, particularly in the wake of Fukushima, realize that there's some probability of exceedance for almost anything you can think of.

MR. JONES: And I agree with you, and we've had a research program on since about 2007. We actually met in August up at Woods Hole, and we actually had an NRC-USGS landslide tsunami probable, you know, tsunami analysis, looking at how to do probabilities for tsunamis.

It was a very productive meeting. For submarine landslides, it's very difficult. For earthquakes, I mean they have these great models. I mean the modeling is actually there, but actually being underwater, the source is to actually get the -- now with side scan to get the data, and of course geologically, things have moved, riverbeds have moved, sources. It's very difficult to go how far back was this actually. We're looking at a current one, how far. So we're exploring that.

CHAIRMAN RAY: Okay. Well that's -- it's not pertinent to Levy particularly, but we are on the subject, and so I wanted to know where you were, and I think you've told me. But it's still something that's out there being looked at, but it's not anything that's within your term.

MR. JONES: Now for surge, it's different. For surge, actually there's a state of the art. Don Reisio, who used to work for the Corps; Peter Vickery, who did the work for the wind speed on structures. We actually have methods that when we do the Reg Guide, we'll be able to get probabilities. There's going to be big uncertainties in it, but we'll be able to get probabilities. So the old probable maximum hurricane will go away, and you will have exceedance --

CHAIRMAN RAY: Well, you can do the same thing with tsunami, but the uncertainties are just so big that it's nonsense at this time.

MR. JONES: That's what Eric Geist, if he was on the line right now, that's what he would say.

MEMBER BLEY: Henry, is there a report of some kind from your workshop?

MR. JONES: We can provide that, if you'd like that.

MEMBER BLEY: Please. Yes, please.

CHAIRMAN RAY: Yes, because inevitably, this issue will keep coming back, you know. You've got a probability curve for an earthquake. Why can't you have one for a tsunami, blah blah blah. That's something we've been thinking about. So it comes up here, and I just wanted your input.

MR. JONES: I'll provide a report to the committee.

CHAIRMAN RAY: Okay, proceed.

MR. JONES: The applicant determined that the probable maximum tsunami near the site was about 12.94. We actually came up with our modeling, an even more conservative estimate of about 20 feet. In both cases, the probable maximum tsunami does not reach the Levy County site plant grade elevation of 51 feet. That concludes my sections. Are there any questions?

(No response.)

MR. JONES: I'll turn this over to Mark McBride for groundwater.

MR. McBRIDE: Thank you. Because groundwater is not used for cooling or other safety-related purposes at this site, we were concerned primarily with two issues. One is that of the maximum groundwater level. Incidentally, there's a typo here. That should be 49 feet, not 48 feet.

That's of concern, primarily because it's used as a design parameter in calculating subsurface hydrostatic loadings of subsurface parts of the structures. The other issue that we're primarily interested in is the direction and the velocity of groundwater, which might carry radionuclides in case of an accidental release, which I'll talk about in just a moment.

Now let me remind everyone of the general hydrogeological conditions that we're talking about. The groundwater comes fairly close to the surface at this site, and it occurs in an unconsolidated surficial aquifer, and below that in the Floridan aquifer, which is predominantly limestone, some of it dolomitized, as has been pointed out.

The two aquifers are fairly readily connected. There's no confining bed in between them to hinder the flow of groundwater. Groundwater flows generally to the southwest in a horizontal direction. But there's also a vertical downward component of flow from the surficial aquifer down into the Floridan aquifer.

Now based on these conditions, the applicant investigated the local hydrogeology and developed a conceptual model as an aid for thinking about what happens in the groundwater system. They also devoted quite a bit of effort to determining the hydrological properties of the aquifers through pumping tests and other kinds of tests, and they developed a MODFLOW computer model to investigate the question of how high the maximum groundwater level could go.

I'll point out, in case you have looked at the corresponding environmental report, that there's a description of two different groundwater models in the environmental report. This is a different one. It draws, to some extent, on the insights from those models. But it was customized to look at the maximum groundwater level.

Next slide, please. The staff independently reviewed the applicant's analysis, including in particular looking very careful at the tests of hydrolite conductivity, how they were analyzed, and the relative merits of the different tests, the plausibility of various pathways for radionuclide transport with groundwater, and we concluded that the applicant's conceptual model was adequate, and that it addressed groundwater and pathway issues in a satisfactory way.

We did perform confirmatory analysis of groundwater levels, most importantly performing additional computer runs or starting from, I should say, the applicant's data set to further investigate parameter sensitivity.

We concluded that the model assumptions were conservative. Some of the kinds of conservatism involved were assuming a quite low hydraulic conductivity, and also assuming extremely high precipitation conditions. In fact, the probable maximum precipitation conditions with corresponding infiltration, and concluded that the maximum groundwater level would remain below the, again corrected to 49 feet elevation.

Next slide. The accidental release analysis started with the usual assumptions, which was the failure of the tank having the largest loading of radionuclides, which was the effluent holdup tank. We assumed that 80 percent of the volume of the tank was released directly to the Floridan aquifer.

In other words, we totally ignored any effects of water being trapped within the building, or any retardation that might occur within the surficial aquifer, and we assumed that the groundwater would transport contaminants to either a well at the site boundary, or to the Withlacoochee River, both more or less off in the southwesterly direction.

We reviewed the applicant's work, and the factors that we looked particularly at were the capabilities of the local hydrogeology to delay, disperse, dilute or concentrate the likely effluent, and how the applicant described the effects of postulated release on the possible receptors.

Next please. Our independent review looked at the release and transport scenarios, the conservatism of the assumptions and the calculation methods that were used, and also the effect of the pumping for other water supply purposes, or how that might divert or change the pathways of radionuclide transport.

What we concluded was that the release and pathway scenarios were acceptable, and that assuming direct release to the Floridan aquifer was highly conservative. Then there's the matter of the alternate analysis. There was some discussion between the staff and the applicant about the most conservative, reasonable parameters to use, and the applicant prepared an alternate analysis, which was more in line with the staff's thinking on the appropriately conservative values.

The maximum activities concentrations under the alternative analysis were still below the regulatory limit. This is the Appendix B concentrations.

MEMBER RYAN: I have a question on that last bullet. I'm not sure I understand it. It says "Maximum activity concentrations at receptors have resulted in an effective dose of," however many millirems. It says "less than 54 percent of the regulatory allowable activity, based on the alternate analysis." I don't know what that means.

MR. McBRIDE: Let me see. Are the PNL people on line again?

MEMBER RYAN: I'm just looking at what that -- I mean again, we can cover it tomorrow. But if I could find out what the effect of dose was in some unit of dose, that would end the problem. But that's very confusing the way it's written.

MR. McBRIDE: I'm sorry. I don't have that information with me.

MEMBER RYAN: That's fine. Then we can cover it tomorrow. But I understand where it's going, but kind of the words, I'm getting that's a cut and paste problem, two sentences cut down to one.

MR. McBRIDE: Okay. Well that concludes what I have to say.

MEMBER RYAN: Oh, and just one other question on the second bullet. The direct release to the Floridan aquifer was, I'm going to assume, without dilution or was it just the activity was injected?

MR. McBRIDE: Yes. Basically, the assumption was that 80 percent of the contents of the capacity of the tank was squirted directly into the Floridan aquifer.

MEMBER RYAN: You mean that 80 percent of the radioactive material was injected without dilution in the aquifer.

MR. McBRIDE: Solution, yes.

MEMBER RYAN: So I mean that's a very conservative thing to assume. I just want to make sure I understood it.

MR. McBRIDE: Yes. It's very conservative, and it also obviously avoids a lot of analytical problems.

MEMBER RYAN: And when you do it instantaneously, it also helps to maximize the concentration. I just want to make sure I had the picture in my head. Thank you.

MR. McBRIDE: Yes.

DR. HINZE: The transmissibilities in the Floridan aquifer, the FSAR, I believe, states that there's 100 percent variability. What's this variability due to and what is it's impact upon your calculations?

MR. McBRIDE: The variability comes from, you know, just plain homogeneity that's in the aquifer, plus variability in the methods used to measure the transmissivity.

DR. HINZE: So it's the hydrologic conductivity that's changing?

MR. McBRIDE: Yes.

DR. HINZE: And is this anisotropic?

MR. McBRIDE: I don't think we have any information on that. I would say probably not, not in a horizontal direction at least.

DR. HINZE: Okay. What would be the impact, then, of this? Did you, in your studies in MODFLOW and so forth, did you consider this 100 percent variability? What's the impact?

MR. McBRIDE: Okay. We didn't have enough information to really characterize the variations in transmissivity on an aerial basis. We know that it's different from place to place, by you know, 100 percent or so.

DR. HINZE: So it's aerial?

MR. McBRIDE: It's aerial. Yes, well --

DR. HINZE: It varies vertically as well.

MR. McBRIDE: Generally, the hydrologic

conductivity is highest near the top of the Floridan, and decreases with depth. To make another fine point, we're talking only about the upper Floridan, here above the middle --

DR. HINZE: First 100 meters or so, yes.

CHAIRMAN RAY: Anything else?

MR. ANDERSON: That concludes the staff's presentation for Section 2.4.

CHAIRMAN RAY: All right. So now we can decide if there's anything we can bring forward from tomorrow's agenda. What's your thinking, Brian?

MR. ANDERSON: The staff is prepared to bring forward the agenda item Chapters 15 and 17, Design Basis Accident, Radiological Consequences and QA. That's in the afternoon portion of the agenda tomorrow.

CHAIRMAN RAY: And how do you guys feel about that?

MR. KITCHEN: You said 15 and 17?

MR. ANDERSON: Through 15 and 17.

CHAIRMAN RAY: Here's the microphone.

MR. KITCHEN: Yes, we can do that. We can proceed with 15 and 17, or for that matter, 20 through 23, or whichever you prefer.

CHAIRMAN RAY: Well, it's up to you guys.

I'm just interested in making sure that we don't fritter away time here, and then wind up with you guys being held up longer than necessary tomorrow. So go ahead. You decide, and we'll just give you another -- yes. We'll take, let us take a break until, a six minute break until 25 after the hour, and you tell us what you want to talk about.

(Whereupon, the above-entitled matter went off the record at 4:17 p.m. and resumed at 4:24 p.m.)

CHAIRMAN RAY: Okay. We'll pick up a couple of items from tomorrow's agenda, with the idea in mind that we want to make sure we don't waste time today, but we won't go beyond, won't plan to go beyond 5:00. I doubt that we need to here, but we'll see. But I'm not trying to keep people here until late at night.

ACRS does that plenty, much of the time, but not usually when we're engaged with an applicant. But I do think it's a good idea for us to use this time, and it's been suggested that FSAR Sections 15 and 17, as shown here, are available, ready to go and there's no good reason why we shouldn't do it. So go ahead.

MR. KITCHEN: All right. I'm Bob Kitchen. These are pretty, I believe, fairly straightforward, so probably a good selection here. We're going to talk first about Chapter 15, which is accident analysis. This was purely standard material. The parts that we did for the Levy site, of course, was to ensure that the site-specific atmospheric, the dispersion values or X/Q values that we identified in Section 2.3 were covered by the values in DCD Section 15 Alpha. We did confirm that, and therefore had no changes to make, in terms of ensuring that the site was bounded.

With regard to Chapter 17, QA, two pieces of this really. Of course first of all, we incorporated the DCD material by reference. Also, we adopted the standard material, which was the NEI-06-14 Alpha, which is a QA template developed by the industry and the NEI.

The QA PD for Levy is included in Part 11 of the COLA. The other factor with regard to quality assurance is during development of the COLA, of course, we needed to have a QA program in effect, and we adopted the -- we don't have a fleet QA program within Progress Energy. Each plant has a QA program that's approved by the Commission.

We have adopted the Shearon Harris Nuclear Plant QA program for development of our COLA. So we developed the QA program using those procedures specifically identified for COLA development, and used those in development. That program is defined at Harris in the existing Unit 1 FSAR. Really, that's all we have to say about 15 and 17.

CHAIRMAN RAY: Well, as expected, that didn't take long, and I'll ask my colleagues if there are any questions anyone has on the subject?

MEMBER RYAN: None whatsoever.

DR. HINZE: Can I ask a quick question?

CHAIRMAN RAY: Of course.

DR. HINZE: The parameters for the drilling, as we put here, were less than desirable for obtaining certain rather useful information. I gather that those parameters are followed in the QA? We're talking about the rate of drilling, we're talking about the types of drilling that was being done, and the need for the offset program of boring.

MR. KITCHEN: I may get a little assistance on this, but in the course of doing the evaluation of the site conditions for COLA, we did develop procedures for the drilling activities on site, and those procedures complied with requirements, and I don't know the specific reg guides, but in terms of the locations of borings underneath the foundation.

Actually, I think we exceeded significantly the minimum that would have been allowed. But in terms of from a quality standpoint, and also the procedures reviewed and approved from a technical standpoint, and then to ensure that from a quality standpoint, they met requirements and were complied with.

I think that some of the problems we had with the drilling, as we saw, were maybe unexpected conditions, as opposed to a quality control issue, in terms of where we thought we had low recoveries, as Paul talked about quite a bit.

DR. HINZE: Yes.

MR. KITCHEN: So I think that was really more of an unexpected condition, as opposed to a quality issue in terms of procedure development or control.

DR. HINZE: Okay. So there were quality assurance specifications that you worked within?

MR. KITCHEN: Absolutely.

DR. HINZE: Okay, thank you.

CHAIRMAN RAY: Anything else? If not, we'll hear from the staff on these subjects, and then we'll go over a summary of today, to see that we've got everything identified that we need to keep track of after the meeting is concluded, and we'll adjourn. Unless you guys want to get out of here early tomorrow, we can stay if you want, do more. Think about it. It's up to you.

MR. HABIB: I'm okay. This is Chapter 15 for Levy. My name's Don Habib. I'm a project manager in NRO. The technical staff working on this was Michelle Hart in the Siting and Accident Consequences Branch.

CHAIRMAN RAY: Don, watch that microphone with your papers. Thank you.

MR. HABIB: This table shows the contents of what was reviewed in Chapter 15. It basically identifies what's site specific and what's IDR in standard, and you can see that there are two site-specific items, the consequences of liquid tank failure, and that was talked about in the previous presentation. It was also covered in 11.2

Then the one item we're going to present here is the design basis accident radiological consequences analysis. What the applicant did, basically incorporated by reference, the DBA, dose analysis from the DCD, three locations, the offsite dose factors at the control room and at the technical support center.

When they incorporated by reference, they need to show that the short-term dispersement factors values are less than the DCD values, and those are the only site-related, site-specific inputs. Their X/Q short-term dispersement factors, they provided those. They are less than the AP 1000 DCD factors. The doses are proportional to those factors. We concluded the doses were less than the AP 1000 doses, and that's for all three locations, offsite, control room at the TSC.

CHAIRMAN RAY: And that tower's been in operation for how long?

MR. HABIB: I'd have to ask the applicant.

DR. SINGH: It's been in operation since February of 2007.

MEMBER REMPE: What is the short-term? Is it eight hours, 30 days? What is the definition of the short-term X/Q's? How long is that period?

MR. HABIB: It's two hours.

MEMBER REMPE: Just the two hours, okay.

MEMBER RYAN: When you say there was some difference between the DCD values and what they calculated, what was the margin? Just a rough idea. Was it a factor of ten, a factor of two?

MR. HABIB: They were bounded.

MEMBER RYAN: By .01 percent, with what, a factor of two? Just any kind of rough estimate is fine.

MR. HABIB: I'd have to look it up.

MEMBER RYAN: Okay, that's fine. I didn't mean to put you on the spot today. If you want to just take that as a homework equation, we can put it in the record tomorrow. That will be fine, a homework assignment.

MR. HABIB: It's about a factor of two. About a factor of two.

MEMBER RYAN: For both the short term and the longer term?

MR. HABIB: I'm looking at the -- the exclusionary boundary was a factor of two. For the control room, it wasn't in order of magnitude. It's less than that.

MEMBER RYAN: Okay. But does it create a factor of two? I'm just trying to get an idea. That's fine.

MR. HABIB: I'd say some of these are on the order, are a factor of two. The rest of them look like more than a factor of two.

MEMBER RYAN: Okay. So two is kind of the minimum factor, and then maybe a few are larger?

MR. HABIB: Yes.

MEMBER RYAN: That's fine. Thank you very much.

MR. HABIB: We have a technical staff person who can come tomorrow if you have more questions.

MEMBER RYAN: If it's not much different than your answer given there, there's no need. But if it is different, I'd like to hear about it. Thank you.

MR. HABIB: Okay, done.

CHAIRMAN RAY: All right, Tom.

MR. GALLETTA: All right. This presentation is the staff's review of Chapter 17, Quality Assurance for the Levy County COL Application. My name is Tom Galletta. I'm the project manager in the Division of New Reactor Licensing, AP 1000 Branch.

In support of this chapter and in the audience, from the technical staff is Raju Patel, Office of New Reactors, again, Quality and Vendor Branch.

CHAIRMAN RAY: Can you please explain to us Galletti versus Galletta?

(Laughter.)

CHAIRMAN RAY: Small towns are they? How

far apart are they in Italy?

MR. GALLETTA: Quite a bit. Galletta is from the Lipari Islands and actually Stromboli in southern Italy, just north of Sicily, and Galletti is up in northern Italy, Calabrese.

CHAIRMAN RAY: Well now I see.

MR. GALLETTA: Get that on the record.

CHAIRMAN RAY: Some insight that is. Thank you.

MR. GALLETTA: Probably some relation if you go far enough back. The majority of Levy 17 is incorporated by reference. Again, IBR or IBR standard content. Inherent to each COL, however, is the development of a site-specific quality assurance program.

The two highlighted sections on this slide identify Levy site-specific evaluations. Section 17.1 describes Levy's quality assurance program prior to COL issuance, while Section 17.5 describes Levy's quality assurance program following COL issuance.

The quality assurance program prior to COL issuance is described in FSAR Section 17.1. Progress Energy Florida is using the existing Progress Energy Nuclear Quality Assurance Program for the oversight of contractors. This was mentioned also by the applicant.

The staff inspected the program as it is being applied to Levy nuclear power plants 1 and 2, and found it acceptable. The staff performed a limited scope inspection on April 12th-16th, 2010, at the Progress Energy offices in Raleigh, North Carolina. The inspection report was issued in June of 2010, and no violations were identified.

Quality assurance program following COL issuance is described in FSAR Section 17.5. The COL FSAR Q/A PD is based on NEI Template 06-14 Alpha, Revision 7. The NRC used the requirements of Appendix B to 10 C.F.R. 50, and the guidance in SRP Section 17.5 for evaluating acceptability of LNP COL FSAR Chapter 17.

The QA PD complies with the acceptance criteria in SRP Section 17.5, and the commitments to applicable regulatory guidance. The QA PD provides adequate guidance for the applicant to establish controls that, when properly implemented, comply with Appendix B. That's the staff's presentation on Chapter 17. Do you have any questions?

MEMBER BROWN: Yes. Does this mean that you have two different QA processes, where you're going to be running some? Is that going to be --

MR. GALLETTA: I meant to ask that.

(Simultaneous speaking.)

MR. GALLETTA: We'll let Raju answer that question, just to be on the safe side.

MEMBER BROWN: I mean I didn't quite understand. I've got one before and I've got one after. Obviously, that's in the paper work.

MR. PATEL: I'm Raju Patel from the Office of New Reactors, Quality and Vendor Branch. Prior to issuance of the COL, the applicant is using the existing quality assurance program.

MEMBER BROWN: I got that.

MR. PATEL: Okay, and then they have submitted a QA program description for the applications that will be applied after the COL is issued.

MEMBER BROWN: I got that too. Are they different?

MR. PATEL: They're not different.

MEMBER BROWN: Well, that was the question. So they're the same?

MR. PATEL: Yes.

CHAIRMAN RAY: Well, they meet the same requirements.

(Simultaneous speaking.)

MEMBER BROWN: Well no. I understand there's requirements, and then there's processes you put in place. And that's what I'm asking. I mean are you going to have two different sets of processes that people are going to be following. Meeting the requirements is one thing. I don't have any problem with that. But I'm just worried about a confusion factor. I mean --

MR. PATEL: Well, it would be the same fleet. They're using --

MALE PARTICIPANT: I think the applicant started to answer that.

MR. SEBROSKY: This is Joe Sebrosky. I think we need something from the applicant as far as the construction portion of the QA program.

MEMBER BROWN: Correct.

(Simultaneous speaking.)

MEMBER BROWN: That's why I'm asking the question. That's all.

MR. KITCHEN: This is Bob Kitchen. To answer your question, first of all for the COLA development, we used, as he said, an existing QA program, which is specifically the Shearon Harris program. So we basically adopted, for example, if we were doing engineering reviews or a practice that we needed for COLA development, we used the existing procedures and the QA program for coverage that we would use at Harris.

In our application, we specified that we're going to adopt a QA program based on NQA-1 1994 SAME code. The current fleet is operating to the N45 too. So there is actually a change in the QA program from what we have currently in the fleet, versus what we would have post-COL.

The requirement in our license is that we implement that new QA program for the new plant, either within -- excuse me, within 30 days of the license, or prior to safety-related activities that require QA, and that is an activity we have to do.

We have to adopt revised procedures, implement a program for those activities we're going to do as we move forward with new plant development. So there will be a transition, and to answer your question, in the Progress Energy fleet and for that matter, the Duke fleet, we'll be having a fleet program based on N45-2, and at least for a period of time, a new plant program based on NQA-1 1994.

MEMBER BROWN: You said for a period of time.

MR. KITCHEN: Until the fleet decides to

transfer --

MEMBER BROWN: Transition to the new one, that the new plants fall under?

MR. KITCHEN: Yes, right.

MEMBER BROWN: So you will have -- your fleet will be following two different sets of procedures then?

MR. KITCHEN: Yes sir. You know, and then ultimately, you know, you would think, I can't say this for a fact, but that we would probably go to a common fleet, NQA-1 1994 or a later version-based program. The differences between the two QA programs are there. They're in most cases subtle.

I think they more impact areas like procurement and warehouse storage and those sorts of things. There are differences, but not like it's radically a different program.

MEMBER BROWN: I asked the question only because past history when were building equipments, we had vendors that were building stuff. But they weren't dedicated nuclear manufacturers, so they had some commercial procedures that they adopted, they had our procedures which they adopted, and all of the sudden we saw some slip into ours and with some consequent consequences which they didn't appreciate.

So there were differences. That's all. So I understand what your point is. Thank you.

CHAIRMAN RAY: Okay. Anything else?

MR. KITCHEN: We are good.

CHAIRMAN RAY: All right. We're take a few minutes now to review what our action items are. We'll keep this discussion on the record, since we can capture the results of it that way most effectively. Did you want to participate in this?

MR. ANDERSON: NRC staff is certainly interested in making sure that we've got the same list of action items and follow-up.

CHAIRMAN RAY: What I'm asking is do you want to come up here and do it, or you want to do it from there? How do you want to take care of it? Do you want to tell us what you think the action items are? I assume that you have a spokesman for that. Okay. We, of course, have our own list.

So let me ask the applicant to tell us any things that he feels we have asked for that you haven't yet responded to, and that you intend to respond to.

MR. KITCHEN: Okay. This is Bob Kitchen. The items that I've captured is Mr. Hinze would like to see, we discussed that bedrock topography map. So we're having to provide those for the ACRS. There was a question about 2008 USGS seismic analysis, and the fact that we should review how we're going to document the impact of that on our analysis, if any, and possibly address that at the full ACRS Commission meeting would be one tack.

There were questions about how much confidence, or how much uncertainty, I think was really the question, what's the uncertainty around the 10 to the minus 4 percent dissolution rate, and feedback requested regarding that.

I think one other, and I just wanted to clarify. I think Member Bley had a question about FSAR 19.59 --

MEMBER BLEY: I think that was clarified.

MR. KITCHEN: I think it was. I just wanted to make sure.

MEMBER BLEY: No. I have nothing remaining there.

MR. KITCHEN: Then those are the ones that I had.

CHAIRMAN RAY: All right. Bill, did you want to add anything to what he just recited?

MR. ANDERSON: Yes. There was the request to Kathryn Hanson for the displacement on the Vernon

1951 faults. Kathryn Hanson was going to provide that to us.

MR. KITCHEN: So that was the strike slip, dip slip --

DR. HINZE: Right, and what the order of magnitude was.

(Simultaneous speaking.)

DR. HINZE: I thought that was important in terms of the geophysical expression in the resolution.

CHAIRMAN RAY: And anything that you would like to respond to tomorrow, of course we'll arrange to do that. But you can also find a way, if it becomes necessary, to insert it in a full Committee meeting.

(Simultaneous speaking.)

MEMBER RYAN: -- my question, they're going to come back some more data on the X/Q.

CHAIRMAN RAY: Yes. I was going to turn over this way and see what else there is. I wasn't done. I didn't want you to think I was cutting it off. Staff want to add anything?

MR. ANDERSON: There were several questions that I think NRC responded to during the course of the discussion today, but I have two outstanding items. During the staff hydrology discussion, Henry Jones mentioned a report from a Woods Hole workshop, an NRC-USGS report that we committed to providing to the committee.

CHAIRMAN RAY: Yes, but that's outside the context of the Levy proceeding, so we don't need to keep that on a Levy action item list.

MR. ANDERSON: Okay. Then I guess the single item that I had was I believe it was the last bullet on our groundwater slide had some weird language about some percentage of regulatory requirements, and we were going to respond to a question of what was the actual dose --

MEMBER RYAN: Yes. It looked like a cut and paste probably. Okay, thanks.

CHAIRMAN RAY: All right. Weidong, do you want to add anything to that?

MR. WANG: I think staff mentioned that they will, I'm sure they will prepare for tomorrow, is Dr. Ryan asked about the double-walled pipe for that same issue.

CHAIRMAN RAY: Make sure Bob understands. The question was discharge line, double-wall.

MEMBER RYAN: Yes. What kind of construction and what kind of protections do you have, kind of in line with NEI-08-08.

MR. ANDERSON: Right, I understand. That's on tomorrow's agenda.

MR. WANG: Yes. That's what I thought.

CHAIRMAN RAY: Okay, that's right. It was going to be something we get to tomorrow. That's right.

MEMBER RYAN: I mentioned this earlier. The other one was the X/Q, maybe getting some more detail on those differences from the calculated values.

MR. ANDERSON: Okay. Would you like additional confirmation on the margins that were presented?

MEMBER RYAN: Yes, what the margins were, yes. I got kind of a rough idea from today, but just to confirm that's close enough or that's what they are, that's fine.

MR. ANDERSON: We will provide specifics as to what those margins actually are.

MEMBER RYAN: Great, thank you.

CHAIRMAN RAY: Joy, do you have anything?

MEMBER REMPE: No.

CHAIRMAN RAY: Charlie?

MEMBER BROWN: No.

CHAIRMAN RAY: Mike?

MEMBER RYAN: Nope, that's it. Nothing more.

CHAIRMAN RAY: Bill? Okay. Today we're finishing just about on time here, ten minutes to 5:00. I'm going to be, have a whip in hand tomorrow though, and try to make sure everybody gets done on time, because I know what it's like to have things drag out to the end of the day. With that, we will adjourn until 8:30 tomorrow morning.

(Whereupon, at 4:49 p.m., the meeting was recessed, to reconvene on Wednesday, October 19, 2011 at 8:30 a.m.)

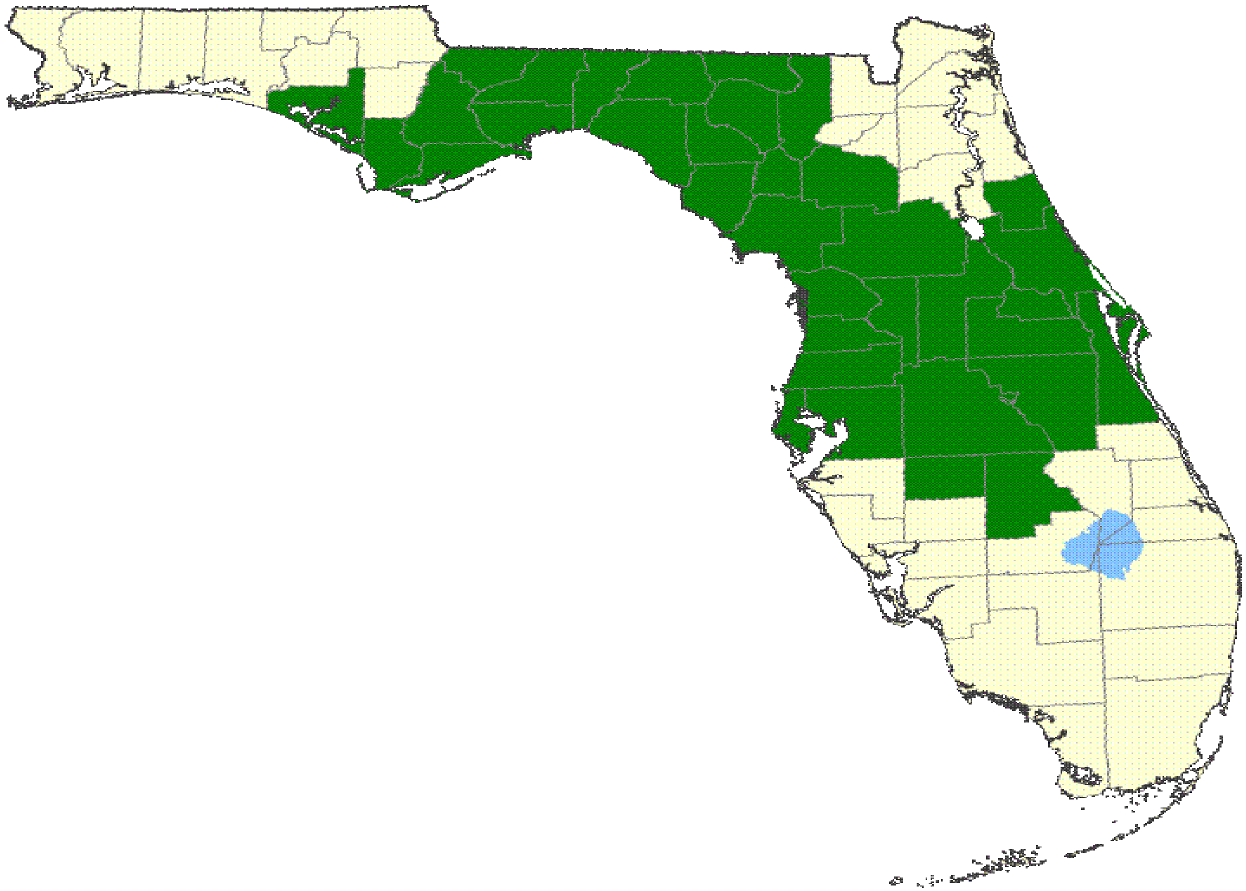
Levy County Units 1 and 2 Combined License Application

John Elnitsky
Vice President
New Generation Programs & Projects

NGG
Think Fleet.

Progress Energy

Progress Service Territory



Site Location

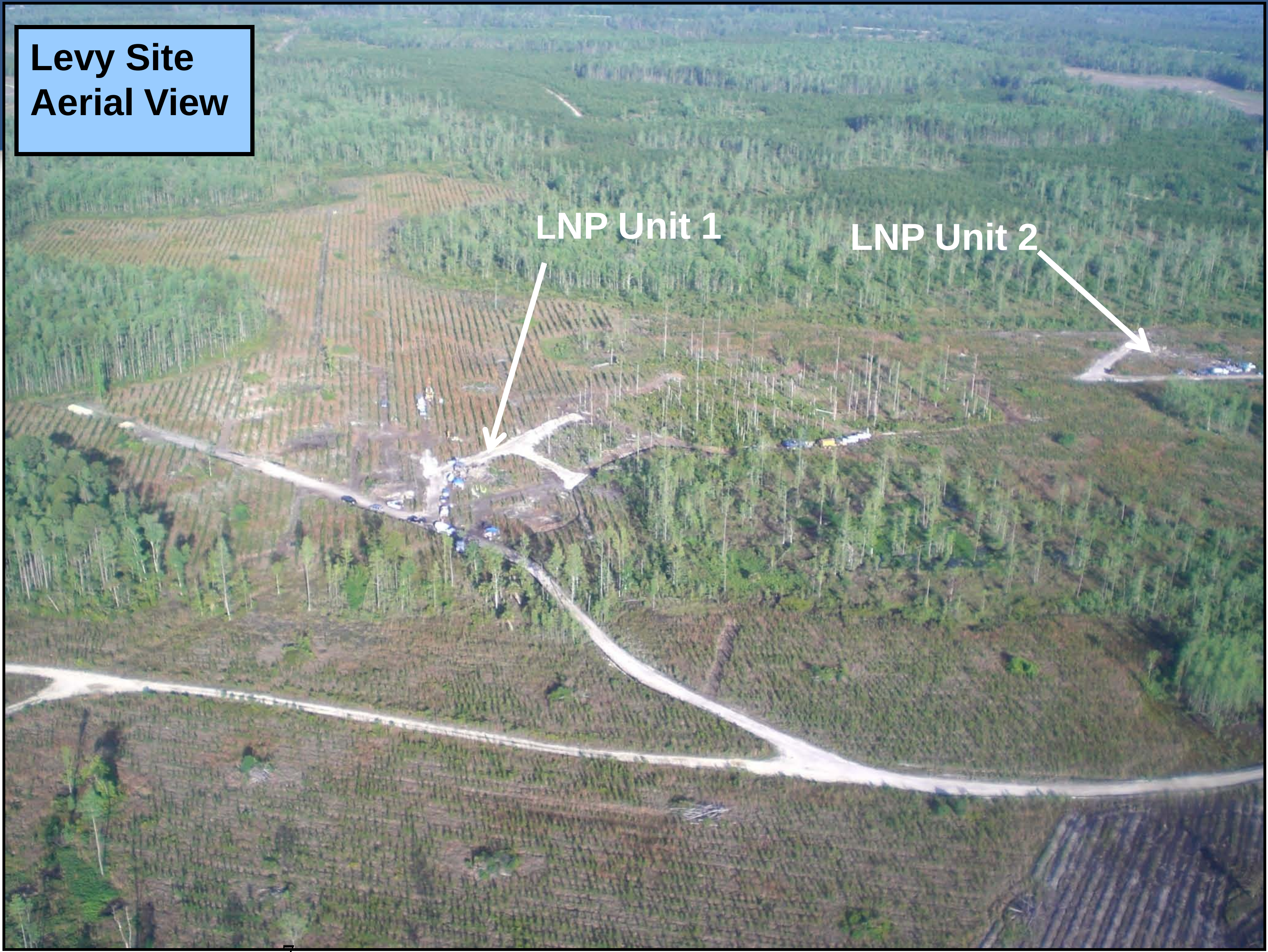
Levy County Units 1 and 2 Combined License Application Overview and Chapter 1

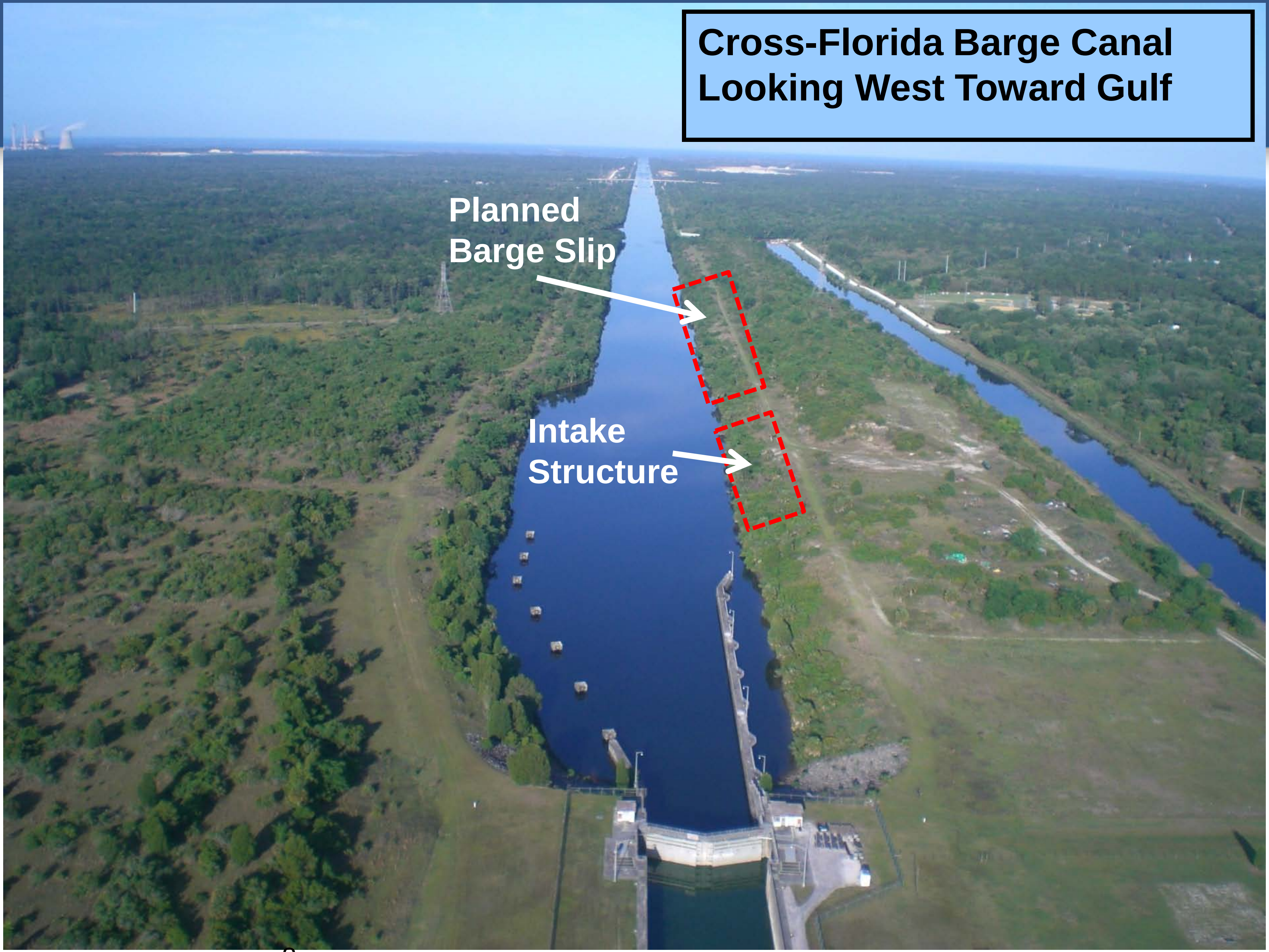
Bob Kitchen – Manager
NGPP Licensing

Site Location

Levy Site

Progress Energy


Levy Site
Aerial View
LNP Unit 1
LNP Unit 2


Cross-Florida Barge Canal
Looking West Toward Gulf
Planned
Barge Slip
Intake
Structure

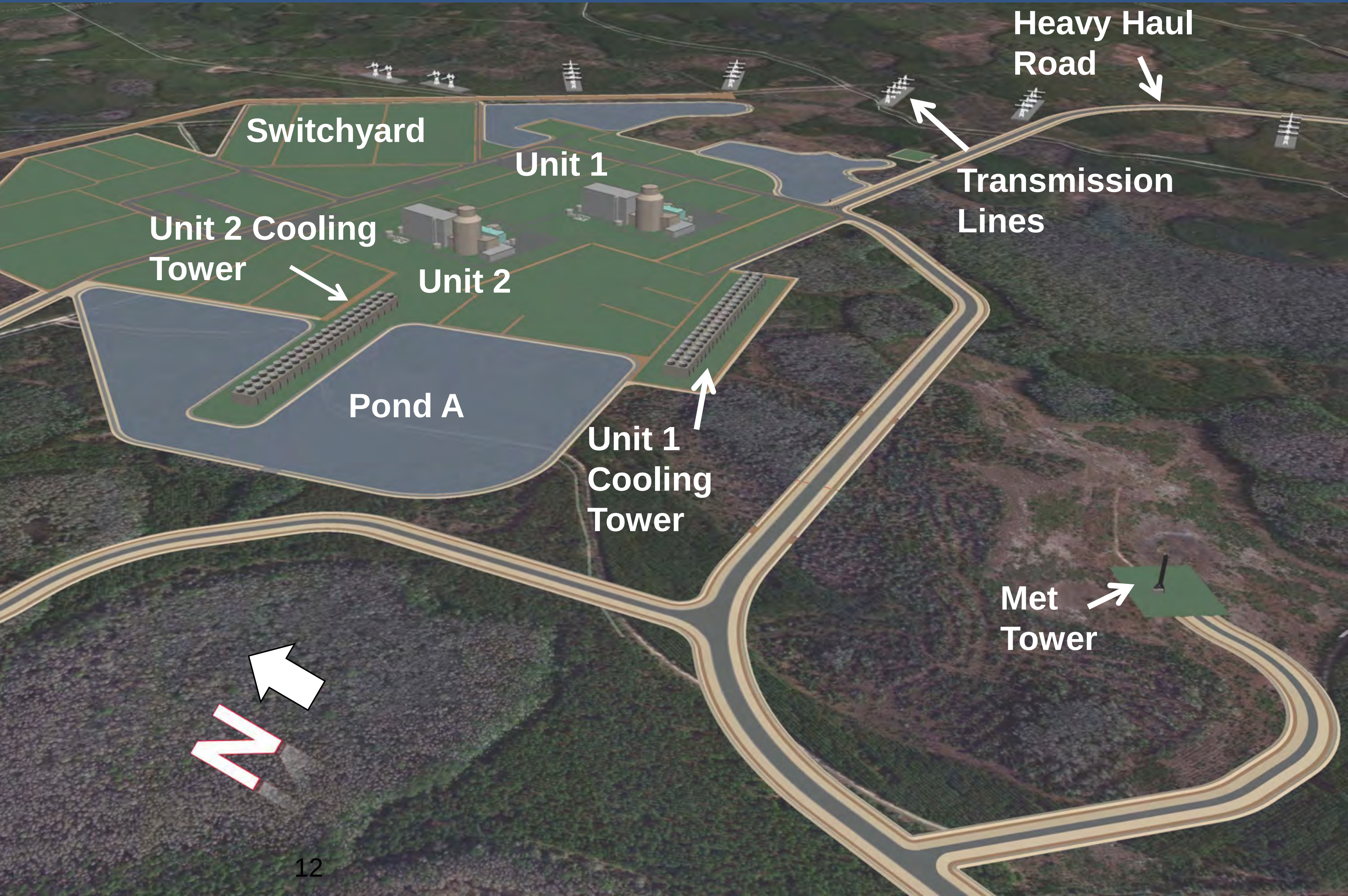
Levy Nuclear Plant Transportation & Water

Crystal River Site Discharge Canal

Chapter 1
Introduction and General Description

- DCD Incorporated by Reference
- Standard material incorporated (including supplements, departures and exemptions)
- Additional site-specific material contained in Sections:
  - 1.2 – Site Layout
  - 1.4 – Identification of Agents and Contractors
  - 1.8 – Interfaces for Standard Design

Section 1.2 Site Layout



Section 1.4
Identification of Agents and Contractors

- COLA Development
  - Sargent & Lundy
  - Worley Parsons
  - CH2MHILL
- Engineer, Procure, Construct (EPC) Contract
  - Westinghouse Electric Company
  - Shaw Group
- Other Technical Support

NGG Think Fleet.

Progress Energy

Section 1.8
Interfaces for Standard Design

- Two Standard Departures
  - Renumber FSAR Sections (1.1-1)
  - Current limiting for voltage regulating transformers (8.3-1)
- Two Standard Exemptions
  - COLA organization and numbering
  - Special Nuclear Material
    - Material Control & Accounting program (Parts 70 and 74)

Presentation to the ACRS Subcommittee

Levy County Units 1 and 2
COL Application Review

Overview of Advanced Safety Evaluation (ASE) and ASE Chapter 1
Introduction and Interfaces

October 18-19, 2011

Staff Review Team

- Technical Staff
  - Aaron Szabo, NRR
  - John Frost, NSIR
  - Duncan White, FSME
  - Ed Roach, NRO
  - Stan Echols, NMSS
  - Gregory Chapman, NMSS
  - James Downs, NMSS
- Project Management
  - Denise McGovern

Overview

- Staff’s philosophy for presentations
  – The staff does not intend to brief the ACRS subcommittee on Certified Design or standard content material
  – Chapters that will not be presented include the following:
    - o Chapter 4, “Reactor”
    - o Chapter 5, “Reactor Coolant System and Connected Systems”
    - o Chapter 7, “Instrumentation and Control”

Overview Cont'd.

- The staff does intend to provide a high-level description of the site-specific content on a chapter by chapter basis
  - The staff does not intend to brief every site-specific item, rather it intends to brief the ACRS on a subset of those issues, as appropriate

Levy County COL Application

- Levy County Application consists of:
  - Material incorporated by reference (IBR) from the AP1000 Design Control Document (DCD)
    - Staff's safety evaluation for the AP1000 design certification reflected in NUREG-1793 and its supplement
    - Staff's safety evaluation of AP1000 DC amendment was completed and presented to the committee

Levy County COL Application Cont'd.

- Standard content material (applicable to all AP1000 COL applicant)
  - The Levy County safety evaluation for standard content references Vogtle's advanced safety evaluation report
    - o Standard content evaluation material is double indented and italicized
    - o Standard content evaluation contains some language from the Bellefonte safety evaluation report with open items to capture evaluations that were performed when Bellefonte was the reference COL
- Levy County plant specific information

Levy County COL Overview

Part Number	Description	Evaluation
1	General and Administration Information	Section 1.5.1
2	Final Safety Analysis Report	In Appropriate SER Chapters
3	Environmental Report	Final Environmental Impact Statement
4	Technical Specifications	Chapter 16
5	Emergency Plan	Section 13.3
6	Limited Work Authorization Request	Not Applicable
7	Departures and Exemption Requests	In Appropriate SER Chapters
8	Safeguards / Security Plans	Section 13.6
9	Withheld Information	In Appropriate SER Chapters
10	Proposed Combined License Conditions (Including ITAAC)	In Appropriate SER Chapters
11	Enclosures (Cyber Security, QA, LOLA)	Sections 13.8, 17 and, 19A

Overview of Levy COL FSAR Chapter 1

FSAR Section	Summary of Departures/ Supplements
1.1 Introduction	Incorporated By Reference (IBR) with Standard and Site-Specific Supplements
1.2 General Plant Description	IBR with Site-Specific Supplements
1.3 Comparison with Similar Facility Designs	IBR
1.4 Identification of Agents and Contractors	IBR with Site-Specific Supplements
1.5 Requirements for Further Technical Information	IBR
1.6 Material Referenced	IBR with Standard and Site-Specific Supplements
1.7 Drawings and Other Detailed Information	IBR with Site-Specific Supplements
1.8 Interface for Standard Designs	IBR with Site-Specific Supplements
1.9 Compliance with Regulatory Criteria	IBR with Site-Specific Supplements
1.10 Nuclear Power Plants to be Operated on Multi-Unit Sites	Standard and Site-Specific Supplements

Departures and Exemptions

Departures

- COL application organization and numbering (Section 1.5.4)
- Class 1E voltage regulating transformer current limiting features (Section 8.3.2)

Exemptions

- COL application organization and numbering (Sections 1.5.4 and 2.0)
- Exemption from 10 CFR 52.93(a)(1)
- From requirements of 10 CFR 70.22(b), 70.32(c), and 10 CFR 74.31, 74.41 and 74.51(Section 1.5.4)

Levy Nuclear Plant Overview FSAR 2.5 and Foundation Design

Vann Stephenson
General Manager
NGPP Engineering

NGG Think Fleet.

Progress Energy

Section 2.5 / Chapter 3

- Overview
  - Vann Stephenson

- Sections 2.5.1, 2.5.3 & 2.5.4 (Geology / Geotechnical)
  - Dr. Paul Rizzo

- Foundation Concept
  - Dr. Paul Rizzo

- Sections 2.5.2 (Vibratory Ground Motion)
  - Dr. A.K. Singh

- Chapter 3
  - Dr. A.K. Singh

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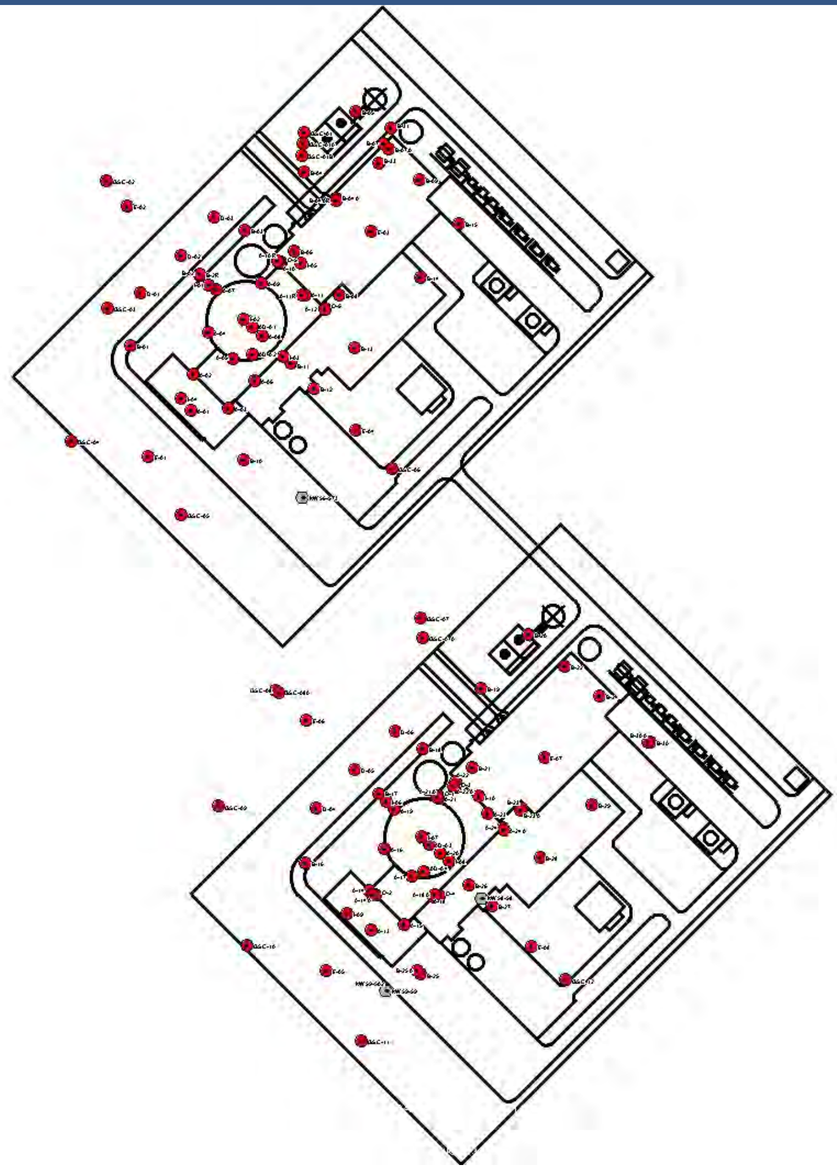
Site Characterization – RG 1.132 Compliant

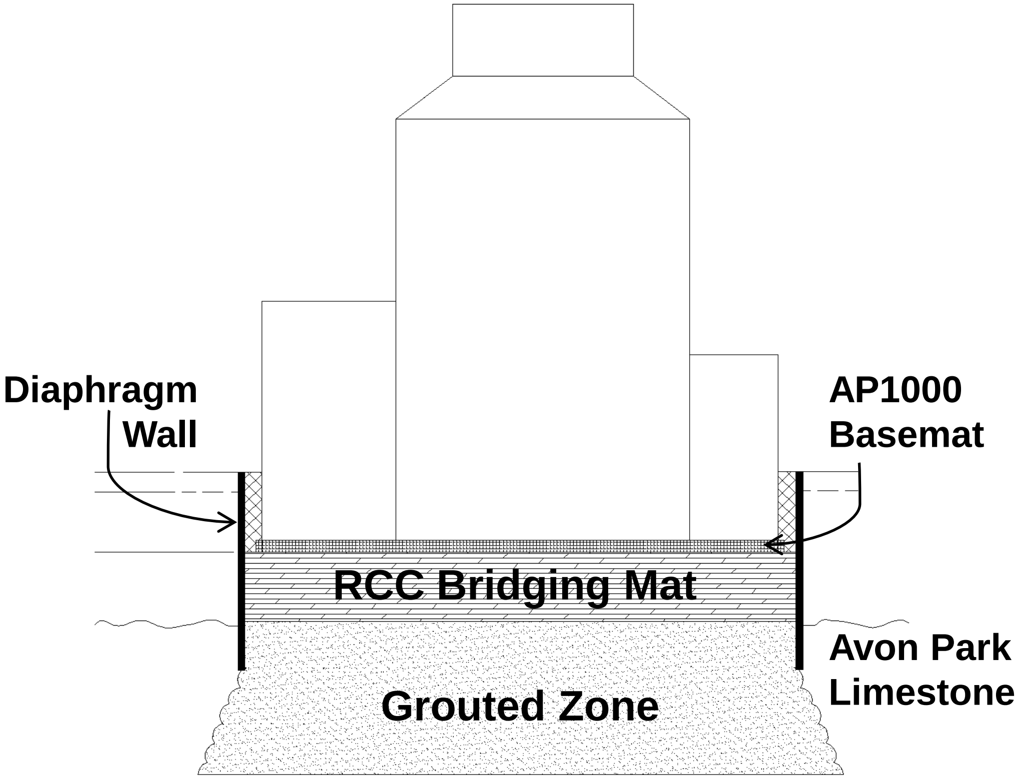


Site Characterization – Summary

- Avon Park Formation (bedrock) located approximately 67 feet below existing grade
  - Existing Site Grade is at Elevation 43 ft.
  - Design Plant Grade is at Elevation 51 ft.
- Water Table varies 1 to 8 feet below the existing site grade
- Soil Boring Program:
  - Identified isolated zones of low recovery – conservatively postulated to be small karst features
  - A supplemental subsurface investigation was performed to further investigate the areas of low recovery.
  - Identified a few isolated pockets of potentially liquefiable material in the overburden above the Avon Park Formation. (Note that the earthwork design provides features to prevent liquefaction)

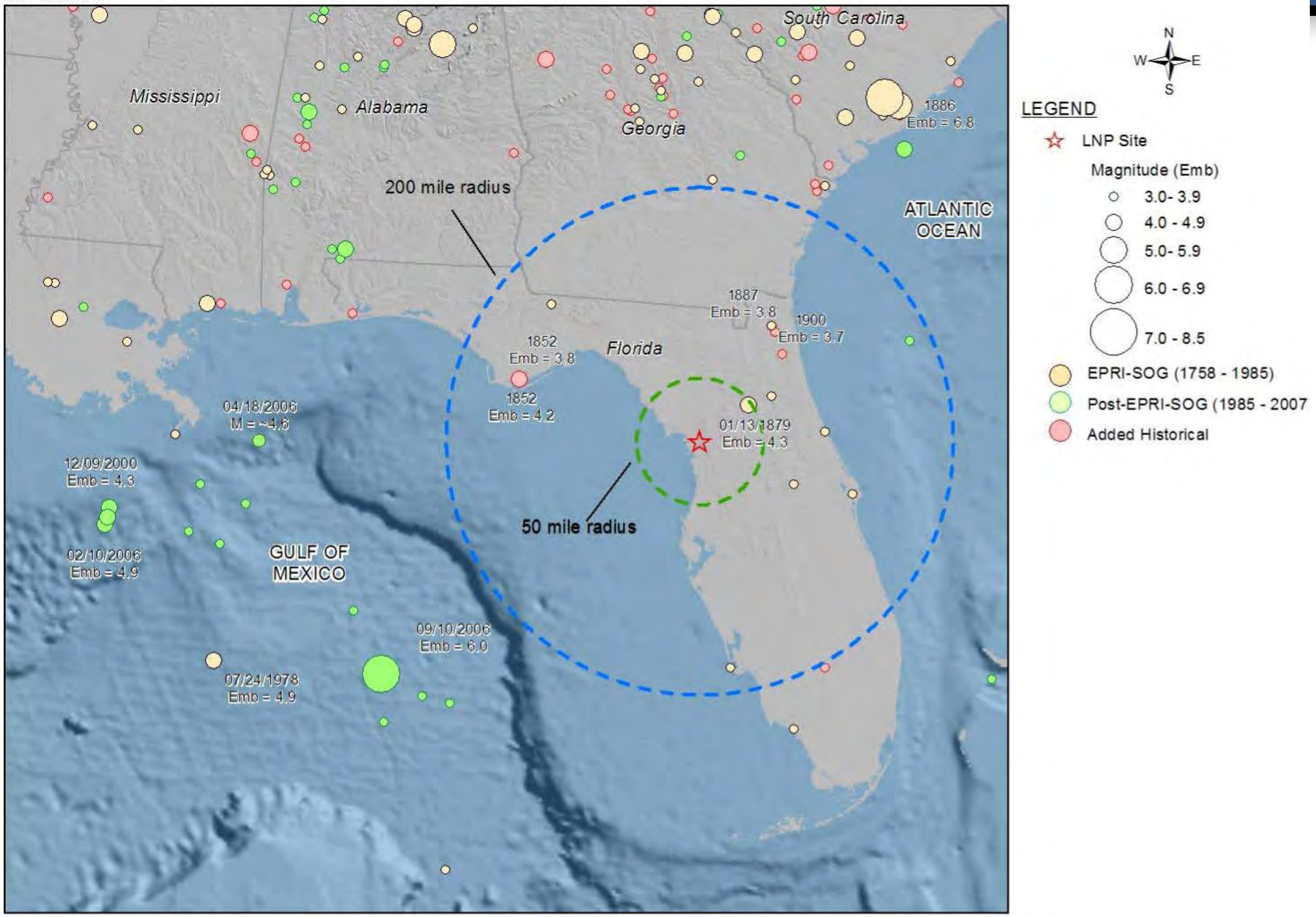
Nuclear Island Foundation Design Concept

- Diaphragm Wall
- 75-foot thick Grouted Zone
- 35-foot thick RCC Bridging Mat
- AP1000 Basemat



Regional Seismicity

LNP COL 2.5-2



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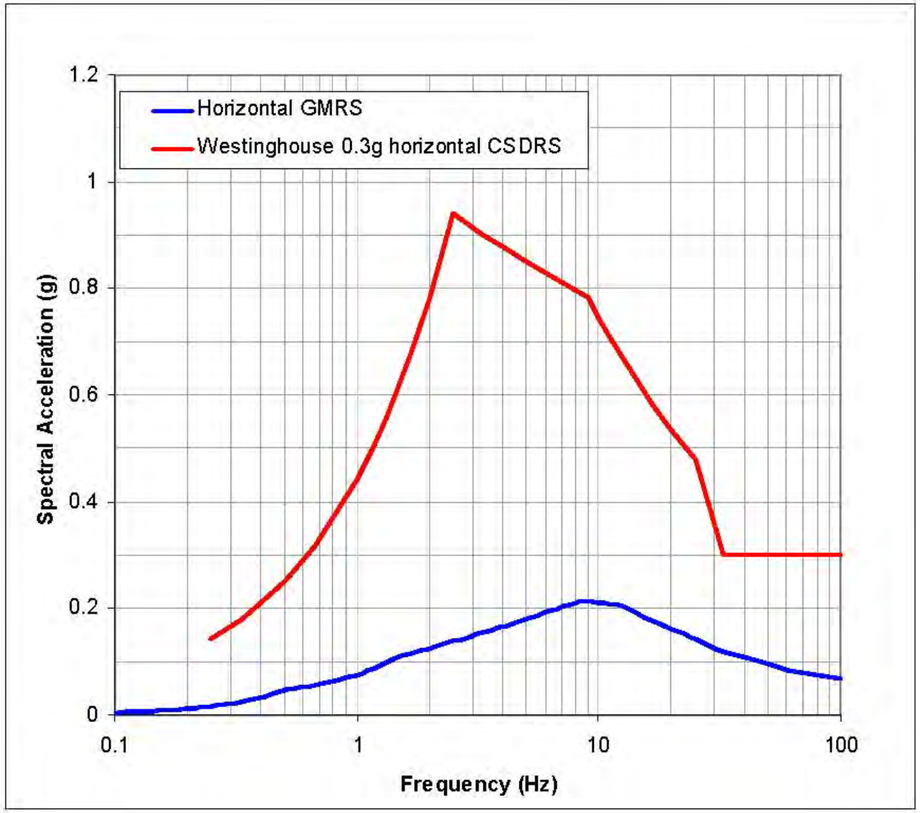
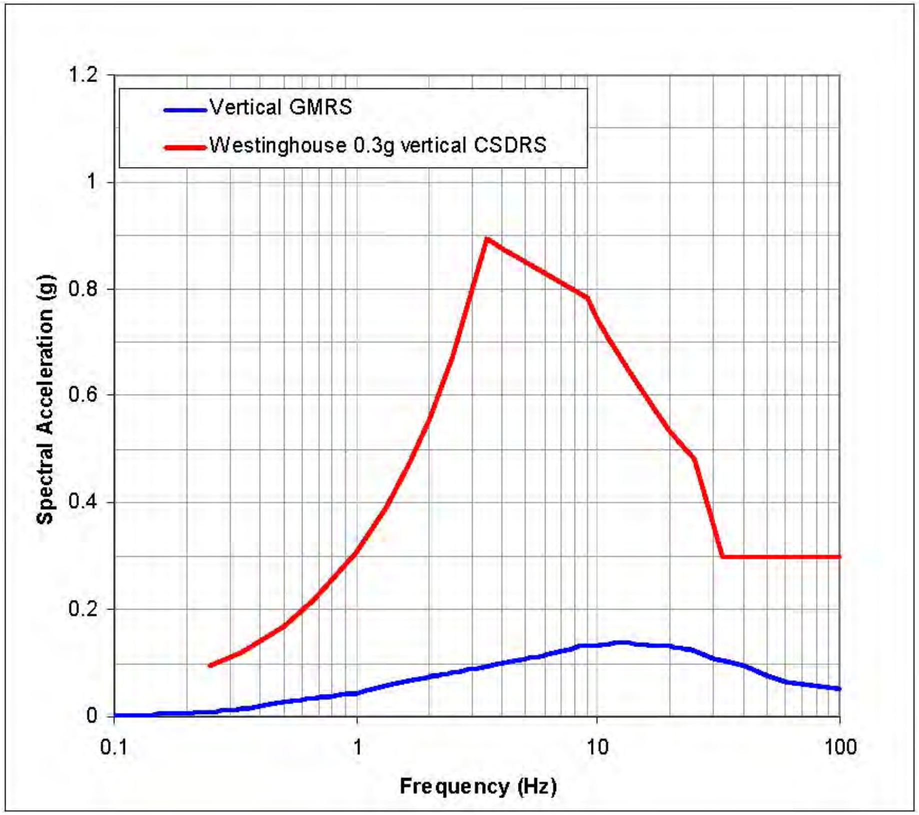
Levy Ground Motion Response Spectra vs. AP1000 Certified Site Design Response Spectra





Site Specific Soil –Structure Interaction Analysis

- 3D SSI analysis performed considering site characteristics
  - LNP floor response spectra are enveloped by DCD AP1000 Floor Response Spectra (FRS)

Levy Nuclear Plant
FSAR Sections 2.5.1, 2.5.3, 2.5.4
and Foundation Concept

Dr. Paul Rizzo
Paul C. Rizzo Associates, Inc
Foundation Engineering

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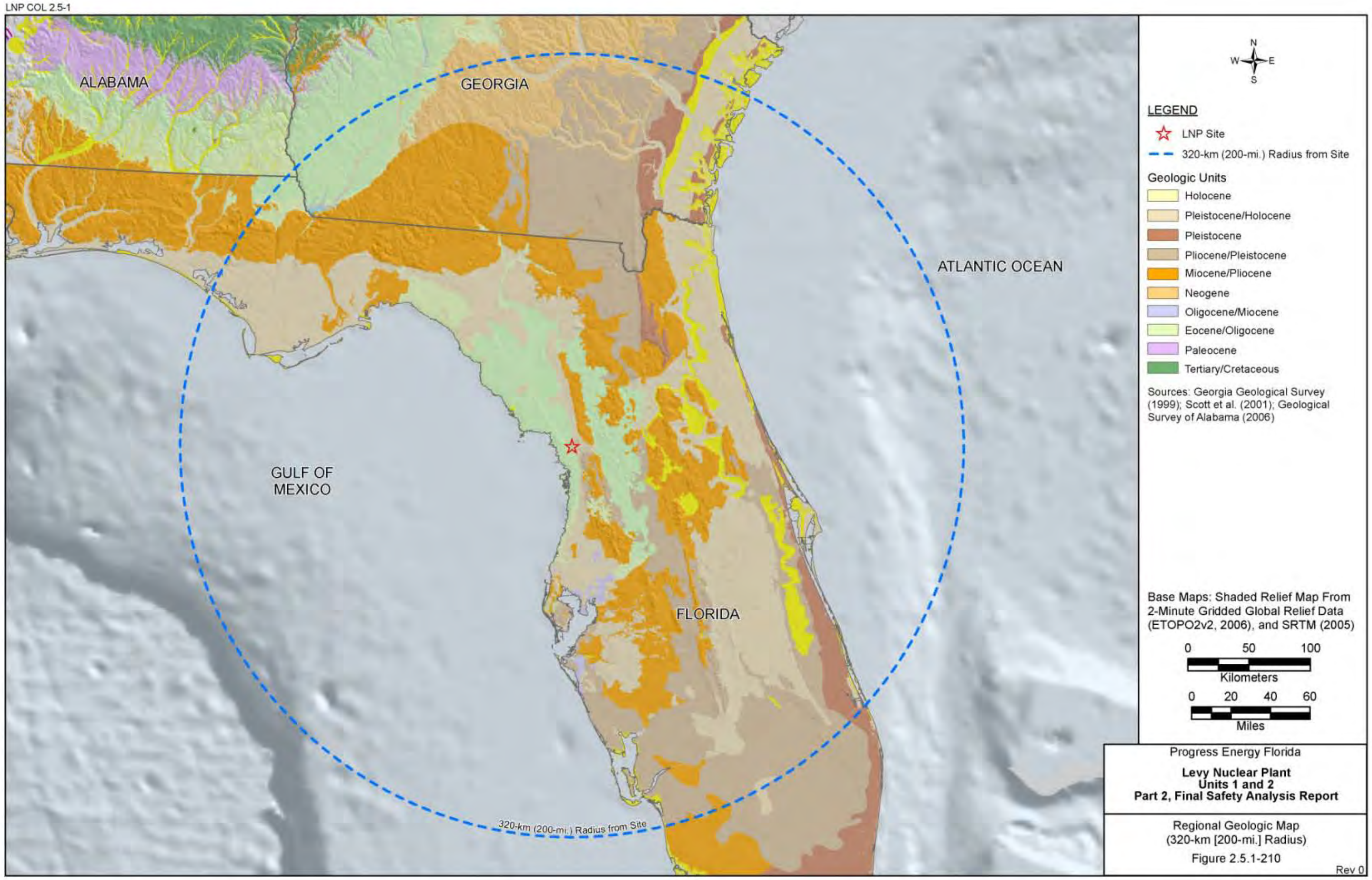
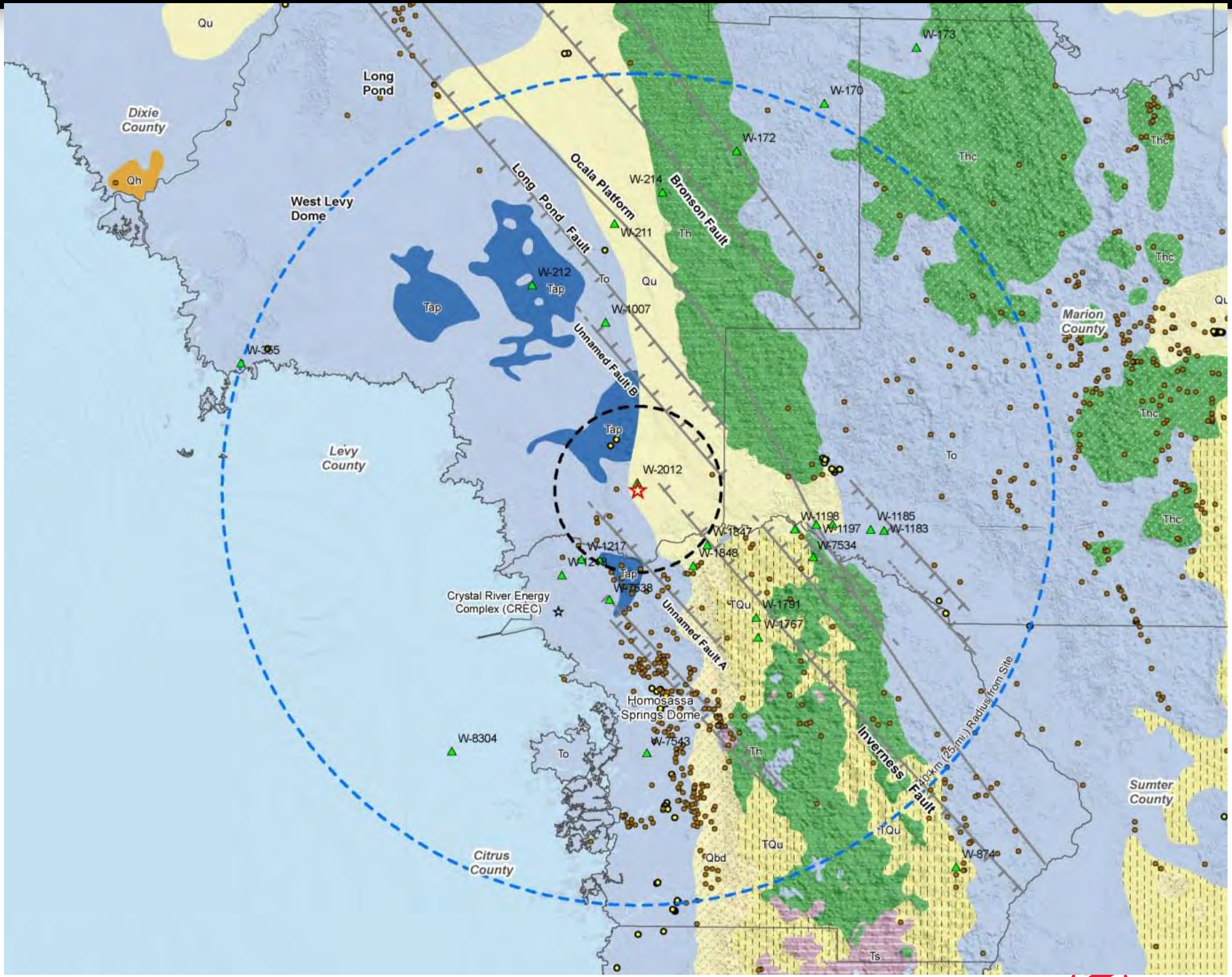
Regional Geologic Map (200-mi.)



Site Geologic Map (25-mi. and 5-mi.)



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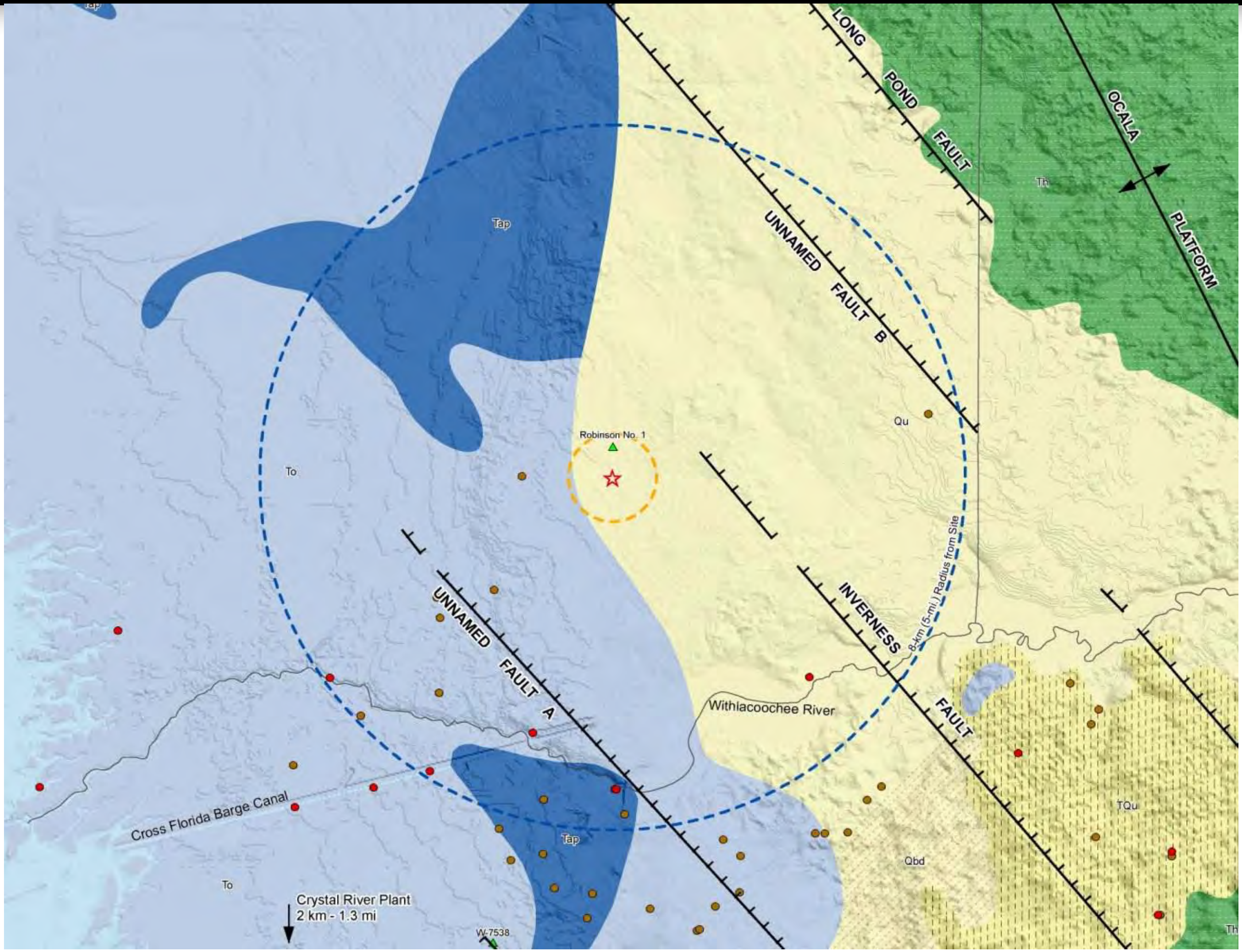
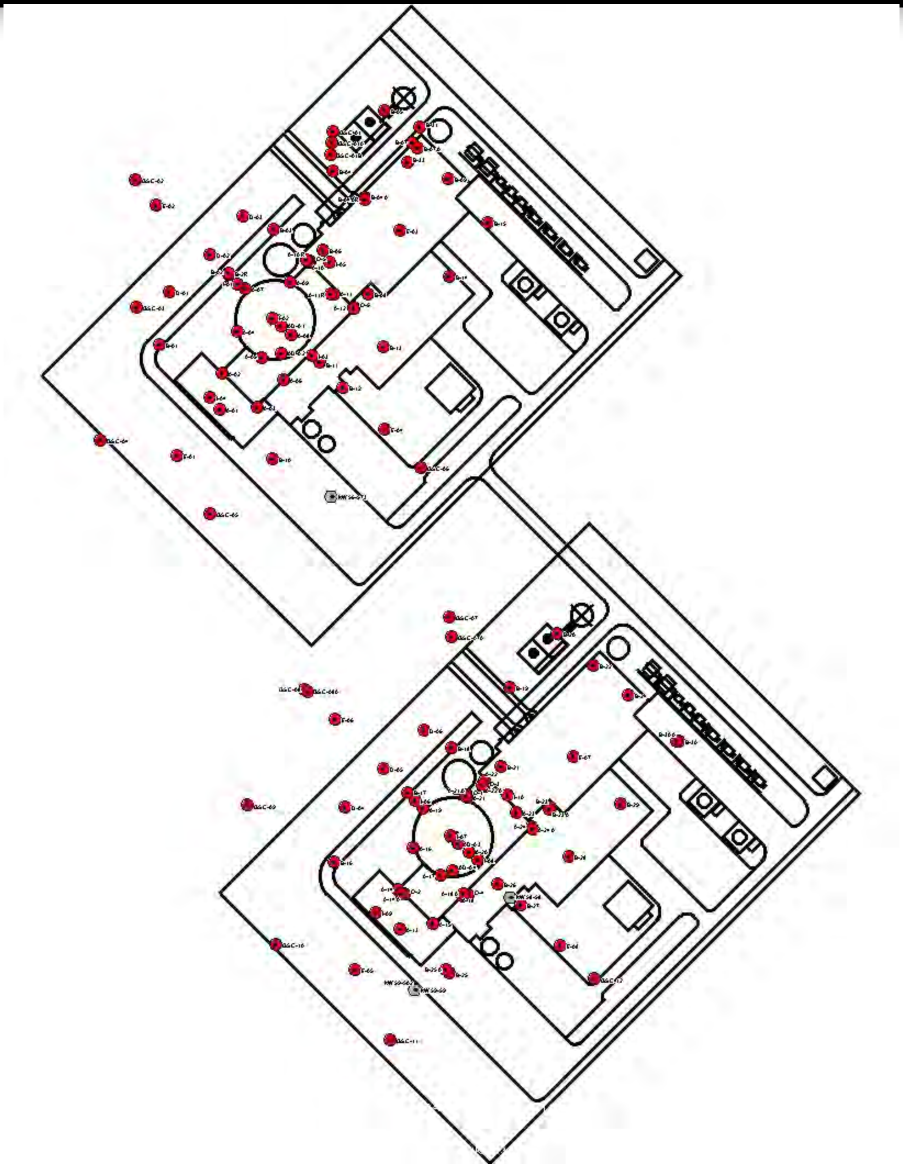
Surface Faulting
Postulated Faults within LNP Site Area



FSAR 2.5.3 Surface Faulting

- Geology Investigations Included:
  - Extensive literature review & expert interviews
  - Photo-geologic interpretation of remote sensing data
  - Geomorphic analysis of topography
  - Field Reconnaissance of quarries & river beds
- Conclusions from Surface Faulting Evaluation
  - No pronounced lineaments
  - No capable tectonic surface deformation
  - No capable tectonic sources identified within 25 mi
  - No potential for non-tectonic deformation
  - Karst-related deformation is specifically addressed
  - Excavations will be mapped as per Reg Guide 1.132

Summary of Site Investigation



Summary of Field Investigation

- RG 1.132 Investigation Program
  - Borings: 116 borings, 45 ft to 500 ft
  - Geophysical Testing: 18 borings
- Investigation of Low Recovery Zones
  - Detailed Assessment of all logs
  - Offset Boring Program
  - Grout Take Test Program

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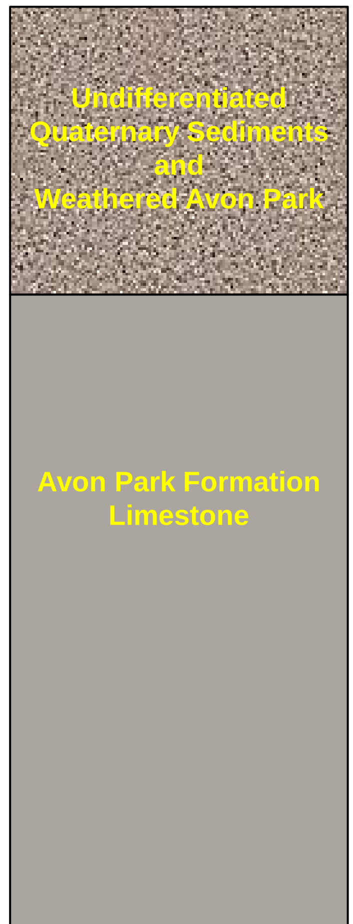
Typical Composite Profile

Depth (bgs)

Elevation (msl)

0 ft | **43 ft**



67 ft | **-24 ft**

>500 ft | **Below -457 ft**

Interpretation of Geologic Conditions for Design

- <u>Geologic Structure</u>
  - Local dip is shallow; generally to the southwest, ~1 ft/mile
  - Local fractures closely spaced; major orthogonal set
  - No faults exist
- <u>Foundations</u>
  - NI - Concrete Mat bearing on Avon Park
  - Turbine Bldg, Annex Bldg & Radwaste Bldg – Drilled Shafts
- <u>Geologic Hazards</u>
  - Karst features correlate to groundwater moving through vertical fractures
  - Vertical fractures coalesce with horizontal bedding planes to form a karst feature

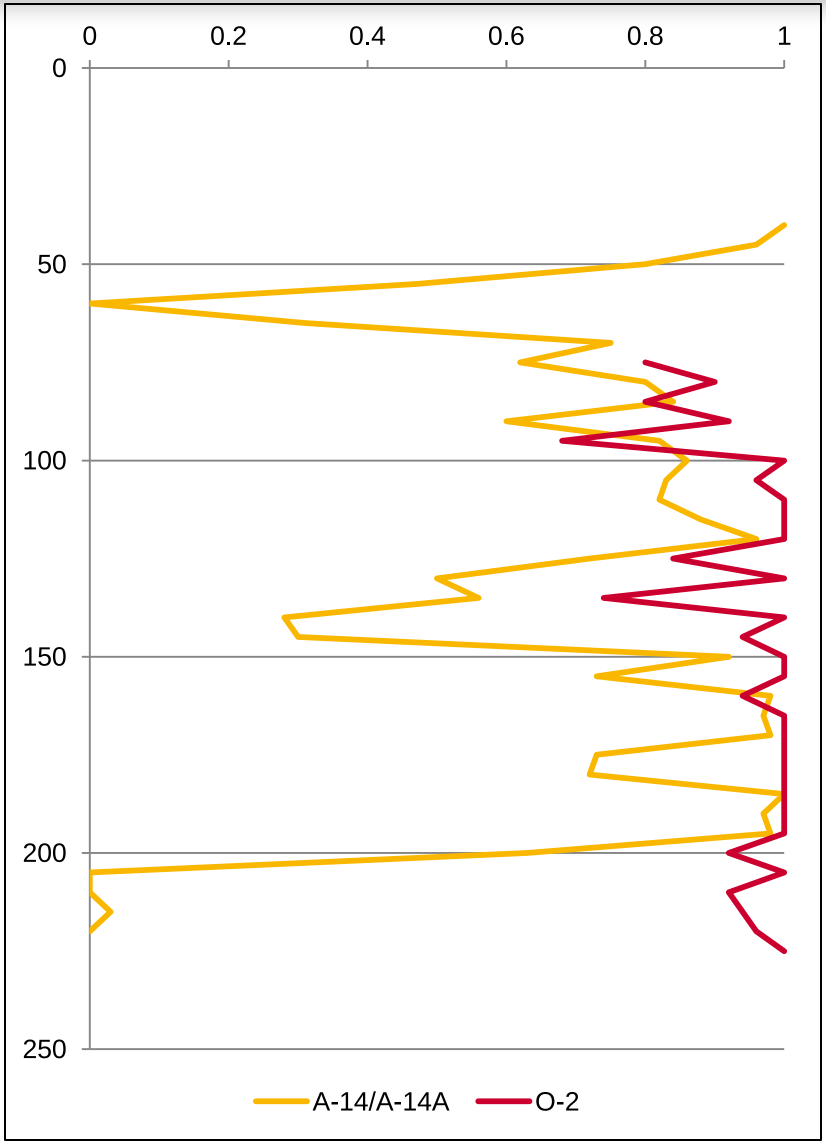
Low Recovery Zone Characterization

- Evaluation of low recovery zones for design
  - Literature review
  - Detailed analysis of logs
    - Rod drops, drill fluid losses, core recovery, RQDs
    - Acoustic televiewer and caliper surveys
  - Offset Boring Program
  - Grout Takes from initial borings
  - Grout Takes from Grout Test Program
  - Site Vicinity Fracture Investigation

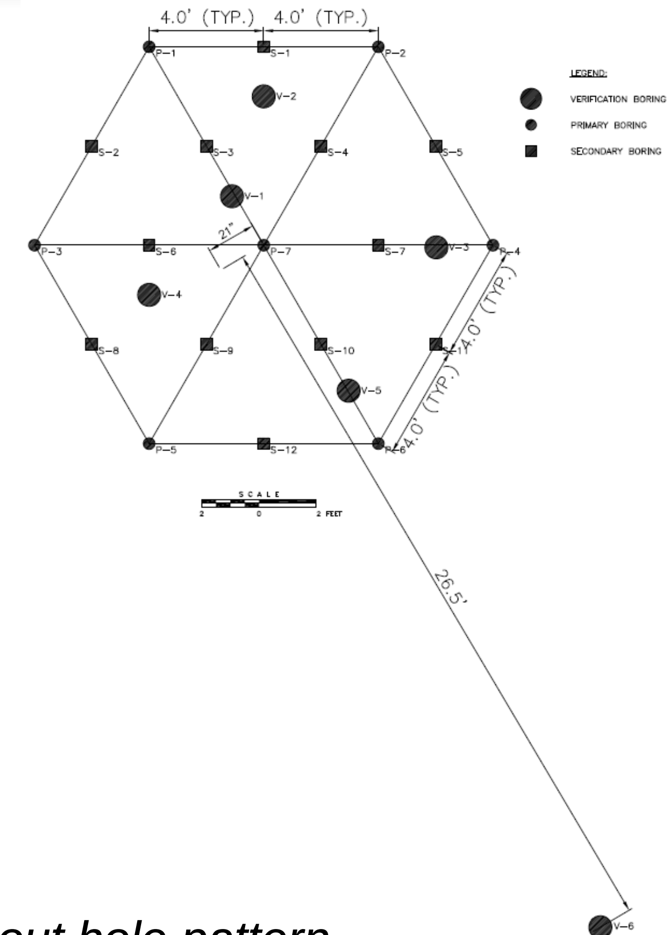
O-1 Core Recovery: 100% Recovery (Run 26)

- In A-21, this depth saw 40% recovery

O-2 and A-14A
Recovery – Offset Program vs Initial Program



Summary of Grout Test Program



Grout hole pattern

Site location

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Fracture Investigation

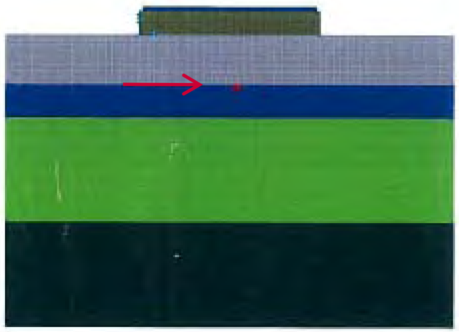
- Literature Search (Faulkner, Vernon, etc)
- Photo-lineaments analysis
- Field reconnaissance of Avon Park quarries
- Field reconnaissance of Avon Park exposures (road cuts, stream banks, etc)
- Inglis Lock Construction Data

Results - Karst Characterization

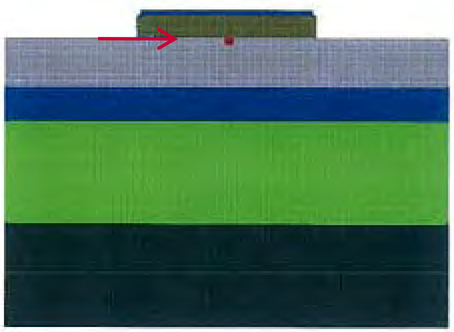
- For purposes of Design & Analysis of Long Term Behavior
  - Postulate ungrouted vertical fracture coalesces with an ungrouted horizontal bedding plane and "morphs" to a karst feature
  - Postulate 10 ft wide feature develops over life of plant in Avon Park
  - Postulate feature is undetected
  - Postulate feature is open void -- not infilled

Karst Characterization Design

Two Elevation Cases



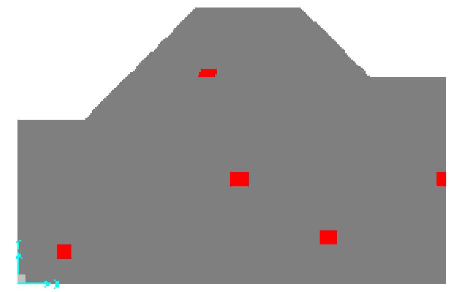
<u>Case A</u>: Cavities located below grouted limestone (El. -99 ft)



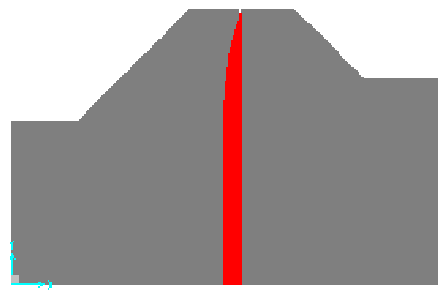
<u>Case B:</u> Cavities located directly beneath RCC (El. -24 ft)

Four configurations of karst evaluated for each Case

1 - No Cavities



2 – Multiple Cavities

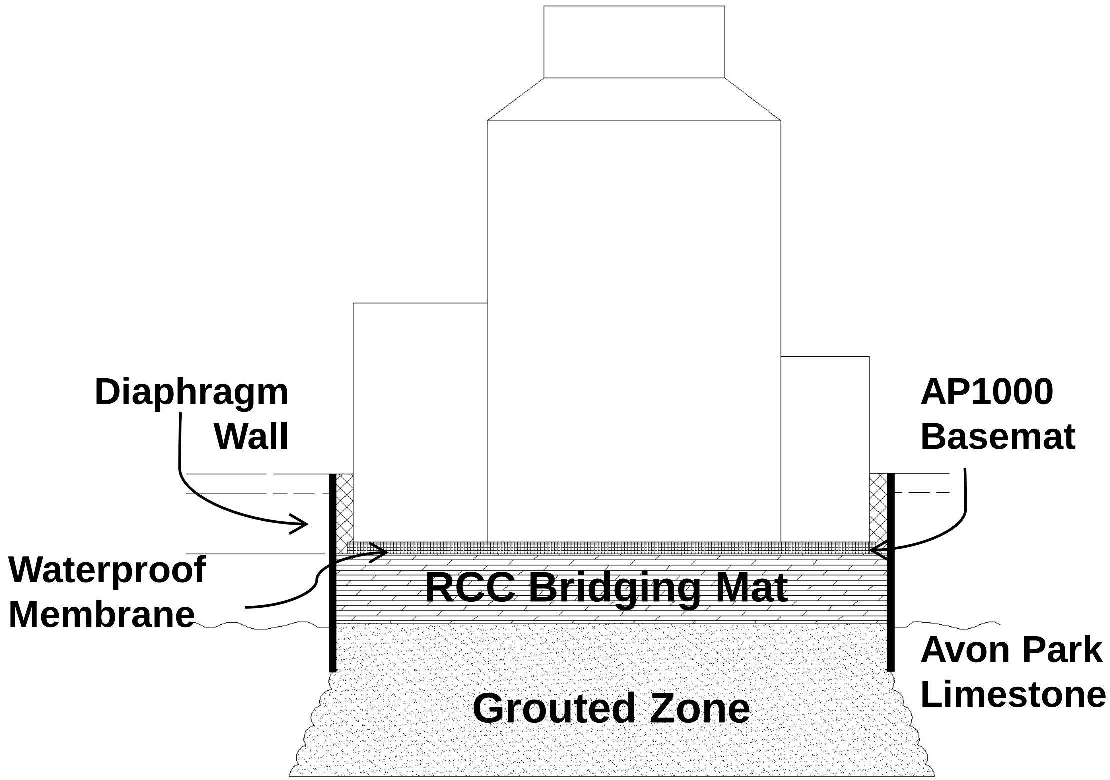


3 – E-W Continuous Cavity

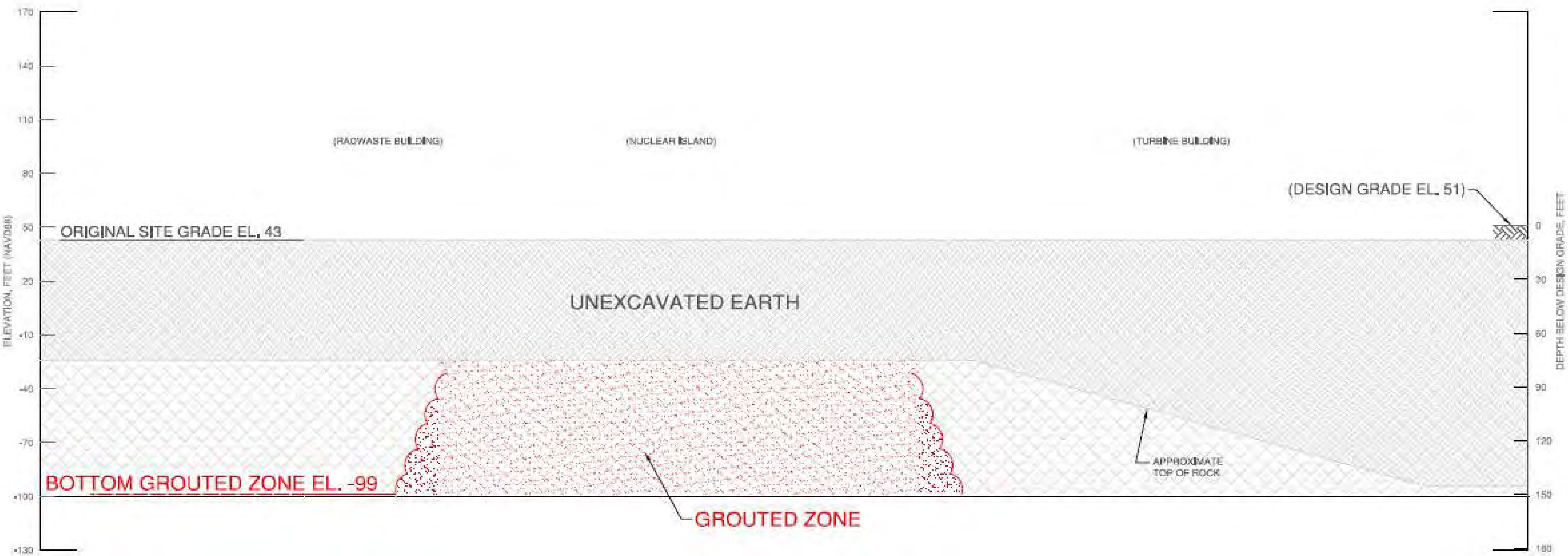
4 – N-S Continuous Cavity

NI Robust Foundation Design

- AP1000 Basemat
- 35-foot thick RCC Bridging Mat
- 75-foot thick Grouted Zone
- Long-Term Monitoring Program



Inject Grout into 75 ft of Avon Park



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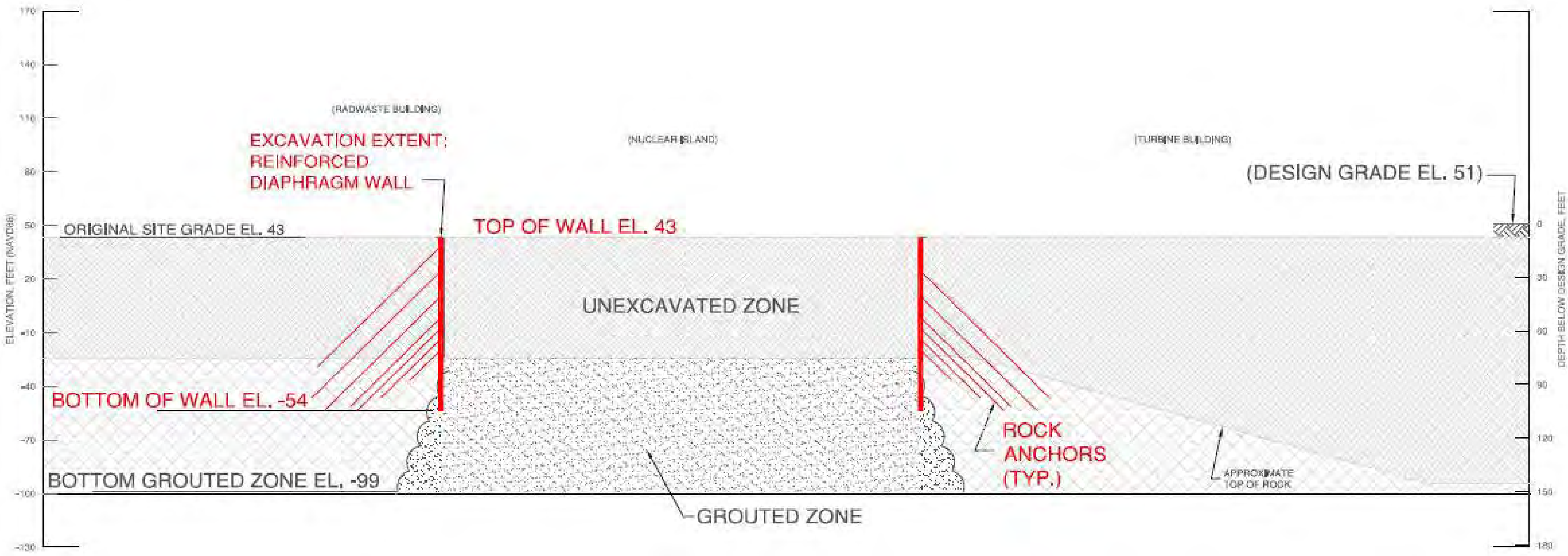
Install Diaphragm Wall



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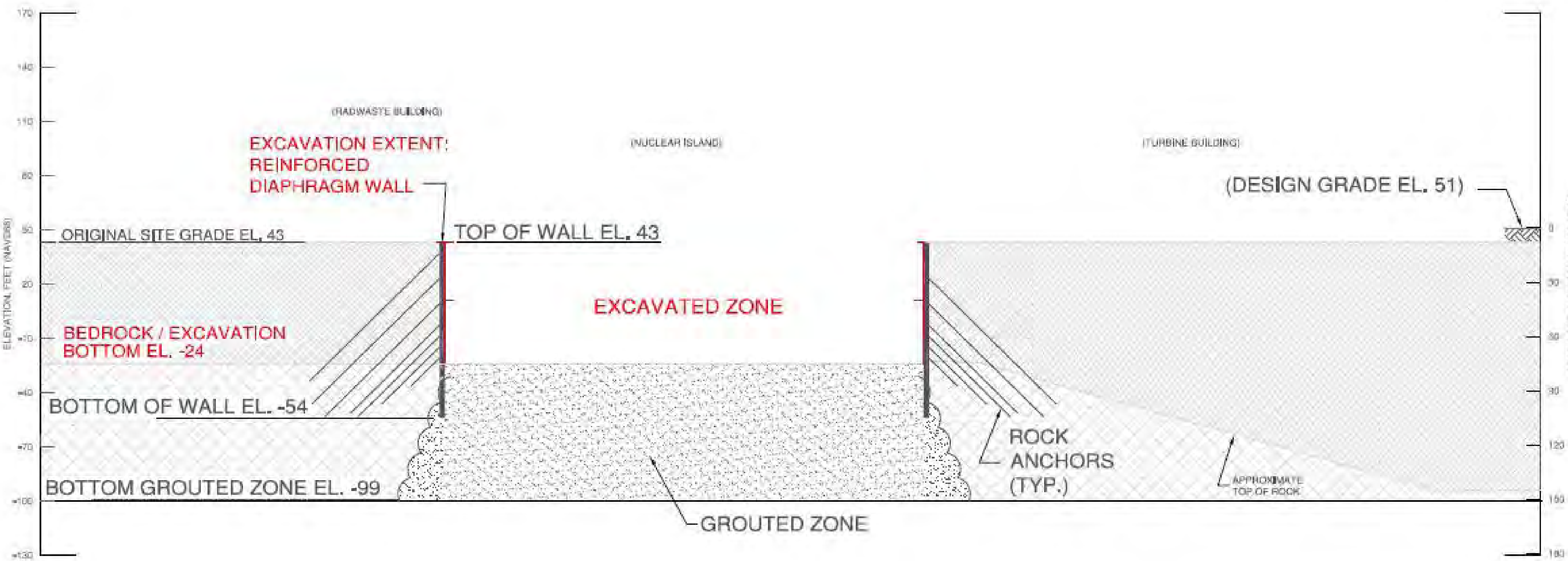
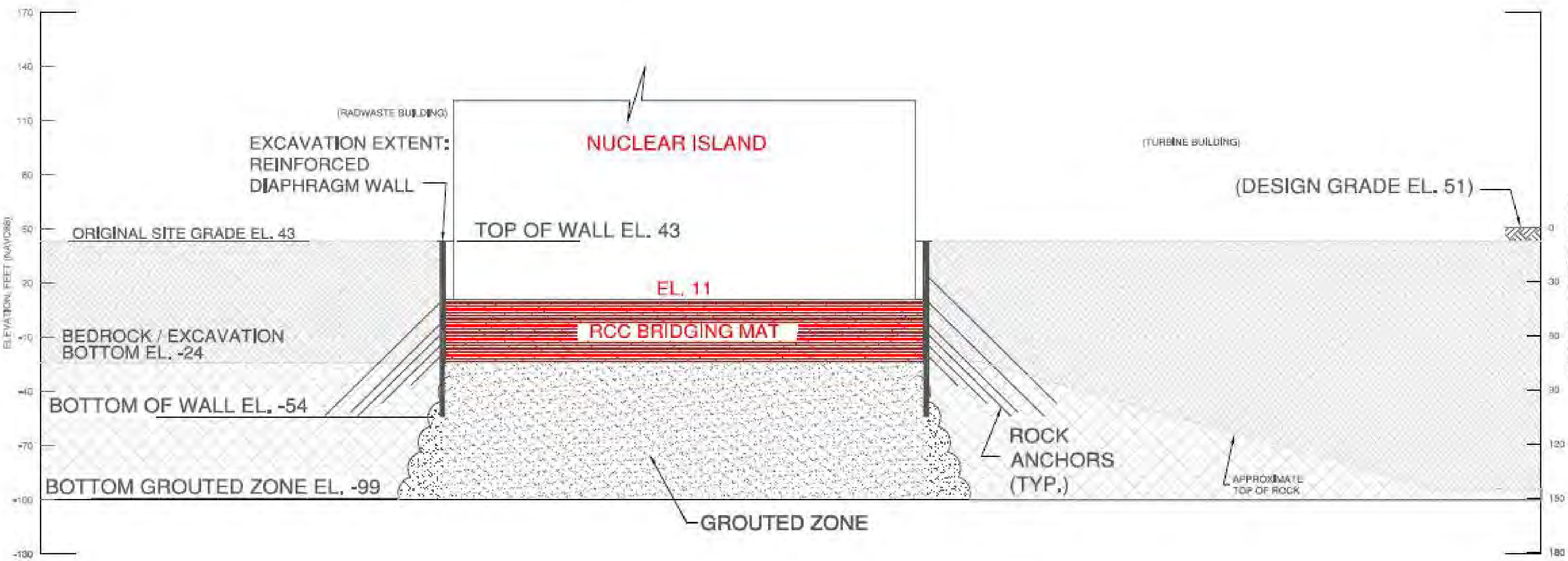
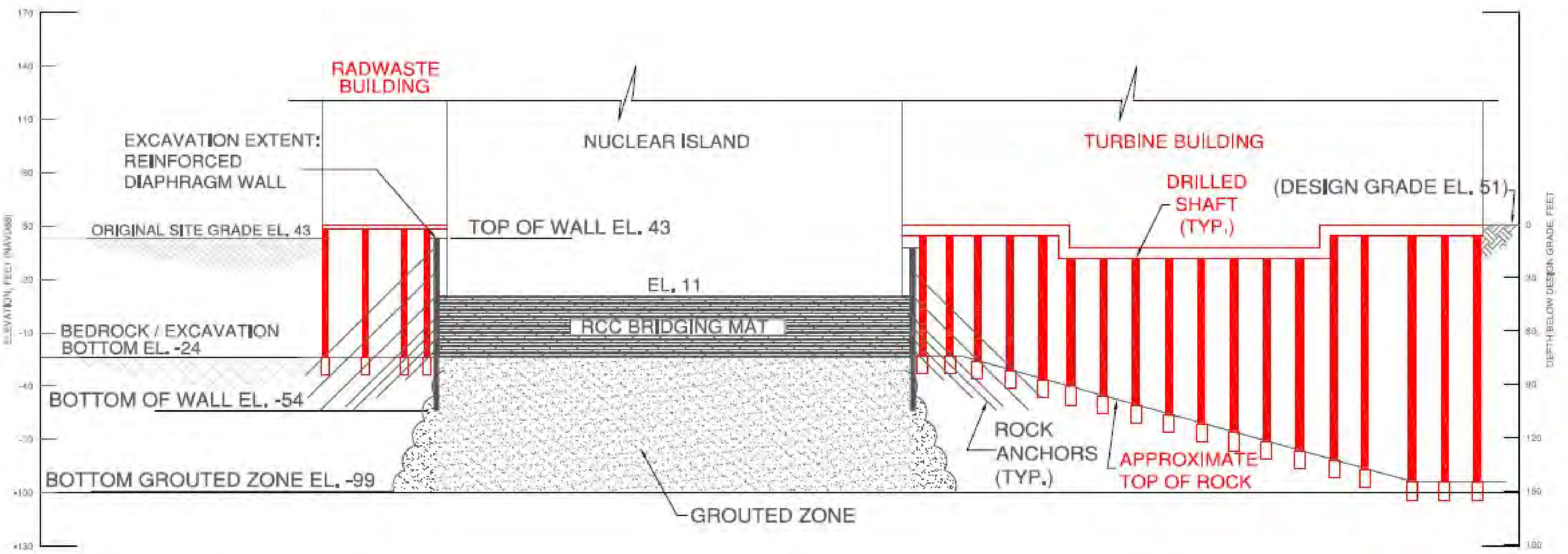
Excavate to Avon Park – Map Walls & Rock



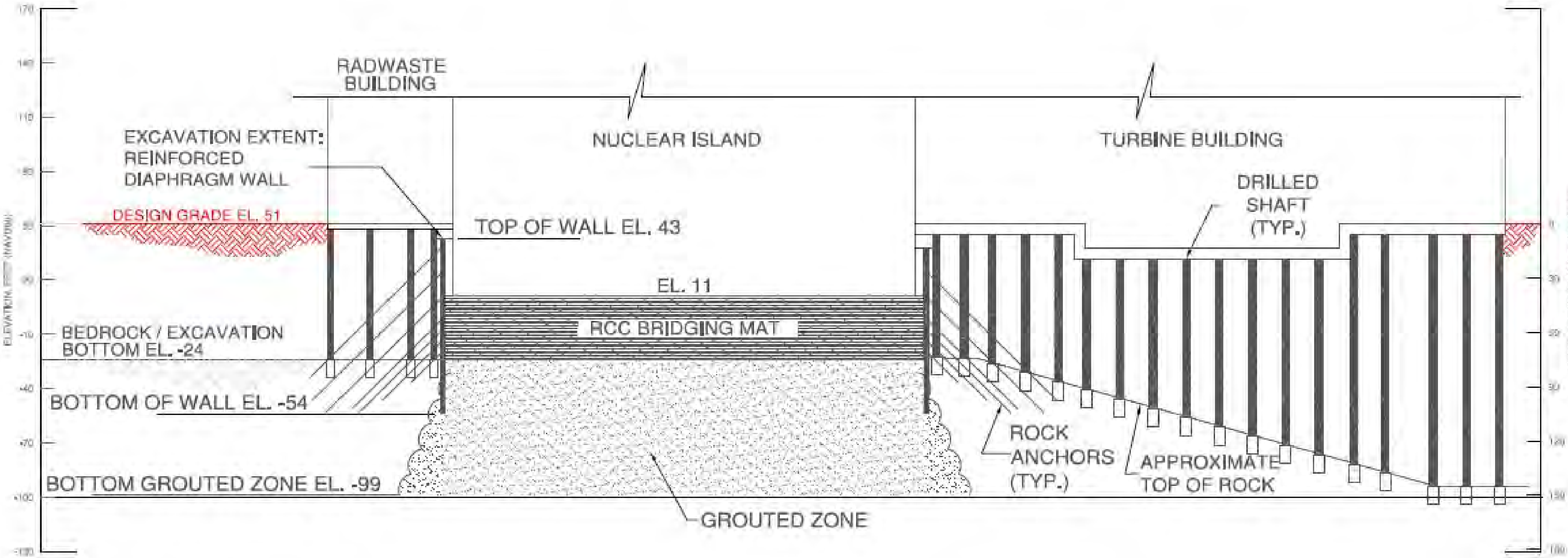
Construct 35 ft thick RCC Bridging Mat



Install Drilled Shafts –Turbine, Radwaste, Annex



Raise Site Grade to El. 51 ft



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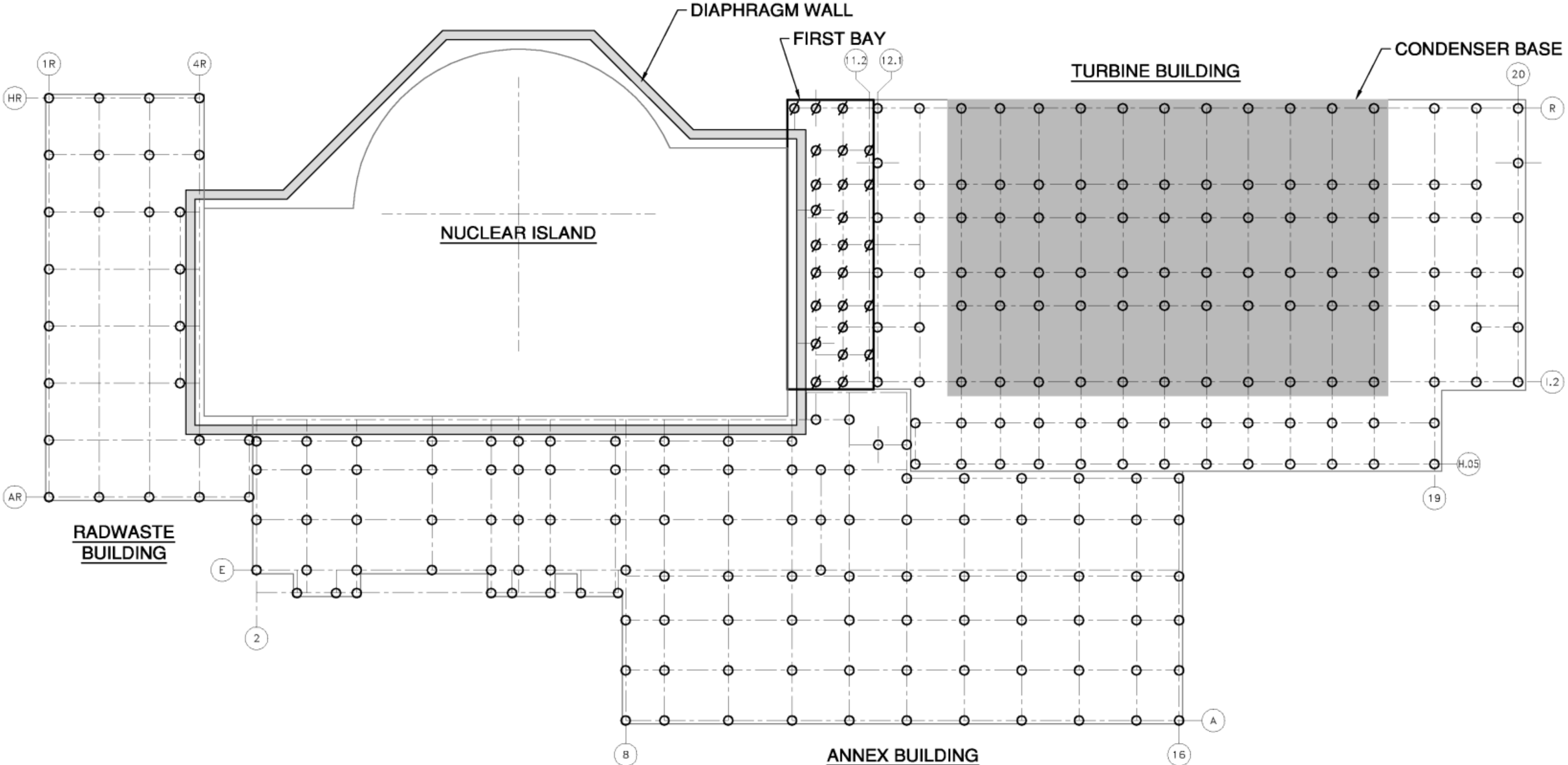
Drilled Shafts



RCC Strength and Constructability Verification

- Testing experience from large commercial RCC projects (Dams)
  - RCC mix design
  - Compressive, tensile, and shear strength data
  - ACI 318 and USACE EM 1110-2-2006 design allowable
- LNP Pre-COL Testing
  - LNP RCC mix design
  - Cylinder tests from LNP Specialty testing

Taum Sauk RCC Dam

Taum Sauk RCC Placement

RCC Strength and Constructability Verification

- Post COL RCC Testing
  - Large RCC pad (40’x40’x6’) will be constructed
  - Cored cylinder and test blocks from RCC test pad used to verify strengths
  - License Condition
- RCC Testing during Production Construction
  - Non-destructive density, temperature, and strength measurements
  - QA and QC inspections
  - ITAAC

Taum Sauk Test Pad

Levy Nuclear Plant
FSAR Section 2.5.2
Vibratory Ground Motions

Dr. AK Singh

Vice President & Project Director

Sargent & Lundy

Vibratory Ground Motions Evaluation

LNP Vibratory Ground Motions evaluations complies with RG1.208

- Updated earthquake catalog includes events through December 2006
- The Charleston, SC source was updated per the Vogtle ESP
- Two earthquakes in 2006 within the Gulf of Mexico (GOM) were added to the catalog to account for offshore seismicity
- The seismicity in the GOM was added to the EPRI-SOG model
- The EPRI (2004, 2006) ground motion models were used for PHSA and UHRS
- The CAV filter was used for surface UHRS and performance based GMRS

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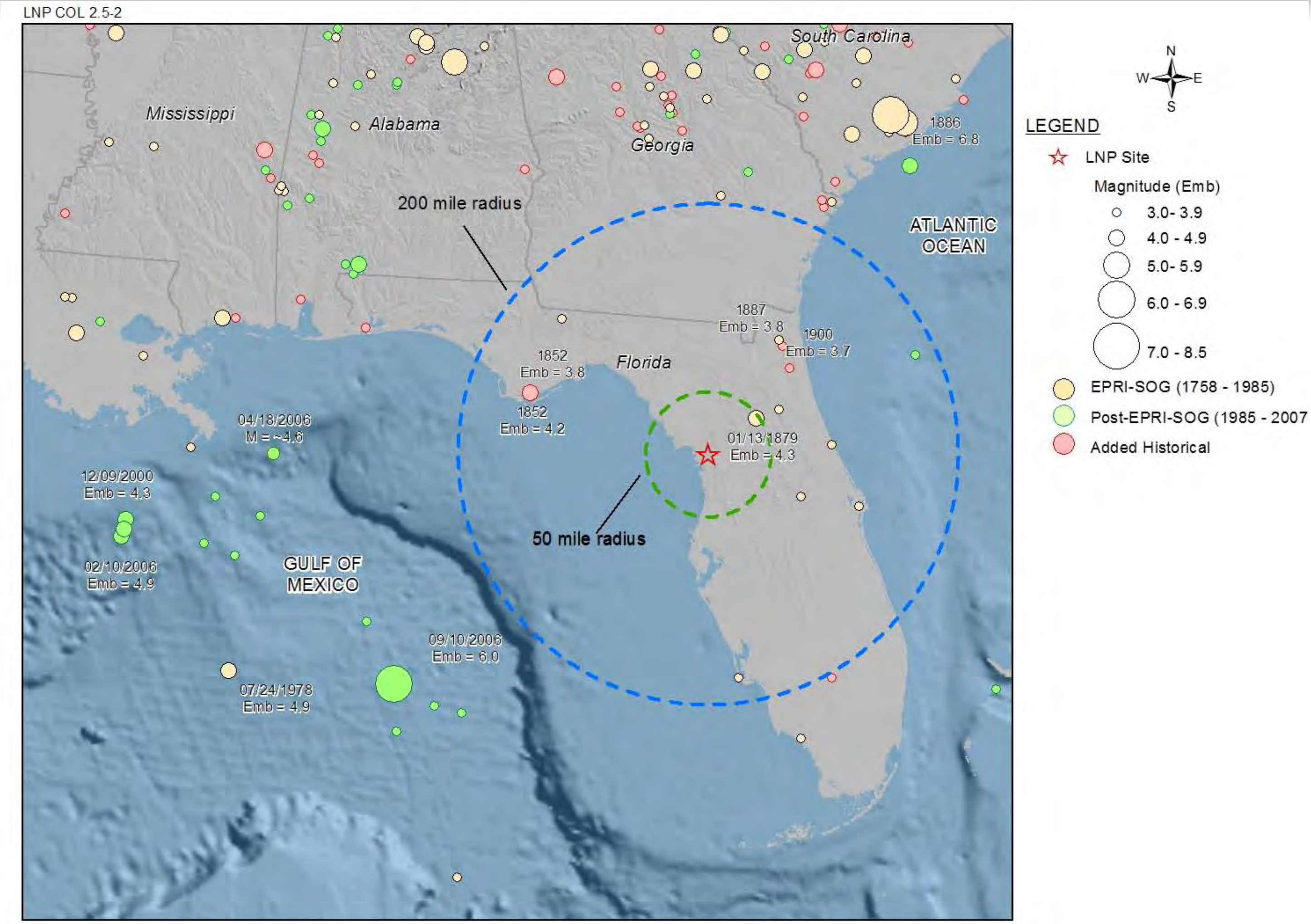
Locations of Earthquakes in the Site Region



Vibratory Ground Motions Evaluation Conclusions

- No new seismic source based on pattern of seismicity within the site region based on updated EPRI SOG SSC

- No significant revisions to the seismic source geometry required based on similar spatial distribution to that observed in EPRI-SOG (1988)

- Earthquakes in the site region are random and not associated with capable tectonic sources

- Largest contributor to the site hazard is the Charleston, SC source; controlling earthquake m_b 7.1 at 278 miles

- GMRS is enveloped by the CSDRS

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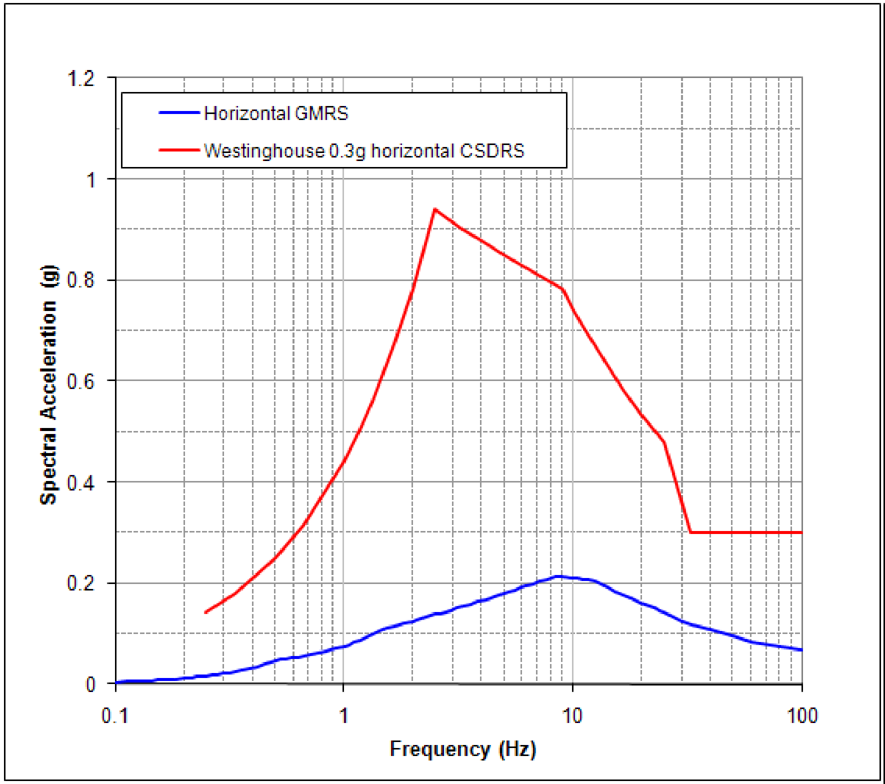
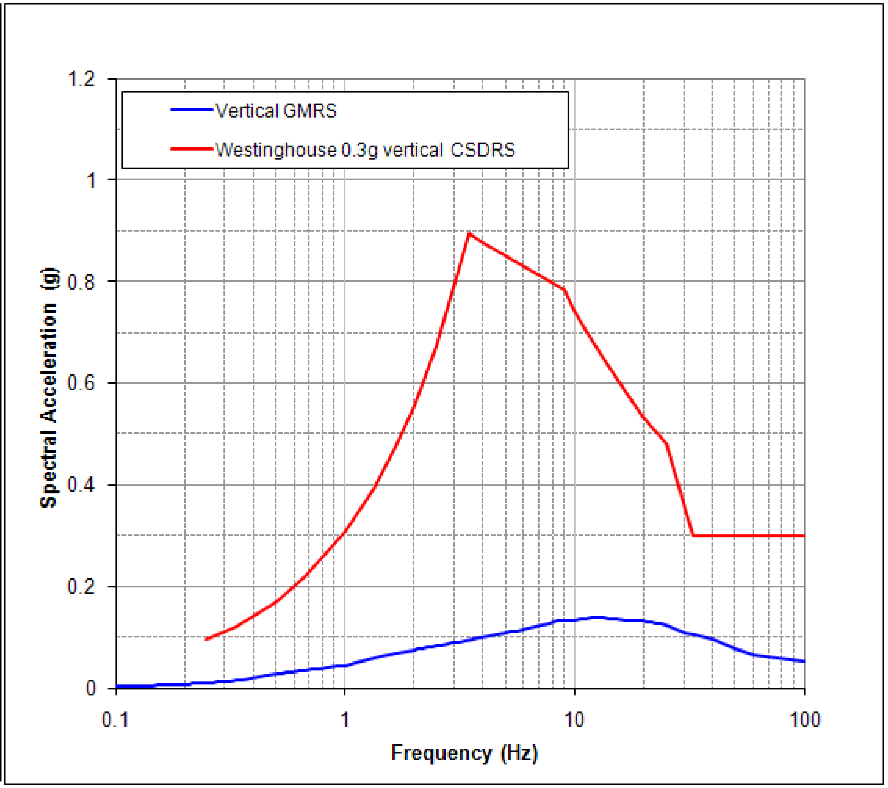
LNP Ground Motion Response Spectra





LNP site GMRS developed at the top of weathered limestone (El 36 ft.)

NGG Think Fleet.

Progress Energy

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Presentation to the ACRS Subcommittee

Levy Nuclear Plant Units 1 and 2
COL Application Review

Advanced Safety Evaluation Section 2.5
Geology, Seismology, and Geotechnical Engineering

October 18, 2011

NRC Review Team

- Technical Reviewers and Presenters
  - Dr. Gerry Stirewalt, Senior Geologist, Presenter
  - Meralis Plaza-Toledo, Geologist
  - Dr. Vladimir Graizer, Seismologist, Presenter
  - Dr. Stephanie Devlin, Seismologist
  - Wayne Bieganousky, Senior Geotechnical Engineer
  - Zuhan Xi, Geotechnical Engineer, Presenter
  - Ricardo Rodriguez, Geotechnical Engineer
- Project Manager
  - Brian Anderson

2.5.1 Basic Geologic and Seismic Information

- **Primary Topic of Interest for FSAR Section 2.5.1 is development of karst and associated dissolution features**
  - Appropriate to focus on assessment of karst, which was identified by the applicant as the only potential geologic hazard in the site area.
  - Preponderance of published data document that the Florida Platform, comprising the Floridian Plateau and Florida Penisula and containing the site region, has been tectonically quiescent since the start of Cretaceous time (145.5 Ma). Therefore, capable tectonic structures and surface faulting are of neglible concern at the Levy site.

2.5.1 Basic Geologic and Seismic Information

Good outcrops are sparse, so careful examination of core was very important for assessment of karst and associated dissolution features at the Levy site.

2.5.1 Basic Geologic and Seismic Information

- **Assessment of karst and dissolution features**
  - Karst and associated dissolution features are common in the region that includes the Levy site (i.e., the Floridian Section of the Coastal Plain physiographic province of Central Florida).
    - Fractures and bedding planes that occur in the Avon Park Formation, the Middle Eocene (48.6-40.4 Ma) foundation unit at the Levy site, may enhance dissolution and development of karst at the site.
  - In September 2009, staff directly examined core from slanted grout test boreholes and confirmed a paucity of subsurface dissolution voids and fractures in the Avon Park Formation based on both grout uptake results and visual examination of core.

Grouted fracture in core from the Avon Park Formation.

Core from the Avon Park Formation shows small dissolution vugs and no fractures.

2.5.1 Basic Geologic and Seismic Information

- **Assessment of karst and dissolution features (Cont’d) – Soft weathered zones**
  - In February 2010, staff examined boring logs, core photos, and written core log descriptions for six “offset” borings, drilled adjacent to locations of original site characterization borings using techniques to improve core recovery. (Cores from original site characterization boreholes were examined during an April 2009 site audit.)
    - Based on borehole data, staff documented that low-recovery zones in the original site characterization boreholes were “soft” weathered zones in the normal stratigraphic sequence of the Avon Park Formation and not dissolution voids.
    - Staff also documented that the low-recovery “soft” zones were discontinuous based on the borehole data.

Core from a “soft zone” (i.e., a weathered horizon) in the Avon Park Formation.

2.5.1 Basic Geologic and Seismic Information

- **Assessment of karst and dissolution features (Cont’d) – Thickness of Quaternary sediments**
  - Thickness of Quaternary (2.6 Ma to present) sediments overlying the Avon Park varies from <3 m (10 ft) in the site area to at least 24 m (80 ft) near LNP Units 1 and 2.
    - Thickness of Quaternary sediments overlying the Avon Park Formation could be related to deposition in collapsed dissolution cavities.
    - Due to paucity of dissolution voids in site borings and documented erosional/depositional history of the site region, however, increased thickness of Quaternary deposits observed in borings is most likely due to deposition of sediments in paleochannels.
    - Depositional/erosional episodes are related to sea level fluctuations, not Cenozoic (65.5 Ma to present) tectonism.

2.5.1 Basic Geologic and Seismic Information

- **Assessment of karst and dissolution features (Cont'd) – Dissolution rates**
  - Upper 150 m (500 ft) of the Avon Park Formation consists primarily of dolomitized limestone (dolostone), which is less susceptible to dissolution than pure limestone.
    - An estimate of dissolution rates for the less dolomitized Ocala Formation at Crystal River Nuclear Generating Plant Unit 3 (CR3) gave a rate of 1E-4 percent per year at that site. Calculated rate was 6E-3 percent over a 60-year plant life for CR3.
  - Dissolution rates for the Avon Park Formation are lower than for the Ocala Formation because it is dolomitized. Potential for dissolution of the Avon Park Formation at the LNP site is negligible during life of the plant.

2.5.1 Basic Geologic and Seismic Information

- **Assessment of karst and dissolution features (Cont'd) – Springs and lateral extent of voids**
  - Absence of springs in the Avon Park Formation in the site vicinity indicate no subsurface conduits exist for rapid groundwater flow.
    - Borehole data show no evidence for interconnected subsurface voids or extensive enlarged fractures in the subsurface at the site location.
  - Maximum lateral extent of voids in the Avon Park Formation conservatively calculated to be 3 m (10 ft), based on increasing grout volumes calculated from borehole data by 50% for vertical fractures and 100% for horizontal bedding planes. Maximum lateral extent of voids calculated from actual grout uptake was 1.6 m (5.3 ft).

Core from the Avon Park Formation shows a small dissolution vug and no fractures. Core box contains a softer, more friable horizon collected in the same core run. The foam spacer marks a zone of no core recovery.

2.5.1 Basic Geologic and Seismic Information

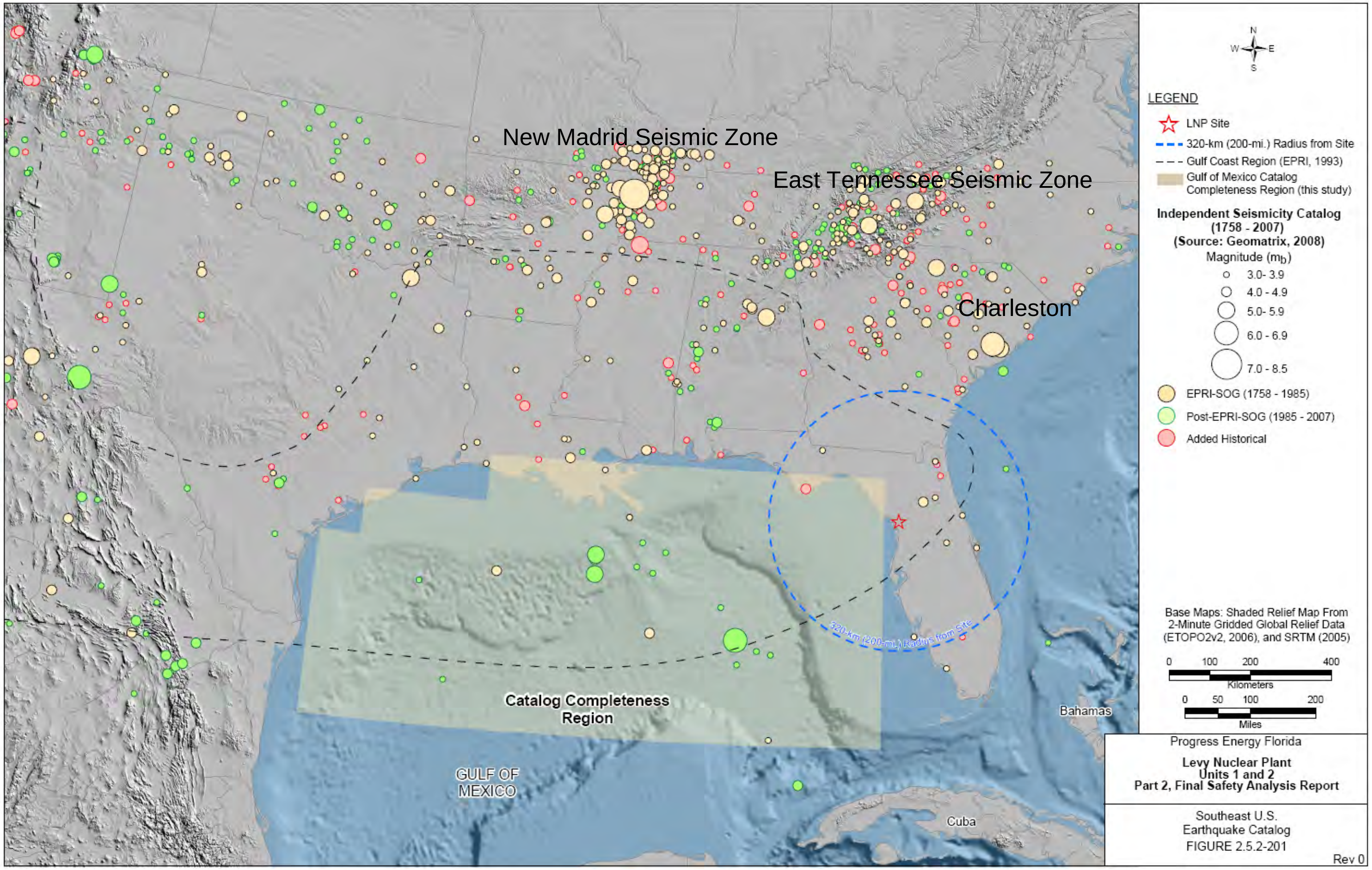
- **Assessment of karst and dissolution features (Cont'd) – Fracture and bedding intersections**
  - Intersections of vertical fractures and horizontal bedding planes may be areas of enhanced dissolution due to increased groundwater flow.
    - Borehole data show no evidence for extensive, dissolution-enlarged fractures or bedding planes in the subsurface at the site location.
    - Direct examination by staff of Avon Park Formation outcrops in April 2009 and September 2010 documented a primary orthogonal fracture set oriented N39W and N51E. This outcrop-scale fracture set, with fractures spaced 6-8 m (20-25 ft) apart, parallel regional fracture trends.
  - Regional fracture systems control stream drainages and alignment of sinkholes.

2.5.3 Surface Faulting

- **Geologic Mapping License Condition 2.5.3-1**
  - Geologic Mapping License Condition 2.5.3-1: The licensee shall perform detailed geologic mapping of the excavations for LNP Units 1 and 2 nuclear island structures; examine and evaluate geologic features other than those for the Units 1 and 2 nuclear islands; and notify the Director of the Office of New Reactors, or the Director’s designee, once excavations for LNP Units 1 and 2 safety-related structures are open for examination by NRC staff.
    - License Condition 2.5.3-1 relates to both tectonic (i.e, faulting) and non-tectonic (i.e., collapse and subsidence due to dissolution and karst development) deformation features.
    - The License Condition is important because the potential for detrimental geologic features occurs in every geologic setting when tectonic and non-tectonic features are considered.

Section 2.5.2 Vibratory Ground Motion

Updated Seismicity Catalog



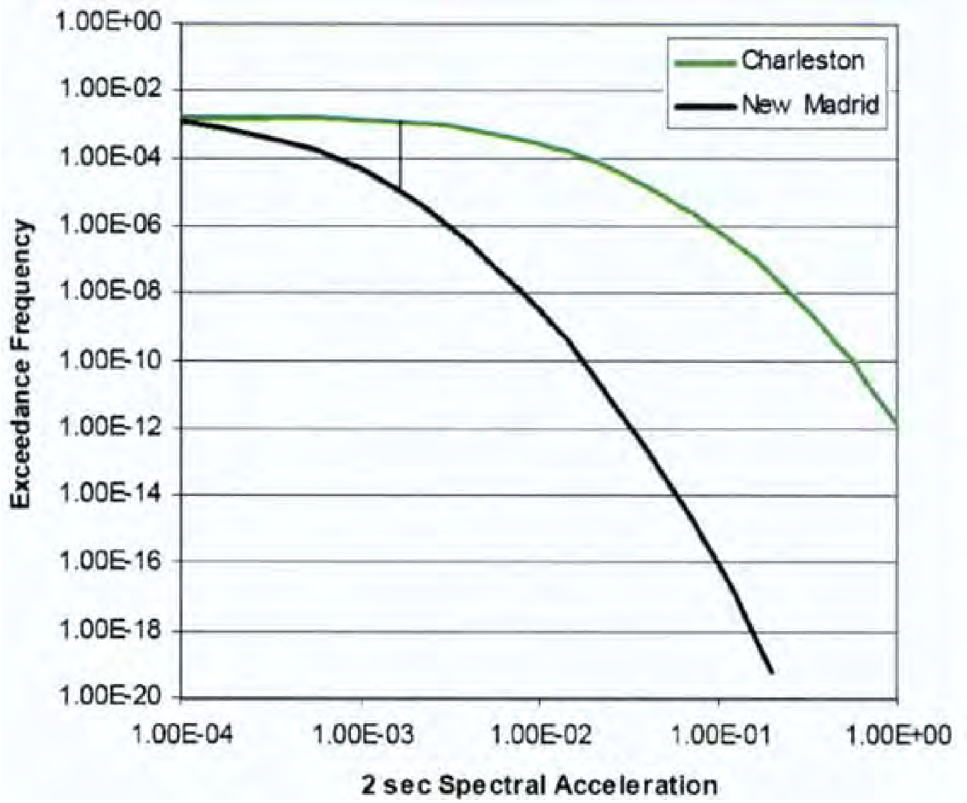
- EPRI-SOG historical earthquake catalog is complete from 1627 to 1984.
- The applicant updated it with seismicity from 1985 through December 2006 using current seismicity catalogs (ANSS, USGS, VTSO, ISC).

Section 2.5.2 Vibratory Ground Motion

New Madrid Seismic Zone (NMSZ)

- Issue: The applicant did not discuss the effects of the NMSZ in their FSAR. The staff was concerned about the influence of the NMSZ on the seismic hazard at the LNP site.

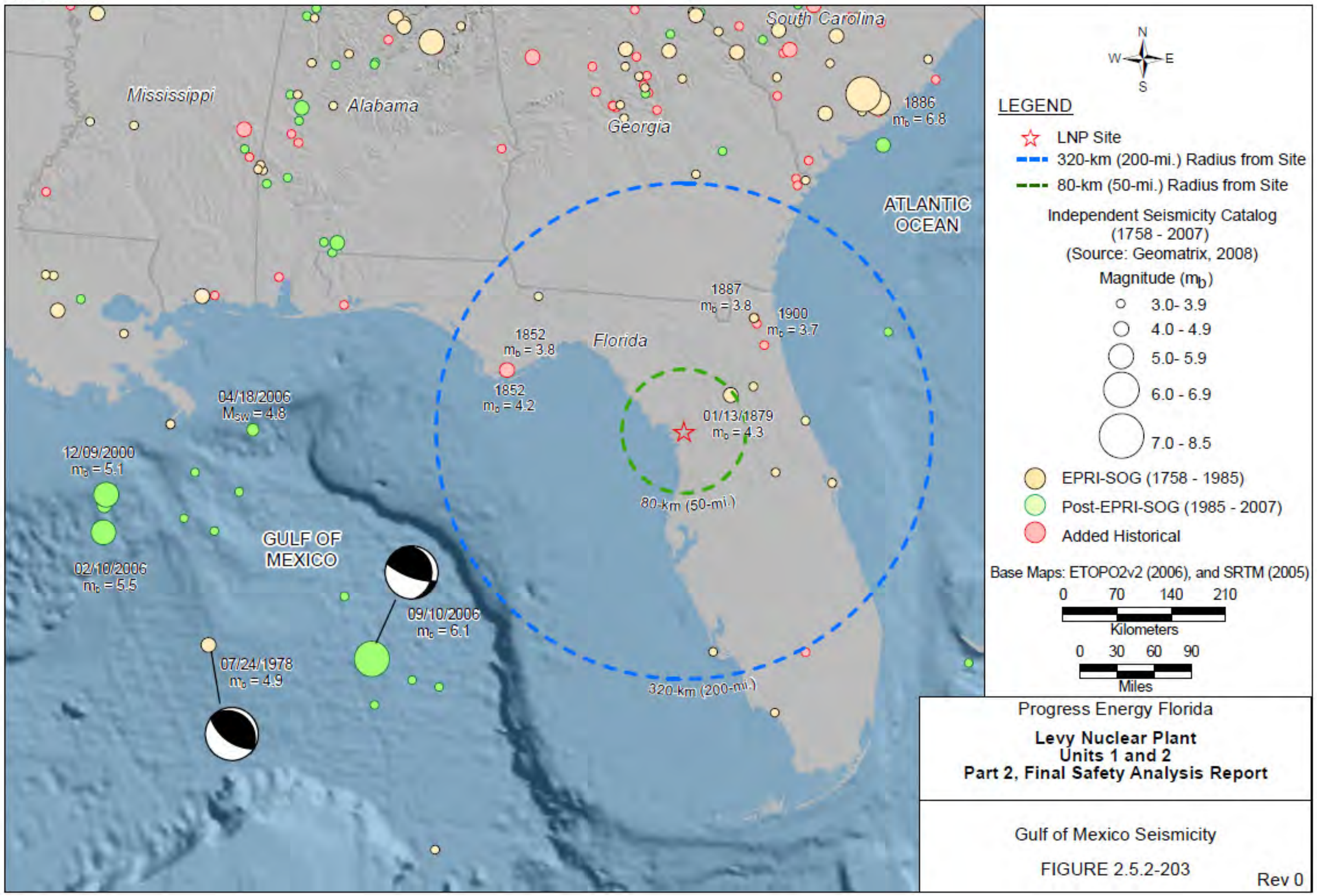
- Resolution: The applicant showed that the NMSZ is less than 1 percent of the hazard from the Charleston source at 2-second mean spectral acceleration. Therefore, the effect of the NMSZ on the overall hazard at the LNP site will be less than 1 percent and this issue is resolved.



Mean hazard curves for the NMSZ and Charleston sources of repeated large-magnitude earthquakes. (AFSER Figure 2.5.2-6)

Section 2.5.2 Vibratory Ground Motion

Site Region and Gulf of Mexico Seismicity



In the site region, there are 15 earthquakes with body-wave magnitudes $m_b \geq 3$ located within 200-mi (320-km) of the LNP site with event magnitudes not exceeding m_b of 4.3.

Section 2.5.2 Vibratory Ground Motion

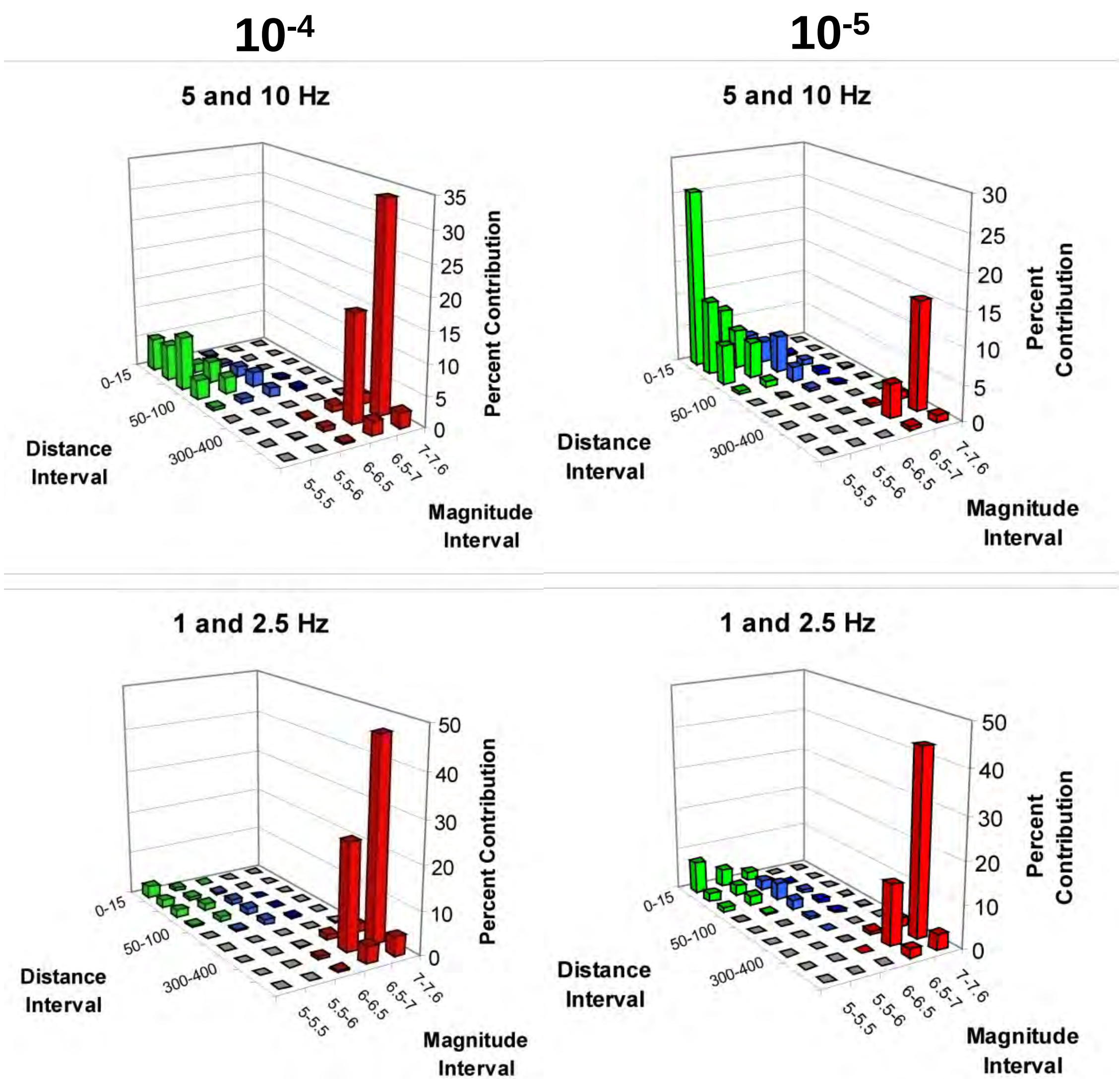
Gulf Coast Source Zone (GCSZ)

- Issue: The GCSZ is included in EPRI/SOG source modeling. Two earthquakes occurred in the Gulf of Mexico in 2006 with m_b 6.1 and 5.5, exceeding the maximum magnitude distribution estimated by the original EPRI teams. The applicant updated the GCSZ magnitude distributions using a SSHAC Level II study. The SSHAC review panel rejected the TI team's distribution recommendation, but the staff believes the TI's update reflected the technical community consensus.

- Resolution: The applicant implemented a sensitivity test with different magnitude distribution scenarios. The sensitivity test indicates that even using the TI team's recommended distribution, the seismic hazard increase at the LNP site is relatively small (<8%). Therefore, this issue is resolved. The staff is tracking related FSAR changes as **Confirmatory Item 2.5.2-1**.

Section 2.5.2 Vibratory Ground Motion

Deaggregation of Hazard for 10^{-4} and 10^{-5} Exceedance Frequencies



Deaggregation Earthquakes:

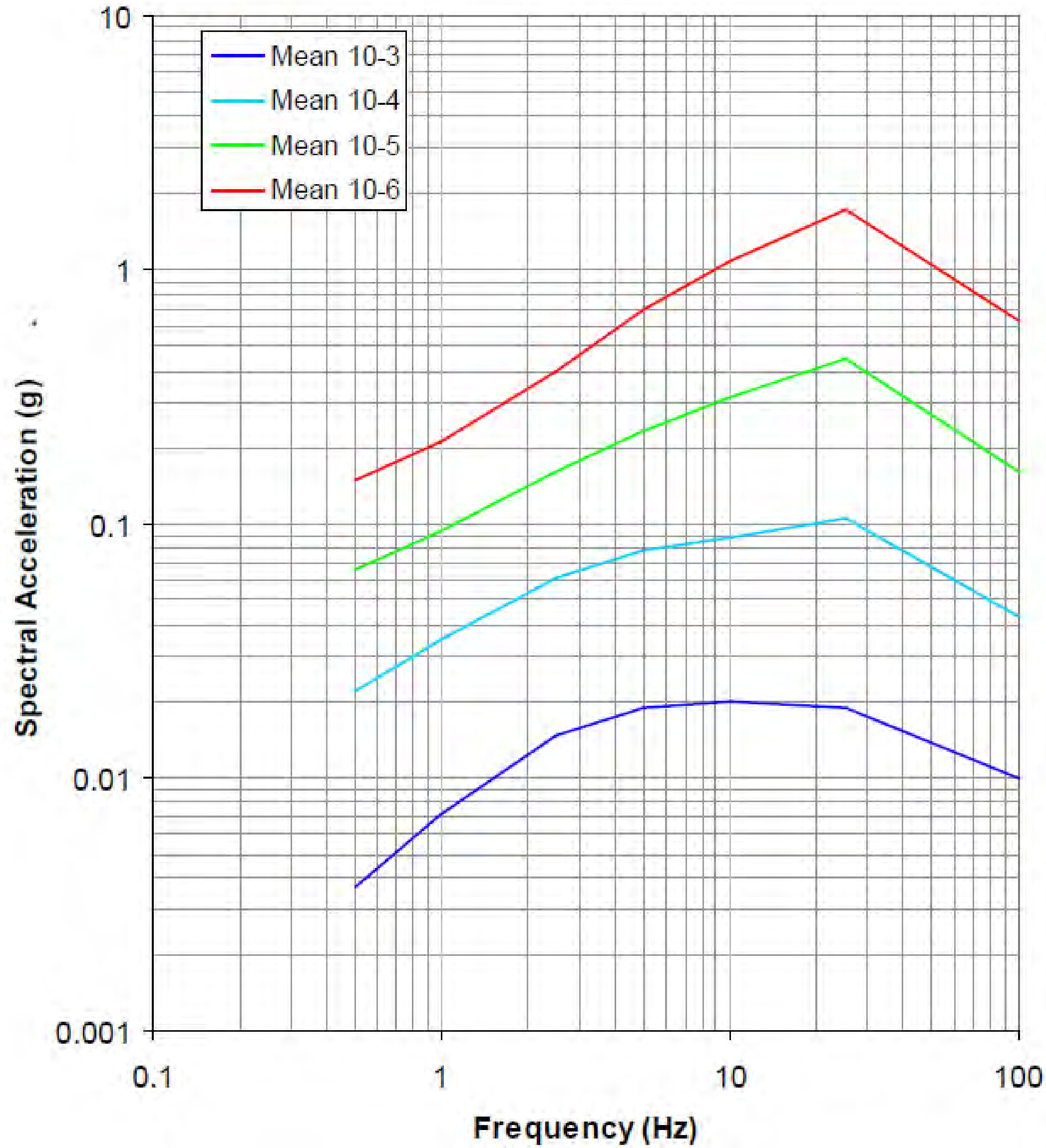
- M 5.5 at about 20 km (local source)
- M 7.2 at about 460 km (Charleston)

FSAR Figures 2.5.2-240 & -241

Section 2.5.2 Vibratory Ground Motion

Uniform Hazard Response Spectra (UHRS) for Generic Rock Conditions

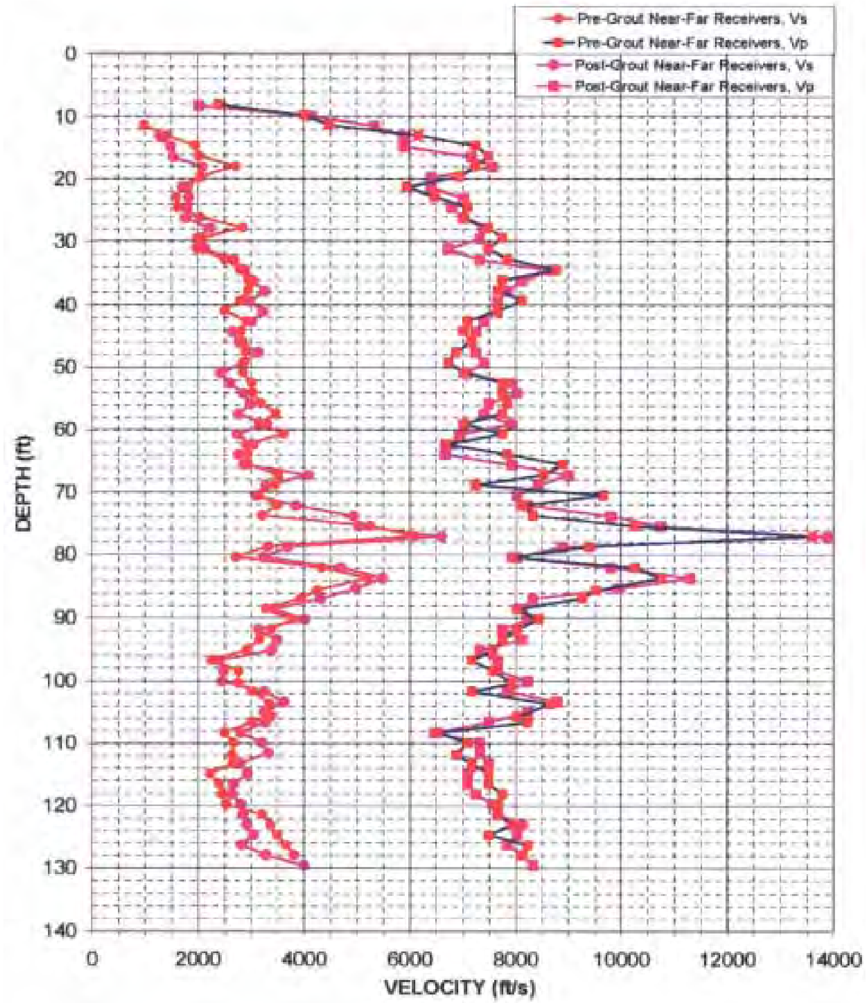
AFSER Figure 2.5.2-2



Section 2.5.2 Vibratory Ground Motion

Grouting Program and Seismic Wave Velocities

- Issue: Staff was concerned that seismic wave velocities are the same before and after the applicant's grouting program.
- Resolution: Applicant's grout test program measured velocities pre- and post-grouting. The measurements demonstrate that the grouting program do not alter the measurements of seismic wave velocities. Therefore, this issue is resolved.



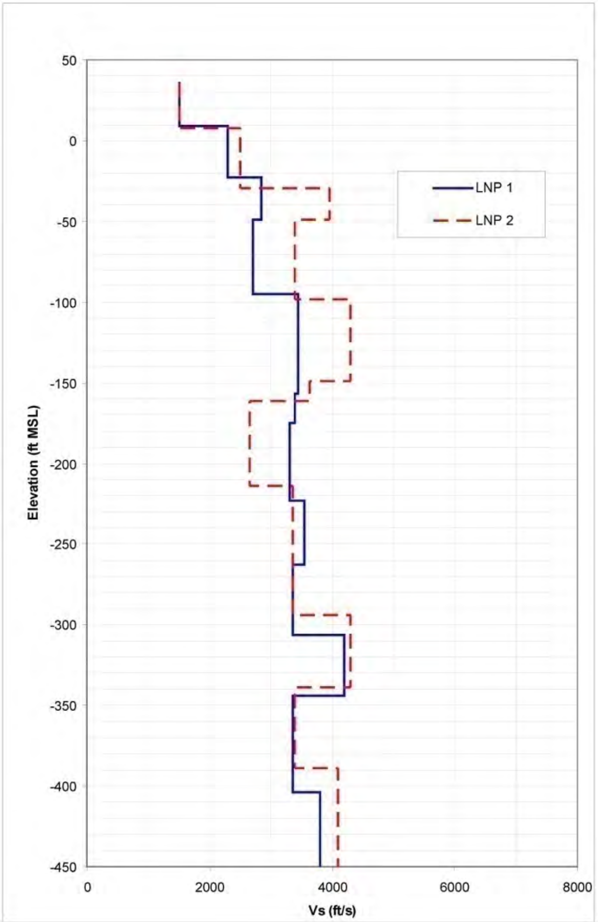
Pre- and post-grouting seismic wave velocities measurements (AFSER Figure 2.5.2-9)

Section 2.5.2 Vibratory Ground Motion

Shear Wave Velocity Profiles

The reference point for the GMRS is at the top of unit S2 (weathered limestone) at an average elevation of 36 ft.

Site amplification functions from the UHRS to the GMRS were calculated using combined shallow and deep velocity profiles consisting of 29 layers on the top of hard rock (Vs =9,300 ft/s) at the depth of ~ 4,300 ft.

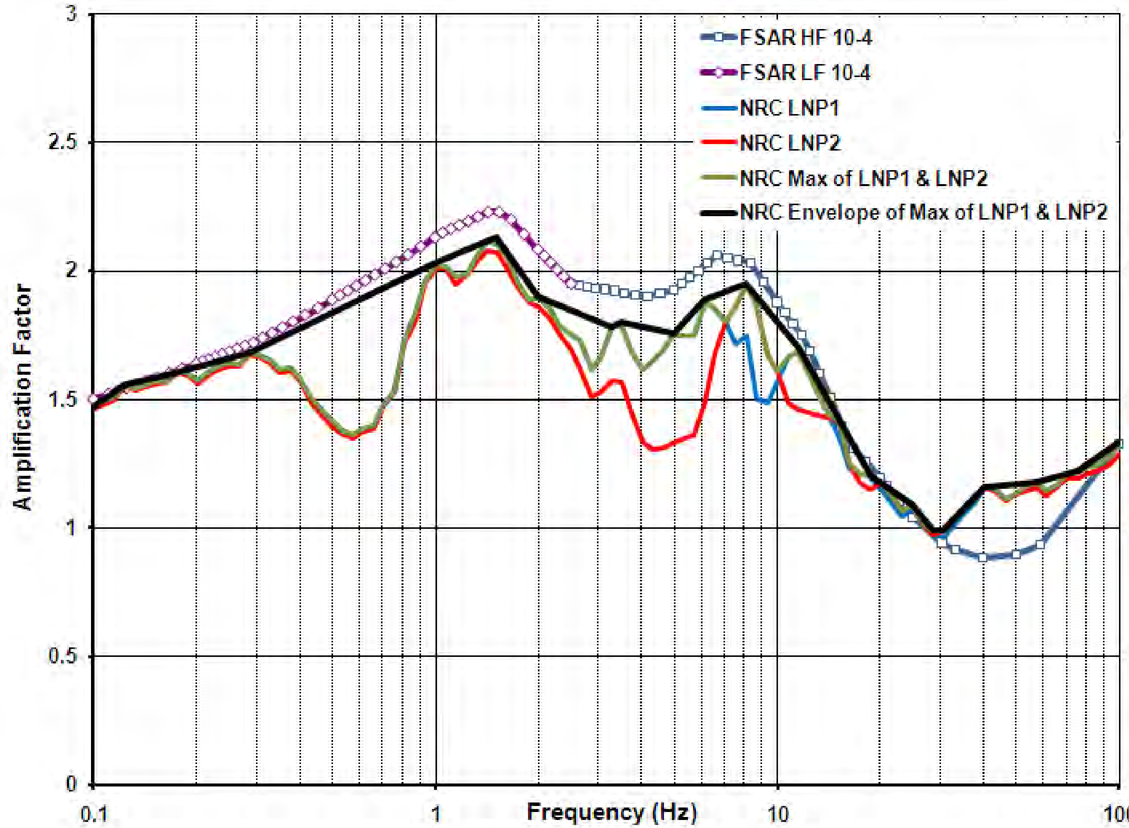


Shallow shear wave velocity profile for the LNP Unit 1 (LNP1) and Unit 2 (LNP2) site (AFSER Figure 2.5.2-3).

Section 2.5.2 Vibratory Ground Motion

Confirmatory Analysis of Site Response Calculations

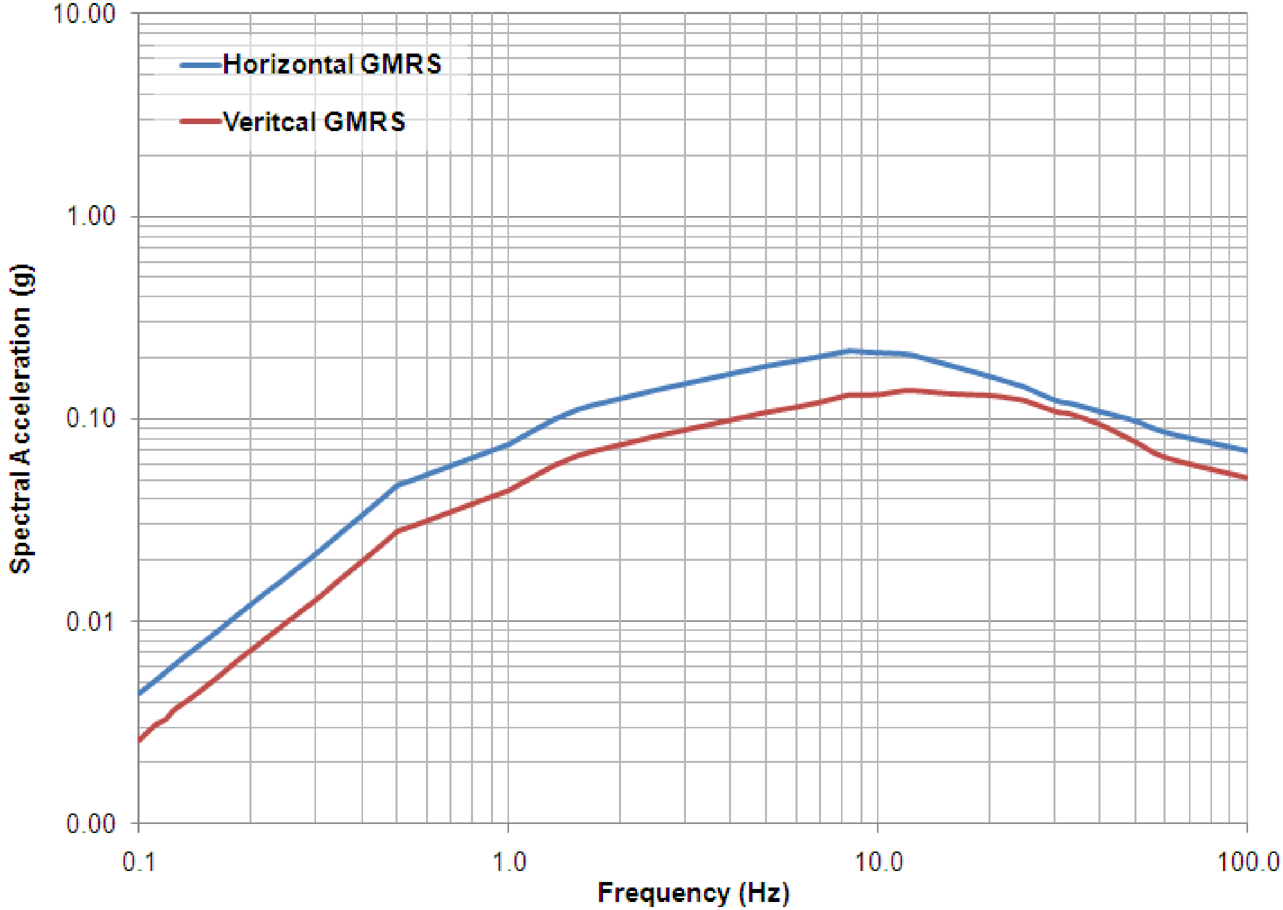
- Amplification functions were calculated for both LNP Unit 1 and 2 profiles and later enveloped to provide conservative estimate.
- NRC staff performed independent site response analysis and confirmed applicant's results.



The applicant's functions are equal or exceed the staff's in the frequency range 0.1 to 30 Hz and 80 to 100 Hz. The staff's function exceeds the applicant's in the frequency range of 30 to 75 Hz, but this exceedance is not significant due to limitations of methods used. (AFSER Figure 2.5.2-12)

Section 2.5.2 Vibratory Ground Motion

Horizontal and Vertical Ground Motion Response Spectra (GMRS)

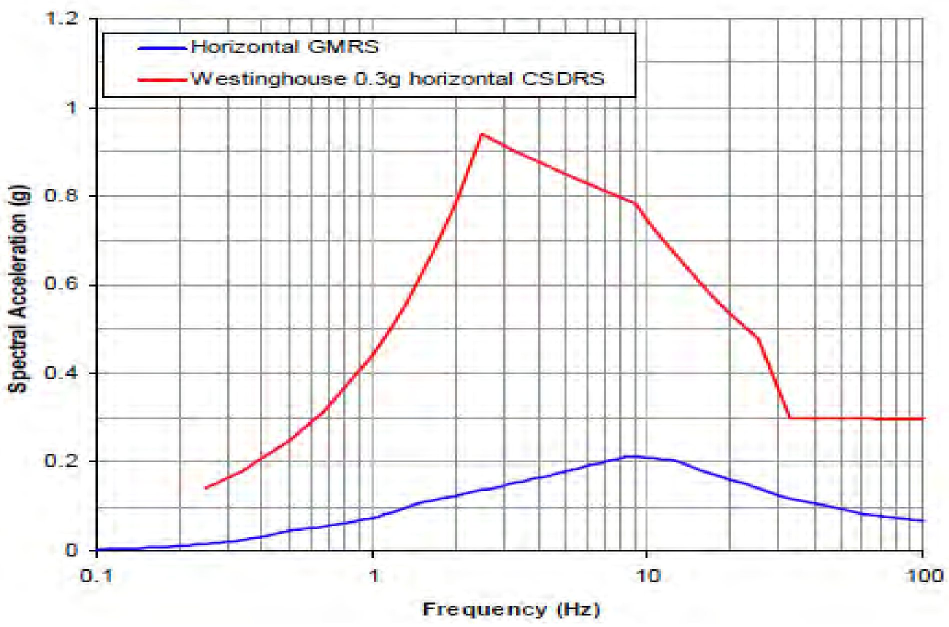


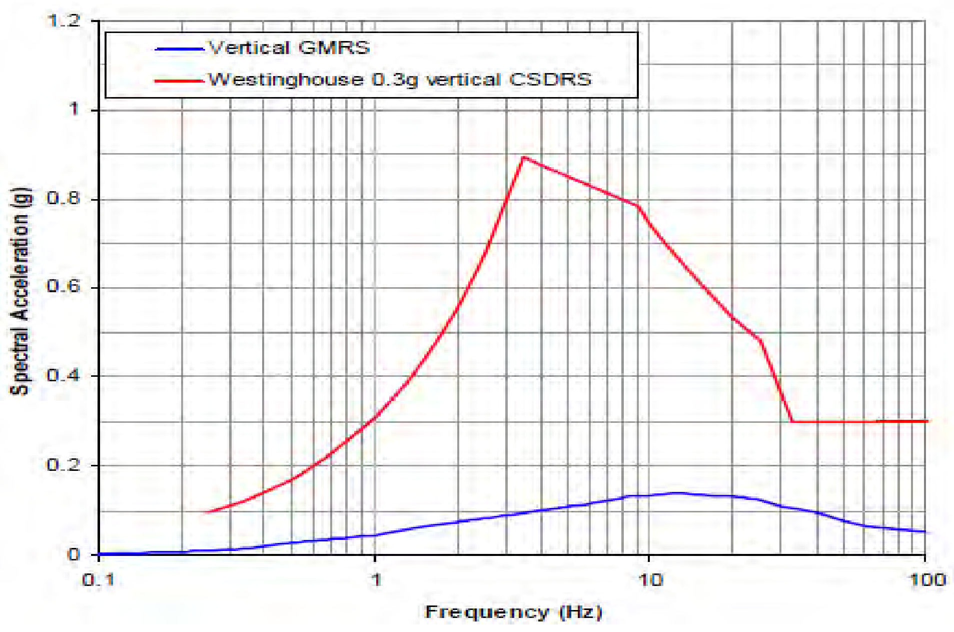
AFSER Figure 2.5.2-5

The reference point for the GMRS is taken to be the top of the weathered limestone at an elevation of 11 m (36 ft), since the upper sands will be removed during construction.

Section 2.5.2 Vibratory Ground Motion

Horizontal and Vertical GMRS and Westinghouse Certified Seismic Design Response Spectra (CSDRS)

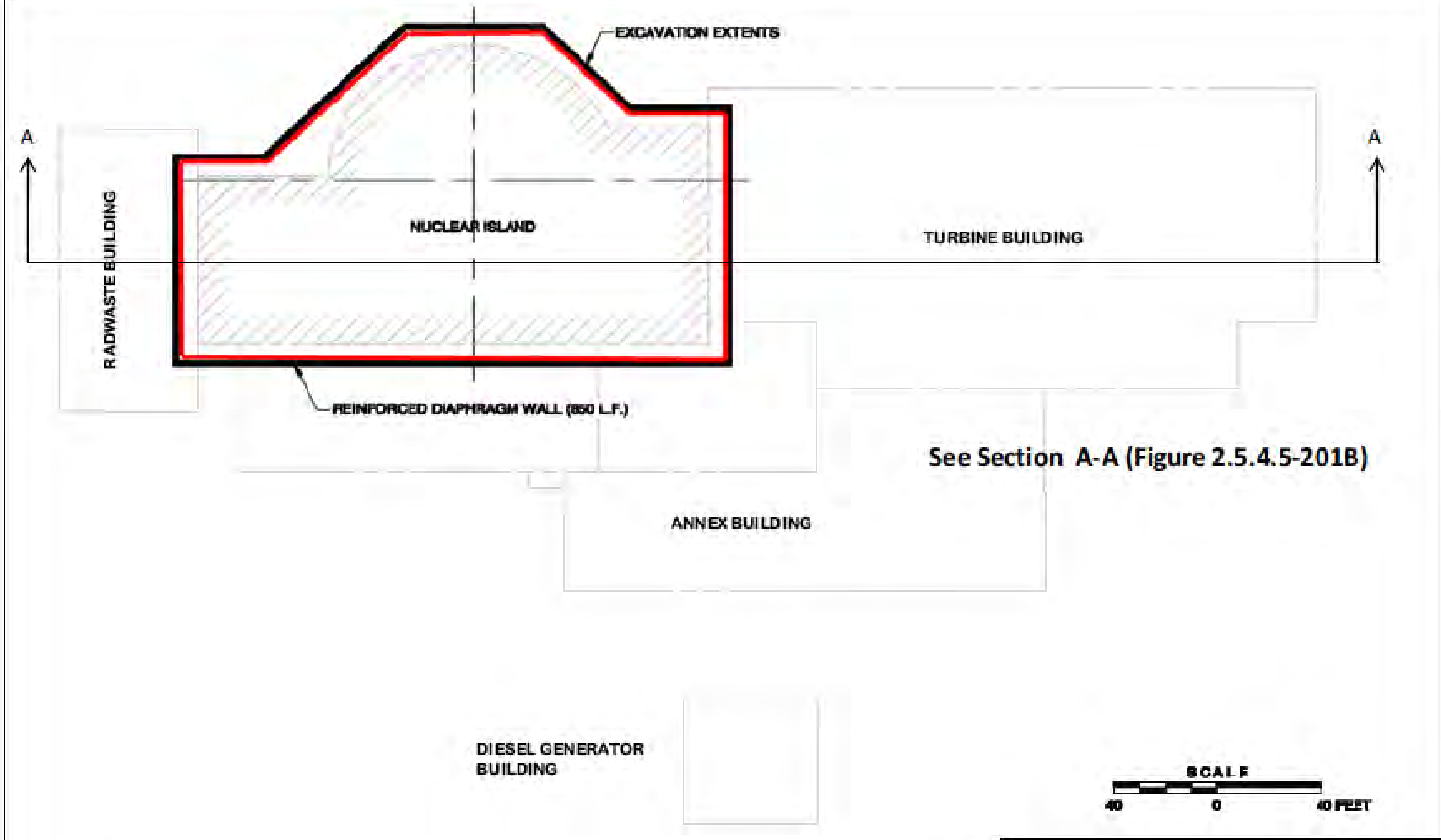




FSAR Figure 2.5.2-296

2.5.4 Stability of Subsurface Materials and Foundations

Foundation Plan



Note:
This Figure presents a conceptual design that was developed for COL Application. Detailed design will be completed prior to construction, and the dimensions and quantities shown herein are subject to change at that time.

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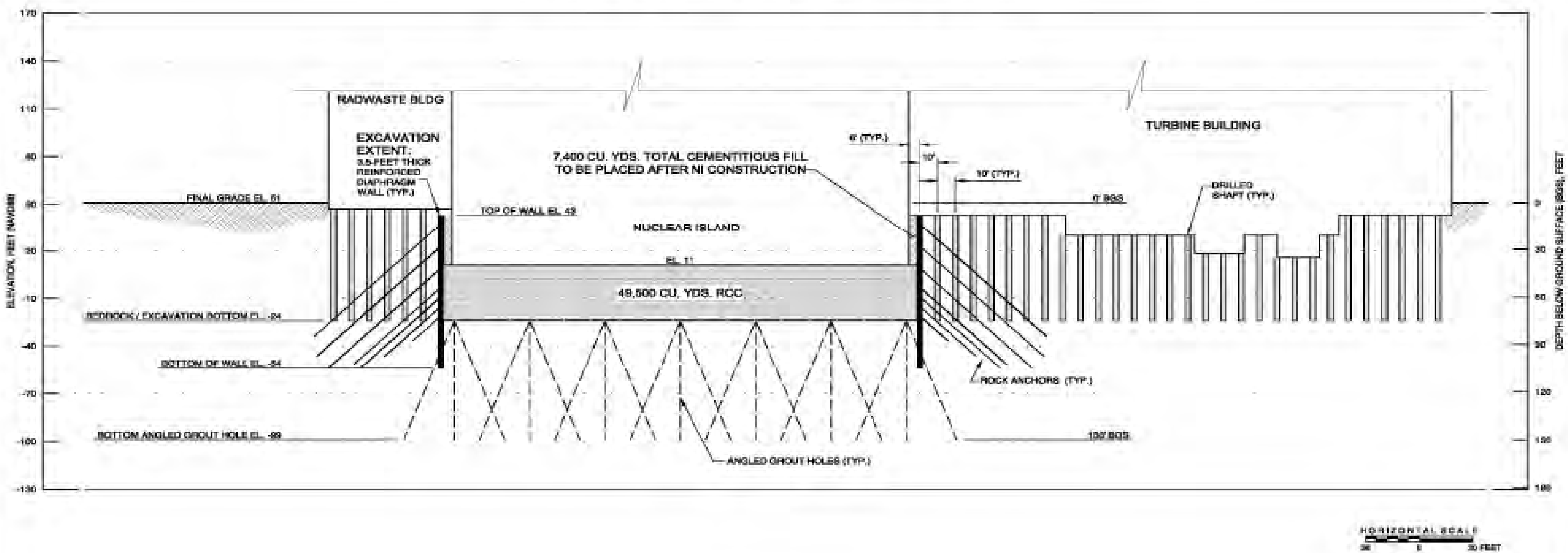
LNP 1 Nuclear Island Excavation Limits
Plan View
FIGURE 2.5.4.5-201A

Rev 0

2.5.4 Stability of Subsurface Materials and Foundations

Foundation Profile

SECTION A-A (FROM FIGURE 2.5.4.5-201A)



Note:
This Figure presents a conceptual design that was developed for COL Application. Detailed design will be completed prior to construction, and the dimensions and quantities shown herein are subject to change at that time.

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LNP 1 Nuclear Island Excavation Limits
Plant South to Plant North Cross Section
FIGURE 2.5.4.5-201B

Rev

2.5.4 Stability of Subsurface Materials and Foundations

Foundation Improvements

- Reinforced tied-back concrete diaphragm wall surrounds NI
- Grout injection from El. -24 ft to El. -99 ft.
  - Inclined grout holes spaced on 16 ft centers followed by split-spaced grout holes on 8 ft centers
  - Grouting on 4 ft centers if two stage grouting does not achieve the desired seepage cutoff
- 35 ft RCC bridging mat replaces unsatisfactory Avon Park limestone from El. +11 to El. -24.
- Drilled pier supported Category II and non-safety related structures
- Vertical drains to relieve excess pore water pressure during SSE to prevent liquefaction of sandy soils underlying Category 2 structures

2.5.4 Stability of Subsurface Materials and Foundations

Important Aspects of Foundation Design Review

- Karst topography
- Grouting
- Bearing Capacity of Avon Park Limestone
- Settlement
- Liquefaction

2.5.4 Stability of Subsurface Materials and Foundations

Safety Evaluation Results

- Extensive dissolution and karst development may be strongly enhanced where vertical joints and horizontal bedding planes intersect. However, this intersection geometry has not produced large dissolution cavities at the site location based on borehole data

- Dolomitization of Avon Park lessens dissolution effects in the Avon Park at the site location

- Grout filled joints accomplished with two stage grouting program will inhibit percolation of rainfall runoff

2.5.4 Stability of Subsurface Materials and Foundations

Safety Evaluation Results (continued)

- Bearing capacity of Avon Park is adequate for static and dynamic loads
  - Safety analysis assumed large 10 ft. x 10 ft. cavity below the 35-ft thick RCC bridging mat
  - Sensitivity analyses varying location of cavities indicated no detrimental effect on stability
- Settlement and differential settlement are below the AP1000 DCD limits
- Liquefaction not possible under NI
  - liquefiable ground outside NI either removed and replaced with engineered backfill or stabilized with drains to prevent liquefaction

Backup Slides for Section 2.5

Backup Slide

Examining an outcrop of the Middle Eocene (48.6-40.4 Ma) Avon Park Formation, the LNP foundation unit, along the Waccasassa River about 25 km (16 mi) northwest of the LNP site during the April 2009 site audit visit.

Backup Slide

Section 2.5.2 Vibratory Ground Motion

Gulf Coast Source Zone (Continued)

SPECTRUAL FREQUENCY (Hz)	PERCENT CHANGE IN LNP SITE GROUND MOTIONS AT FINISHED GRADE ELEVATION
0.5	+2
1.0	+4
2.5	+4
5.0	+6
10.0	+6
25.0	+7
100.0	+7

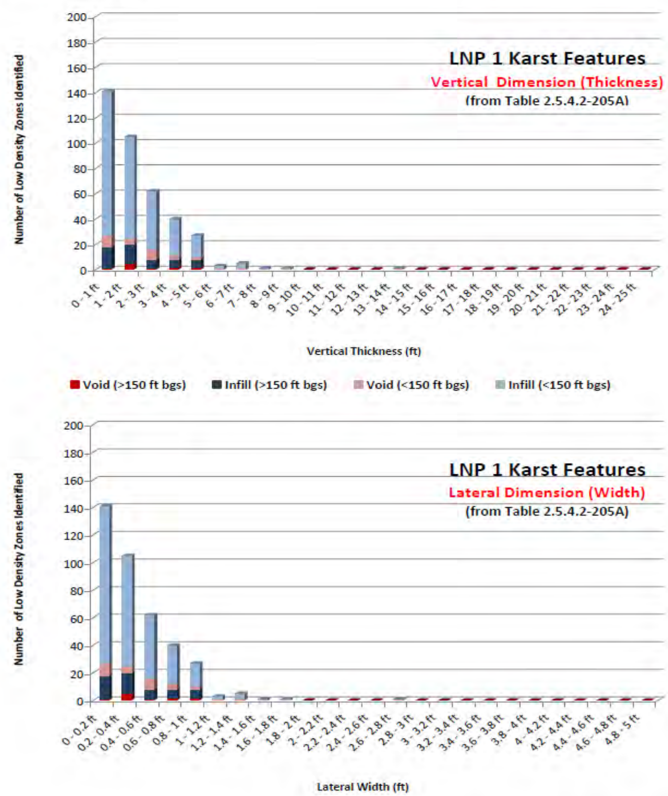
Percent Change in Site Ground Motions at Finished Grade Elevation Resulting from the Use of the TI team's Mmax Distribution of 6.1 [0.1], 6.6 [0.4], 6.9 [0.4], 7.2 [0.1]. (AFSER Table 2.5.2-3)

Backup Slide

2.5.4 Stability of Subsurface Materials and Foundations

Distribution of Vertical and Lateral Dimension of Voids

LNP COL 2.5-1, LNP COL 2.5-5



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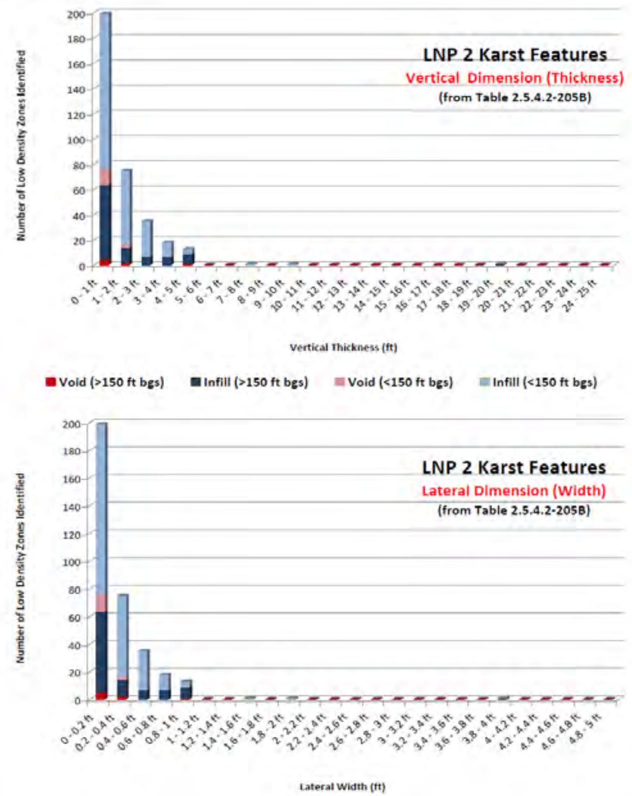
LNP 1 Karst Features
Vertical / Lateral Dimension
FIGURE 2.5.4.1-201A

Rev 0

LNP COL 2.5-1, LNP COL 2.5-5



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LNP 2 Karst Features
Vertical / Lateral Dimension
FIGURE 2.5.4.1-201B

Rev 0

Backup Slide

2.5.4 Stability of Subsurface Materials and Foundations

Stress and Displacement Sensitivity Analyses

- Soft/Stiff Regions
- Lower bound values of elastic modulus are used
- Horizontal variations in elastic properties based on RQD values across the site
- Postulated soft layers based on “no recovery” zones
- The largest total and differential settlements occur when the soft beds were modeled as continuous soft layers
- Total and differential settlements for all cases are less than 0.5 in

- Fracture Patten and Size
- Observed fractures are typically less than 0.1 ft
- 10 ft wide voids modeled through the center of the NI and immediately beneath the RCC bridging mat to aggregate 100 fractures of 0.1 ft
- The maximum elastic settlement was determined to be 0.27 in, with differential settlement of 0.17 in

Levy Nuclear Plant
FSAR Chapters 3 and 19

Dr. AK Singh
Vice President & Project Director
Sargent & Lundy

NGG Think Fleet.

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Chapter 3
Design of Structures, Components, Equipment and Systems

- DCD Incorporated by reference – No Departures
- Standard material incorporated
- Additional site-specific COL Items and Supplements

LNP SUP 3.2-1 and SUP 3.2-2

- Classification of Structures, Components, and Systems
  - The Roller Compacted Concrete (RCC) bridging mat is the only safety related structures, systems, or components outside the the scope of DCD

Site-specific COL Items

- COL 3.3-1 Wind and Tornado Loadings
  - Wind velocity and Tornado characteristics for LNP are bounded by the DCD
- COL 3.4-1 Water Level (Flood) Design
  - Site specific ground water and flood levels satisfy DCD requirements
- COL 3.5-1 Missile Effects
  - The effects of external missiles on safety related components are bounded by the DCD

COL 3.5-1: Aircraft Impact

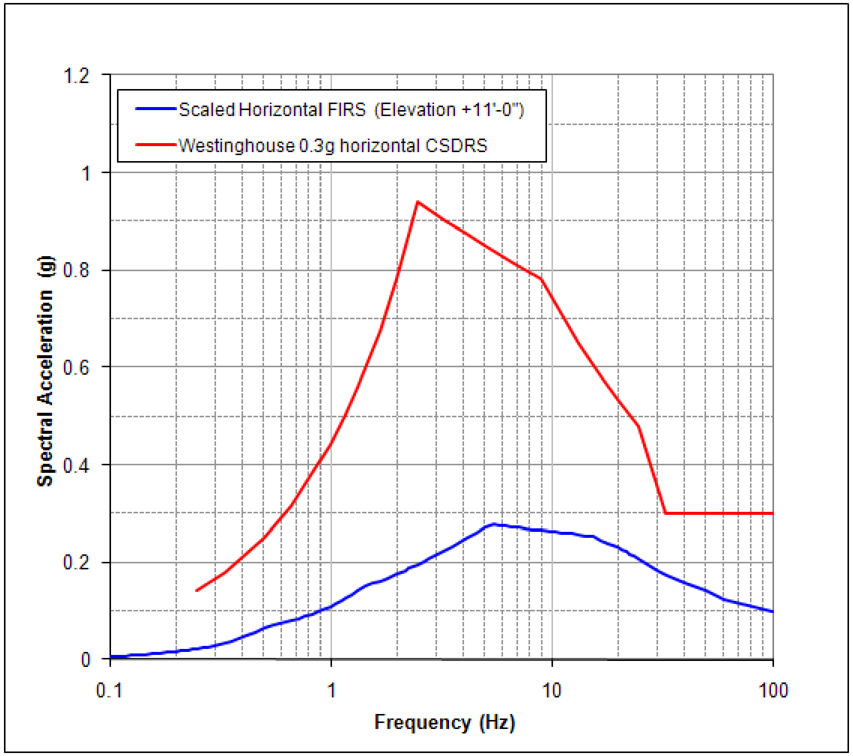
- Large aircraft crash probability of 3.1×10^{-8} is bounded by the DCD acceptance crash probability of 10^{-7}
- Small aircraft crash CDF of 0.4×10^{-12} is bounded by the DCD acceptance criteria of 1×10^{-8} per year

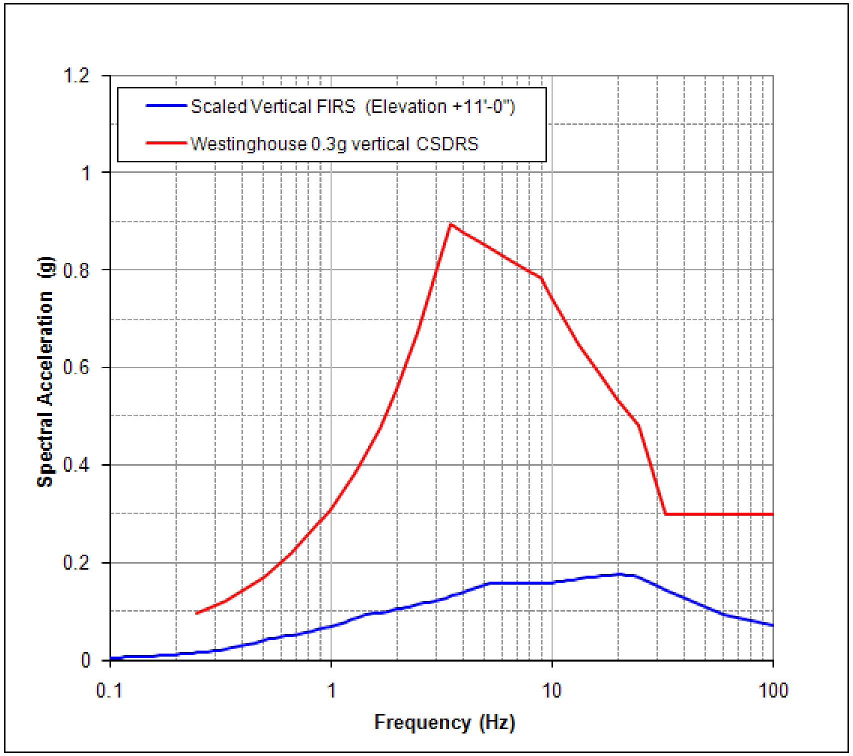
Site-specific COL Items

- COL 3.7-1
  - There are no existing or planned Dams near the site that will affect flood levels at the site
- COL 3.7-2
  - Post earthquake operating procedures will comply with RG 1.166 and 1.167 and are the same as for Vogtle

COL 3.7-3 Scaled FIRS (El +11ft.)

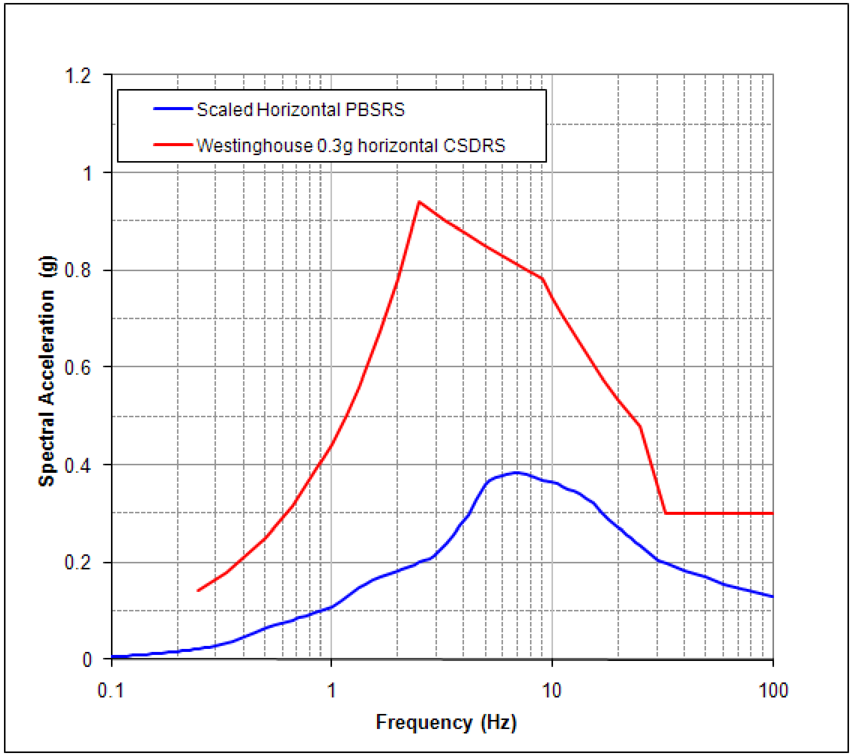
RG 1.208 and 10CFR 50 Appendix S

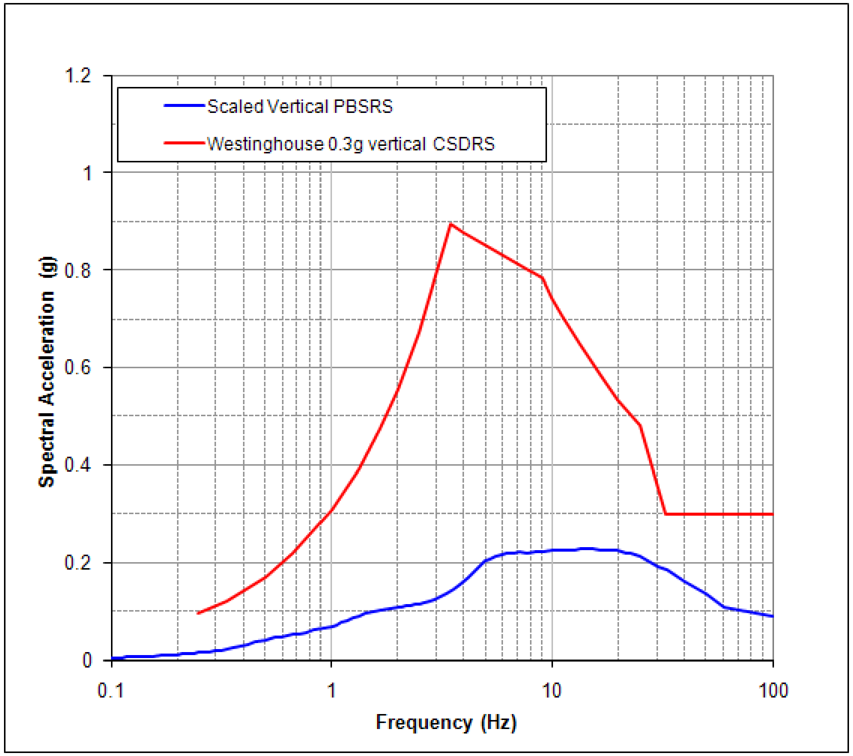




COL 3.7-3 Scaled PBSRS (El +51 ft.)

RG 1.208 and 10CFR 50 Appendix S





NGG
Think Fleet.

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LNP SUP 3.7-5 Adjacent Building Seismic Category II/I Interaction

- No Seismic Category II/I interaction between the NI and the TB, AB, and Radwaste buildings' drilled shaft supported foundations for PBSRS or 10^{-5} UHRS
- 10^{-5} UHRS is > 1.67xPBSRS

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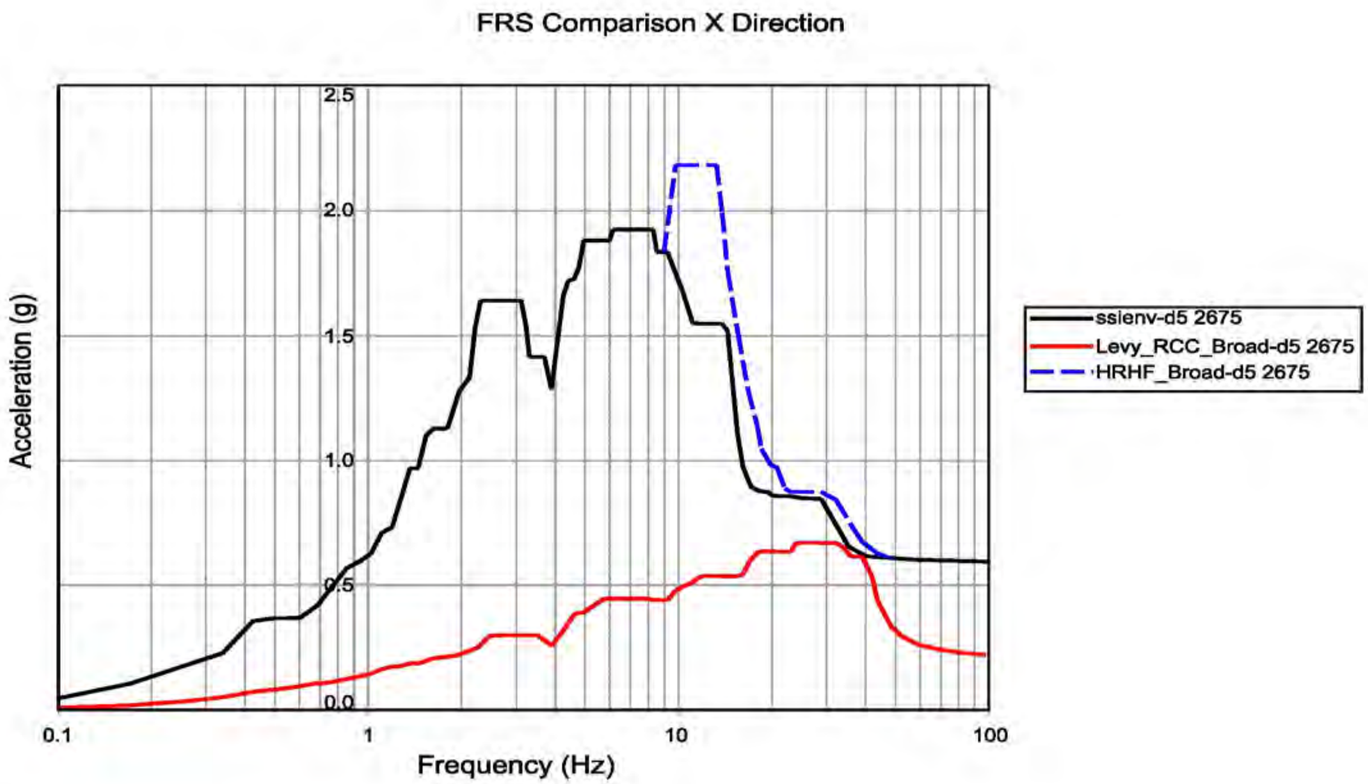
LNP SUP 3.7-6 SSI Analysis

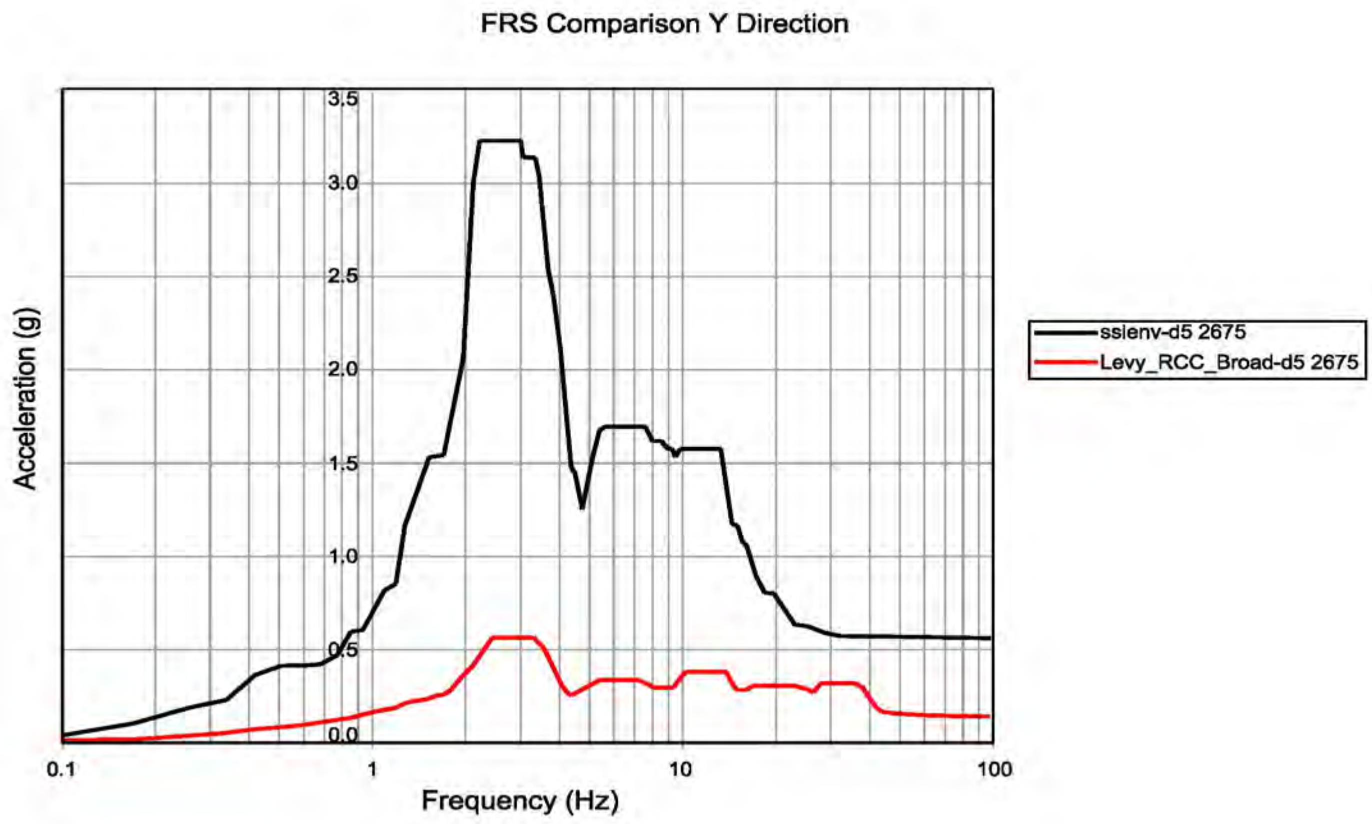
- 3D SSI analysis was performed considering BE, UB, LB, and LLB soil profile, RCC mat, and NI20R model following guidance in NRC DC/COL-ISG-017 and SRP 3.7.2
- SSI analysis results show that the LNP FRS are enveloped by the CSDRS FRS at six key locations

66

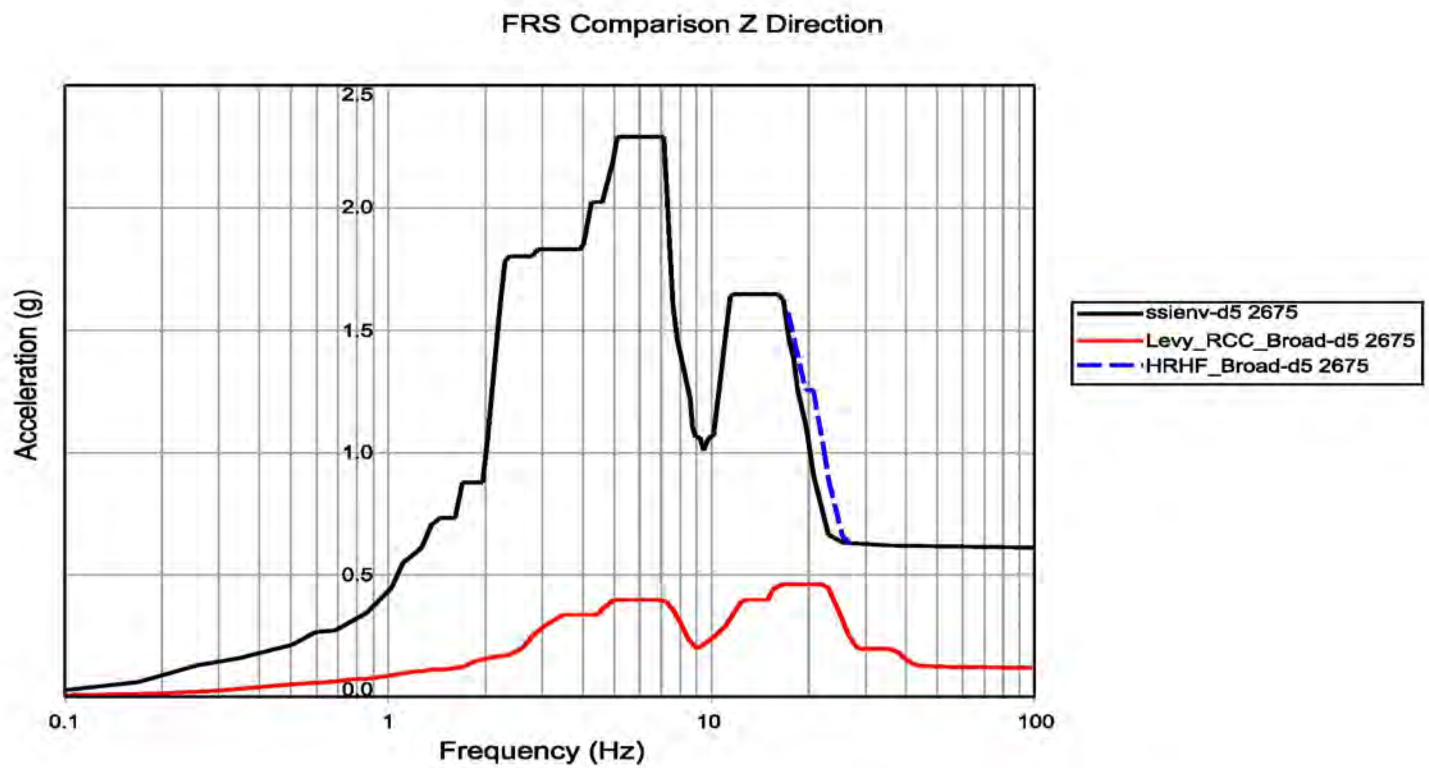
LNP SUP 3.7-6 SSI Analysis



LNP SUP 3.7-6 SSI Analysis



LNP SUP 3.7-6 SSI Analysis



Chapter 19
Probabilistic Risk Assessment

- DCD Incorporated by Reference
- Standard material incorporated
  - COL 19.59.10-1 through COL 19.59.10-6
- Additional site-specific information provided for Seismic Margin Analysis and Winds, Floods, and Other External Events

Section 19.55
Seismic Margin Analysis

- DCD Seismic Margin Assessment (HCLPF) bounds LNP
- Earthwork design precludes liquefaction in soils under and around the TB, AB, and RB for PBSRS or 10^{-5} UHRS
- No Seismic Category II/I interaction between the TB, AB, and RB and NI foundation for 10^{-5} UHRS

Section 19.58
Winds, Floods, and Other External Events

- Site specific evaluation for Winds, Flood, and Other External Events concluded that LNP site is bounded by the DCD evaluation

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Presentation to the ACRS Subcommittee

Levy County Nuclear Plant Units 1 and 2 Combined License Application

Chapter 3 – Design of Structures, Components, Equipment, and Systems

October 18–19, 2011

Staff Review Team

Technical Staff

- Pravin Patel, Structural Engineering Branch
- Vaughn Thomas, Structural Engineering Branch
- Carl Costantino, Structural Engineering Consultant
- Tom Houston, Structural Engineering Consultant

Project Managers

- Terri Spicher
- Brian Anderson

Levy County FSAR Chapter 3

Design of Structures, Components, Equipment and Systems

FSAR Section	Site-Specific Evaluations
3.1 Conformance With Nuclear Regulatory Commission General Design Criteria	• None*
3.2 Classification of Structures, Components, and Systems	• None*
3.3 Wind and Tornado Loadings	• LNP COL 3.3-1 Wind Velocity Characteristics • LNP COL 3.5-1 Tornado Velocity Characteristics
3.4 Water Level (Flood) Design	• LNP COL 3.4-1 Dewatering System and Water Levels
3.5 Missile Protection	• LNP SUP 3.5-1 Turbine Missile from Unit 1
3.6 Protection Against the Dynamic Effects Associated With the Postulated Rupture of Piping	• None*

* This section is entirely IBR or IBR/standard

Levy County FSAR Chapter 3

Design of Structures, Components, Equipment and Systems

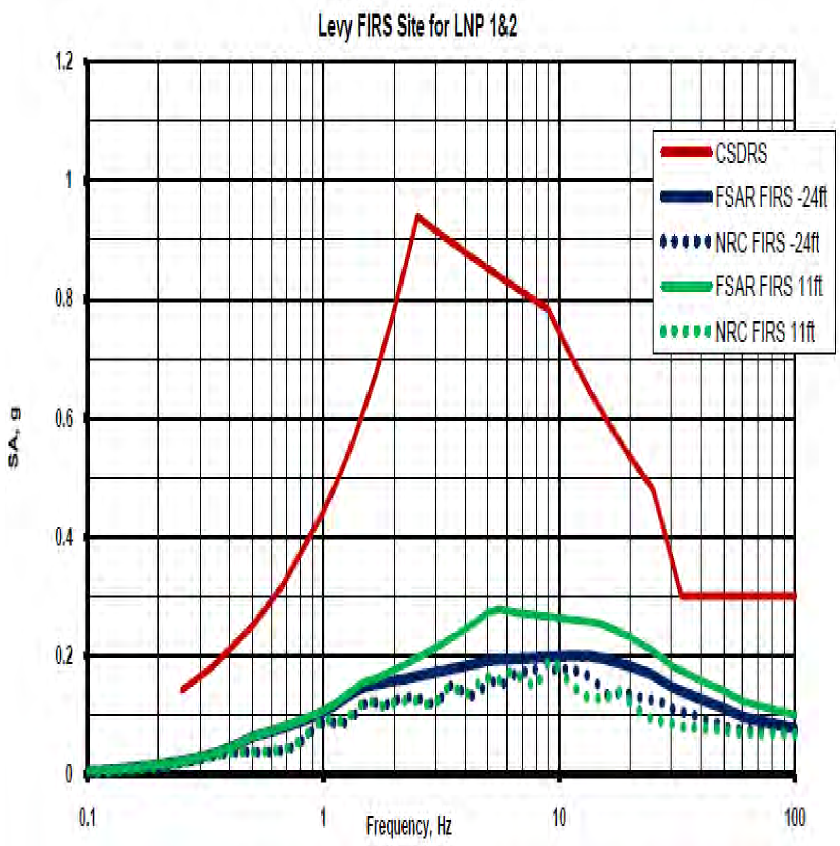
FSAR Section	Site-Specific Evaluations
3.7 Seismic Design	• LNP COL 3.7-3 Design Ground Motion Response Spectra • LNP SUP 3.7-5 Maximum Relative Displacement between the NI and the Category II Building Foundation • LNP SUP 3.7-6 Site Specific Soil Structure Analysis
	• LNP COL 3.7-1 Methods for Seismic Analysis of Dams
3.8 Design of Category I Structures	• LNP SUP 3.8-2 Drilled Shaft Foundations Design and Installation • LNP SUP 3.8-3 Roller Compacted Concrete Strength and Constructability Verification Program
	• LNP COL 2.5-17 Waterproofing Material for Category I Structures
3.9 Mechanical Systems and Components	• None*
3.10 Seismic and Dynamic Qualification of Seismic Category I Mechanical and Electrical Equipment	• None*
3.11 Environmental Qualification of Mechanical and Electrical Equipment	• None*

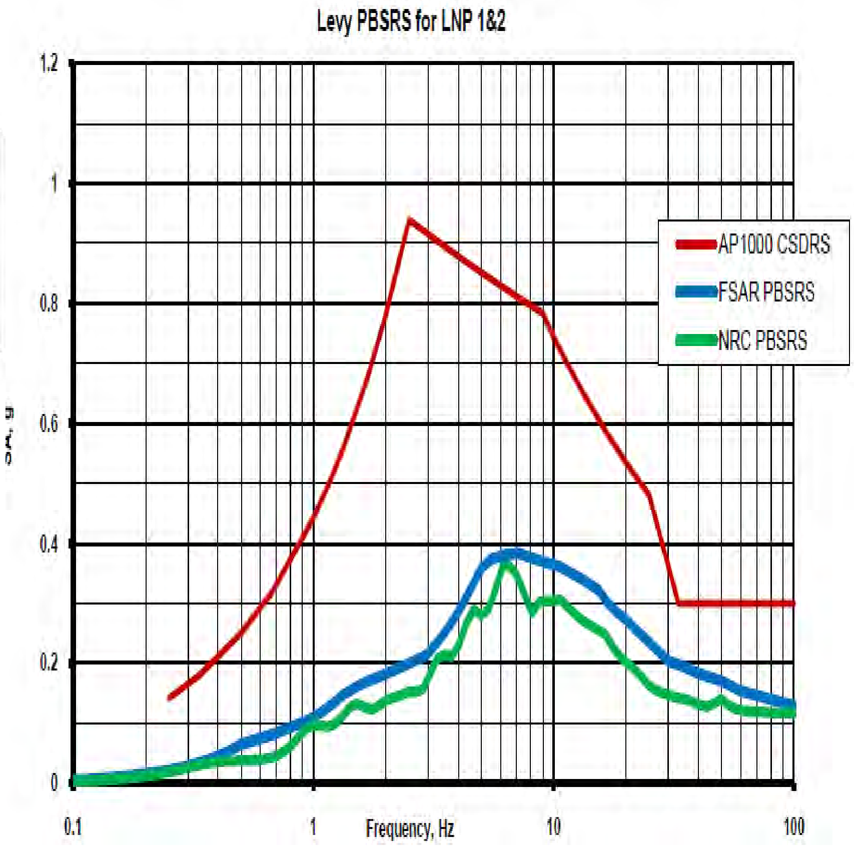
* This section is entirely IBR or IBR/standard

LNP COL 3.7-3
Design Ground Motion Response Spectra

- Issue
  - The applicant developed site amplification functions for the calculation of both the ground motion response spectra (GMRS) and the performance based surface response spectra (PBSRS) following the guidance ISG-017.
    - Engineering backfill required to raise the plant grade to be consistent with DCD soil profiles.

GMRS vs. PBSRS





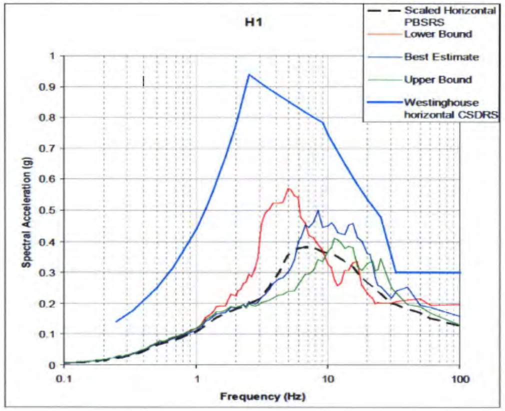
LNP COL 3.7-3
Design Ground Motion Response Spectra

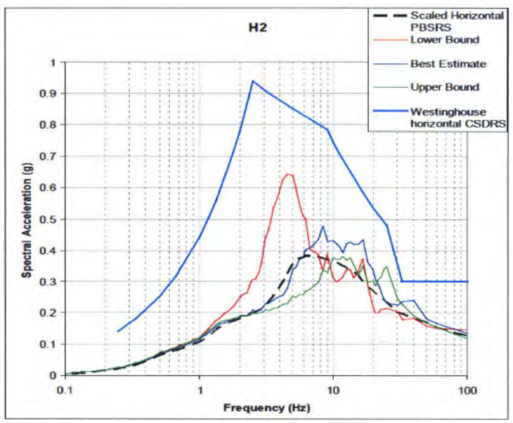
- Resolution
  - The Staff performed confirmatory site response analyses using estimated values of stiffness and damping coefficients for the proposed fill materials to develop surface PBSRS for the site profiles.
  - The Staff developed FIRS spectra at the foundation level to check the minimum required ground motions per 10 CFR Part 50, Appendix S.
  - No significant differences between the staff's and the applicant's calculated PBSRS and FIRS for the 10-4 and 10-5 hazard levels.
  - Both the FIRS and surface PBSRS are well below the AP1000 CSDRS and HRHF.

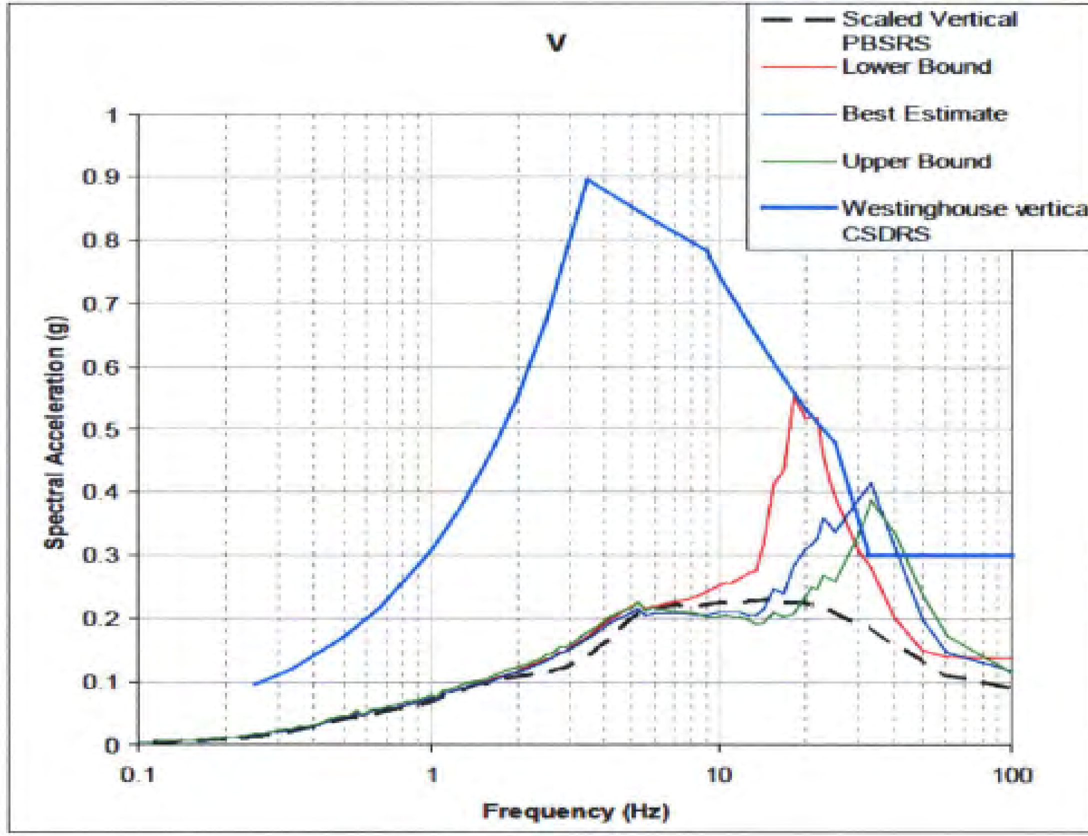
LNP SUP 3.7-6
Site Specific Soil Structure Analysis

- **Issue**
  - The applicant developed horizontal and vertical site-specific SSI input spectra and compared the input spectra to the AP1000 CSDRS.
    - LNP free field response analysis showed that the AP1000 CSDRS for the vertical seismic excitation does not envelope the design grade deterministic surface spectra in the high frequency range.

PBSRS vs. CSDRS







Horizontal

Vertical

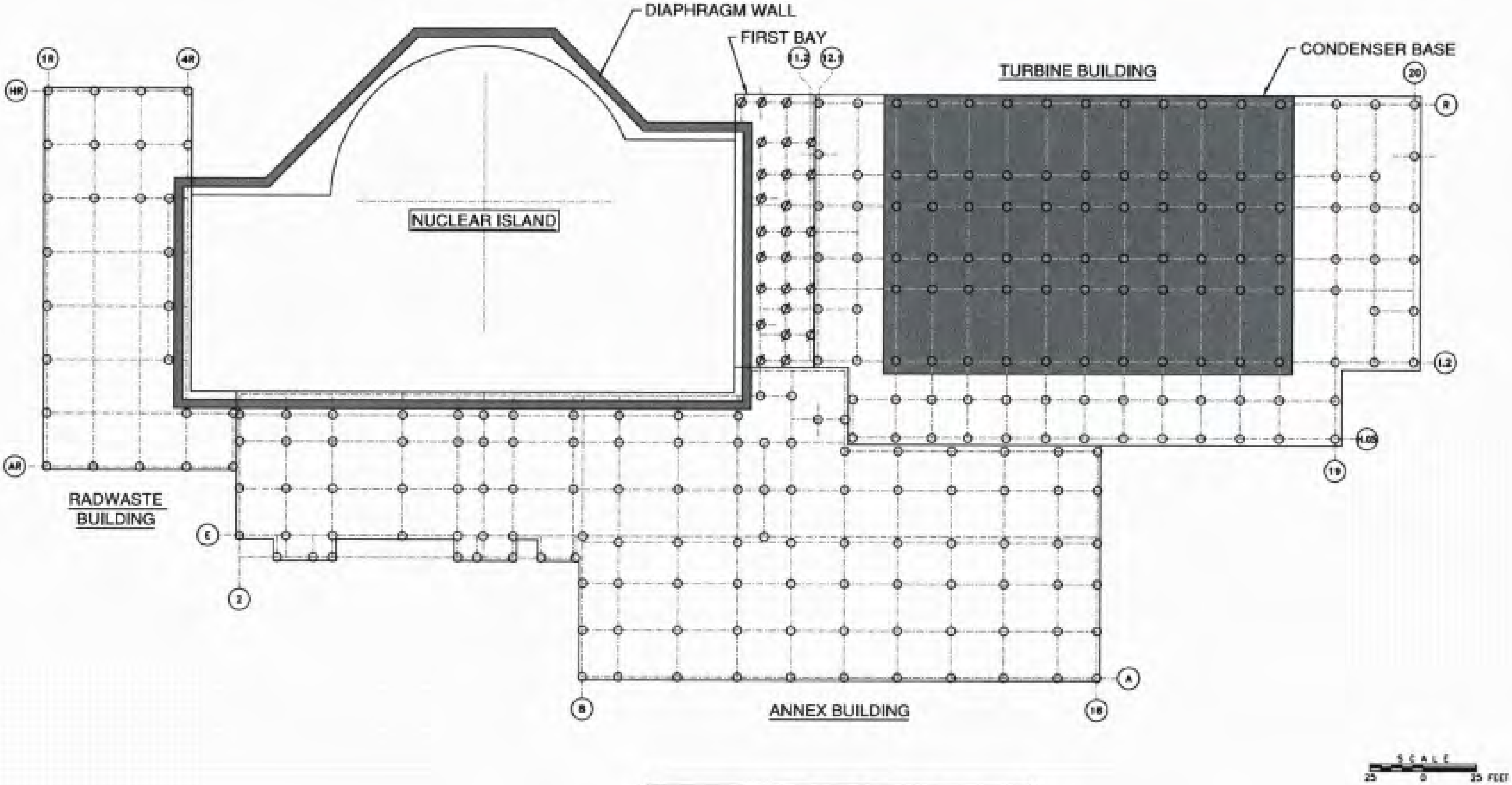
LNP SUP 3.7-6
Site Specific Soil Structure Analysis

- **Resolution**
  - The applicant developed an SSI model to compute ISRS for the site-specific soil profile and foundation geometry.
  - The applicant demonstrated that the LNP ISRS are enveloped by the AP1000 generic ISRS at all of the six NI key nodes with sufficient margin.
  - The information provided by the applicant was found to be adequate to demonstrate that the ISRS are enveloped by the AP1000 ISRS.

LNP SUP 3.7-5
Maximum Relative Displacement between the NI and the Adjacent Building Foundation

- **Issue**
  - Applicant computed the probable maximum relative displacement between the NI and adjacent building foundations.

    - The seismically induced lateral deformation of soils surrounding the drilled shafts needed to be incorporated into the analyses in addition to shaft deformation.
    - Impact of loss of soil support on shaft needed to be incorporated into the analysis.



DRILLED SHAFT QUANTITIES		
BUILDING	NUMBER	
	4'ø	6'ø
TURBINE CONDENSER BASE	66	0
TURBINE FIRST BAY	0	25
TURBINE (EXCLUDING CONDENSER BASE & FIRST BAY)	56	0
RADWASTE	26	0
ANNEX	113	0

LEGEND:

O 4-FOOT DIAMETER DRILLED SHAFT

Ø 6-FOOT DIAMETER DRILLED SHAFT

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DRILLED SHAFT LAYOUT FOR TURBINE, ANNEX, AND RADWASTE BUILDINGS

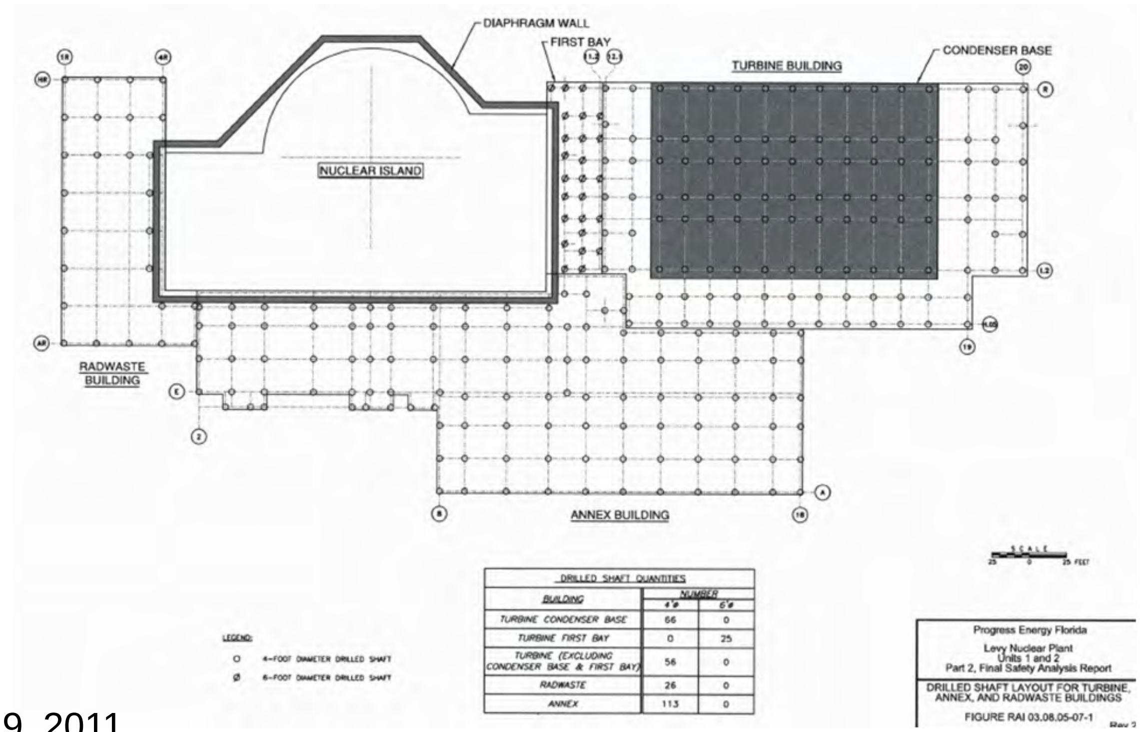
FIGURE RAI 03.08.05-07-1

LNP SUP 3.7-5
Maximum Relative Displacement between the NI and the Adjacent Building Foundation

- **Resolution**
  - Maximum relative displacement computed by the applicant is 0.7 inches.
  - The computed displacement between the NI and adjacent building is less than the 2.0 inch gap required per the DCD.
  - Interaction between NI and adjacent buildings is not a concern.

LNP SUP 3.8-2
Drilled Shaft Foundations Design and Installation

- **Issue**
  - The seismic Category II and non safety-related adjacent buildings (Turbine Building, Annex Building, and Radwaste Building) are supported on drilled shaft foundations.
    - NRC staff requested additional information related to the design methodology of the drilled shafts supporting the structures adjacent to the NI.



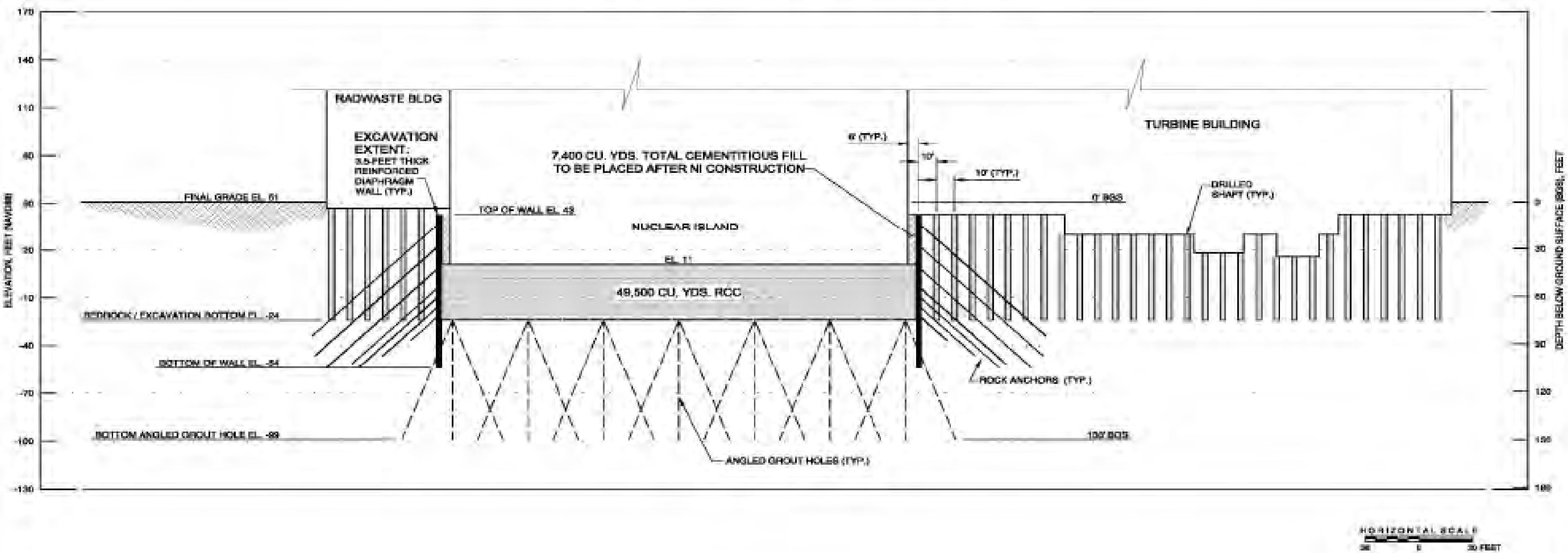
DRILLED SHAFT QUANTITIES		
BUILDING	NUMBER	
	4'ø	6'ø
TURBINE CONDENSER BASE	66	0
TURBINE FIRST BAY	0	25
TURBINE (EXCLUDING CONDENSER BASE & FIRST BAY)	56	0
RADWASTE	26	0
ANNEX	113	0

LNP SUP 3.8-2
Drilled Shaft Foundations Design and Installation

- **Resolution**
  - The applicant demonstrated that the backfill provides lateral support to the drilled shafts.
  - A description of construction sequence and practices to be used for construction of the drilled shafts was provided in the FSAR.
  - An ITAAC was proposed to ensure that the as-built design provides adequate vertical and horizontal capacity and stiffness.
  - The applicant demonstrated that the seismic separation between buildings is adequate to prevent interaction with the NI structures.

LNP SUP 3.8-3
Roller Compacted Concrete Strength and Constructability Verification Program

SECTION A-A (FROM FIGURE 2.5.4.5-201A)



October 18–19, 2011

LNP SUP 3.8-3
Roller Compacted Concrete Strength and Constructability Verification Program

- **Issue (Design Aspects)**
  - A Roller Compacted Concrete (RCC) bridging mat (classified as safety-related) will be used to transmit the NI loads under static and dynamic conditions to the karst foundation**.**
    - NRC staff requested additional information to demonstrate that the RCC Bridging Mat is capable of transferring the NI loads while providing the desired level of performance.
- **Resolution**
  - The RCC construction will follow standard guidance in USACE EM 1110-2-2006, “Roller Compacted Concrete” with additional enhancements related to Quality Assurance.
  - Nominal strength capacities are established during conceptual design phase using ACI 349-01, 318-08 and USACE EM 1110-2-2006 guidance, thus failure probability is consistent with industry codes.
  - Finite Element Modeling of the RCC Bridging Mat was used to confirm capacities greater than expected loading conditions.
  - The applicant demonstrated that the stresses in the bridging mat will remain within code allowable limits and is therefore assured of performing its required function.

LNP SUP 3.8-3
Roller Compacted Concrete Strength and Constructability Verification Program(cont)

- **Issue (Construction Process and Quality Aspects)**
  - Construction verification program did not address the capability of the as-placed material to transfer design forces across the bedding joints.

- **Resolution**
  - The applicant will follow industry standard methods that have been successful on large commercial RCC projects.
  - A detailed test plan describes the quality control and inspection to occur during production.
  - RCC test results from the commercial RCC projects confirm that the use of design values from ACI 318 and USACE EM 1110-2-2006 are appropriate.
  - Post-COL RCC and bedding mix strength verification and constructability testing will be performed on a large test pad at the site prior to production of the RCC Bridging Mat.
  - License Condition for post-COL RCC testing

LNP SUP 3.8-3
Roller Compacted Concrete Strength and Constructability Verification Program(cont)

- **Issue (Construction Process and Quality Aspects)**
  - During pre-COL mix design testing program, the concrete in the test panels did not attain the desired compressive and tensile strength. The applicant attributed the low strength of the cored cylinders from test panels that require the use of small mixing and compaction equipment.

- **Resolution**
  - Use mixing, placement, and compaction equipment consistent with USACE EM 1110-2006 and comparable to that used in large successful commercial projects.
  - Biaxial shear test results on block samples yielded shear strengths at least 1.67 times max design shear demand despite low compressive strength.
  - Post-COL RCC and bedding mix strength verification and constructability testing will be performed on a large test pad at the site prior to production of the RCC Bridging Mat.
  - License Condition for post-COL RCC testing
  - ITAAC for RCC

Presentation to the ACRS Subcommittee

Levy County Nuclear Plant Units 1 and 2 Combined License Application

Chapter 19 – Probabilistic Risk Assessment

October 18–19, 2011

Staff Review Team

Technical Staff

– Malcolm Patterson**,** PRA and Severe Accidents Branch

Project Manager

– Tom Galletta

Levy County FSAR Chapter 19
Probabilistic Risk Assessment

FSAR Section	Site-Specific Evaluations
19.1–19.54, 19.56, 19.57	• None*
19.55 Seismic Margins Analysis	• LNP SUP 19.59.10-6 Site-Specific Seismic Margin Analysis
19.58 Winds, Floods, and Other External Events	• LNP SUP 19.58-1 External Event Frequencies
19.59 PRA Results and Insights	• None*

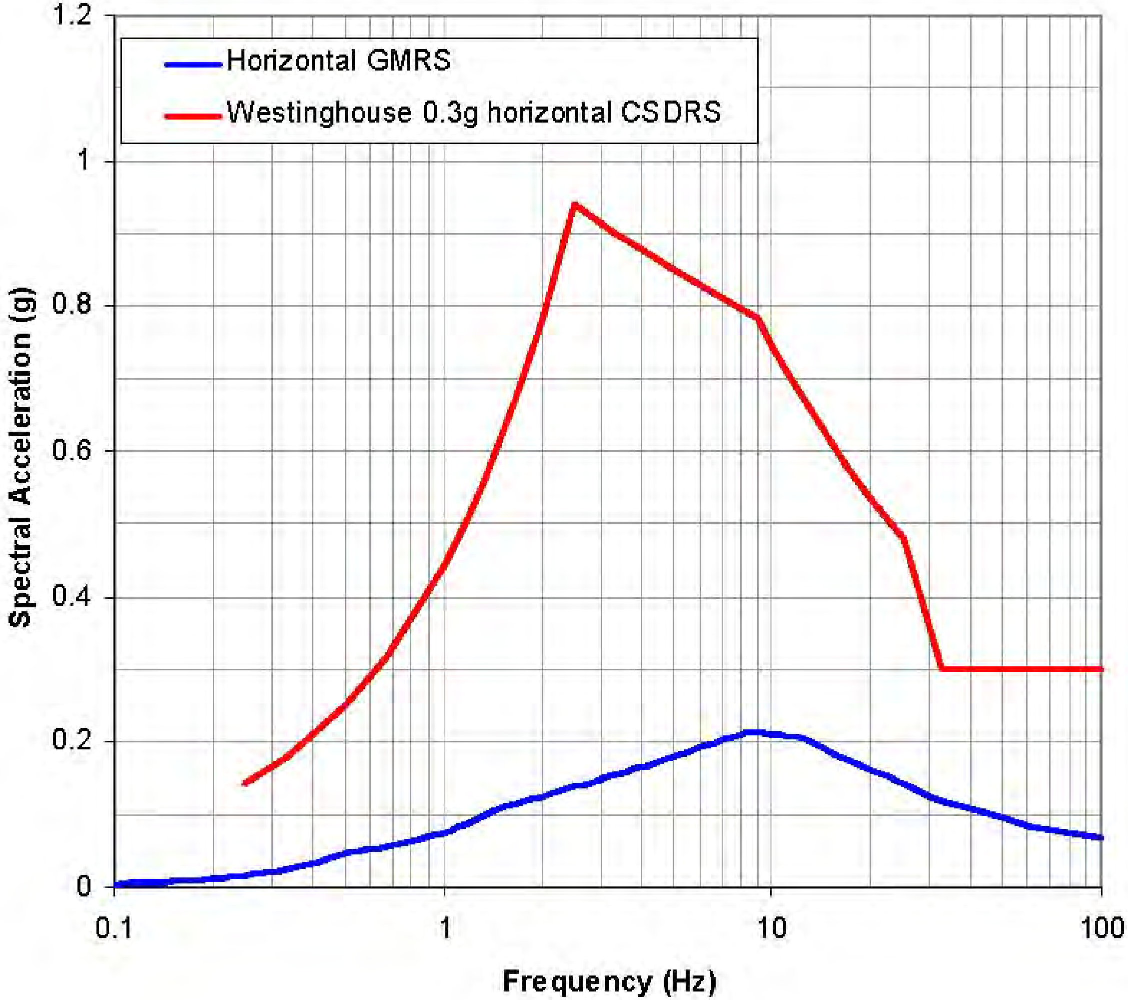
* This section is entirely IBR or IBR/Standard

LNP SUP 3.7-3 and LNP SUP 19.59.10-6 Ground Motion Response Spectra and Seismic Margin Analysis

- Issue
  - Each COL applicant must demonstrate that the seismic margin analysis in the DCD is applicable to the proposed site or perform a site-specific analysis to demonstrate adequate seismic margin.

- Resolution
  - The staff concluded that the seismic margin analysis performed for amending the AP1000 design is applicable to Levy Nuclear Plant Units 1 and 2.

LNP GMRS vs. CSDRS



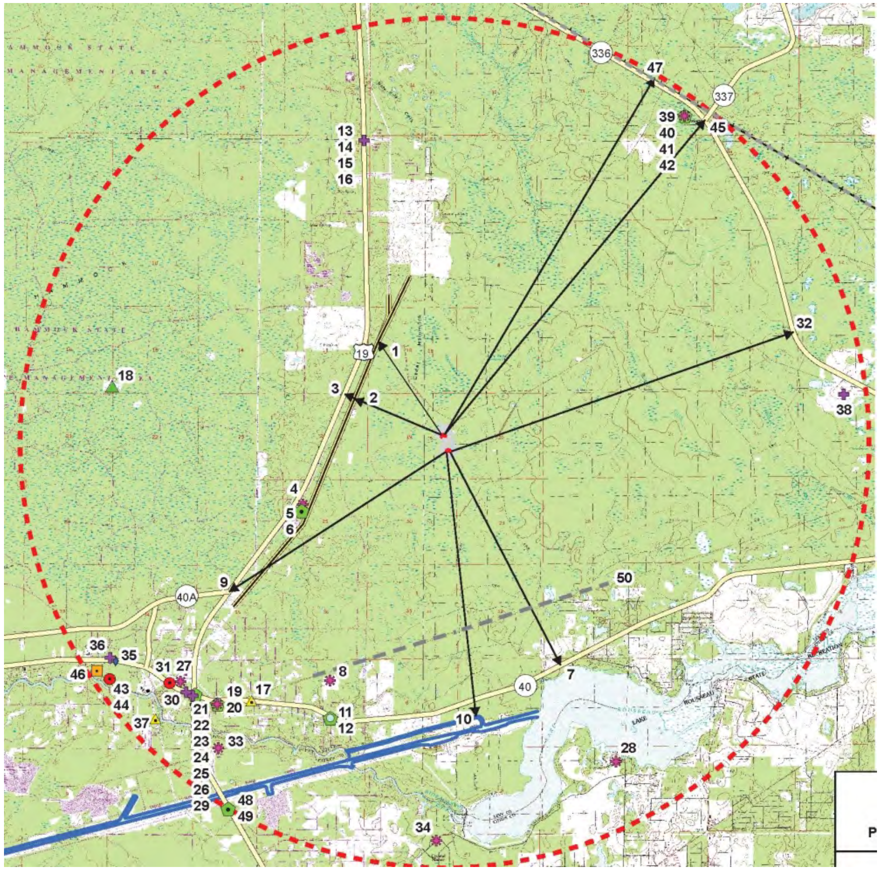
Levy Nuclear Plant External Events

- Issue
  - COL applicant to provide a summary of LNP external events to confirm the basis for concluding that the LNP site was bounded by the generic AP1000 analysis.

- Resolution
  - On the basis of information provided in a plant-specific supplement, the staff confirmed that all external events that contribute to risk, the parameters used for the AP1000 DCD external events analysis bound the reported parameters of the LNP site.

Industrial Activities Near Levy Nuclear Plant

- Pipelines
- Roads
- Railways
- Barge canal
- Mines
- Service stations
- Airway



Levy Nuclear Plant External Events

External Event	Screening Criteria Applied			
	Bounded	Negligible Frequency	Negligible Consequence	Basis
Tornado	•			
Hurricane	•		•[1]	
External flood	•			
Aviation		•[2]	•[3]	
Marine		•		No barge traffic
Pipeline			•	Max conc. < flam. limit
Railroad			•	$D_{closest\ track} > D_{standoff}$
Truck			•	$D_{closest\ highway} > D_{standoff}$
Nearby facilities			•	Ext. fires & toxic chem.

[1] Category 1 hurricane
[2] Large aircraft
[3] Small aircraft

Levy Nuclear Plant Units 1 and 2
FSAR Section 2.4
Hydrologic Engineering

Paul Snead

Supervisor – Environmental Services

NGG Think Fleet.

Progress Energy

Introduction

- DCD Incorporated by reference.

- COL information items addressed
  - COL 2.4-1 Hydrologic Description
  - COL 2.4-2 Floods
  - COL 2.4-3 Cooling Water Supply
  - COL 2.4-4 Groundwater
  - COL 2.4-5 Accidental Release of Liquid Effluents into Ground and Surface Water
  - COL 2.4-6 Flood Protection Emergency Operation Procedures

- Site grade is above the Design Basis Flood level determined by the maximum water level due to extreme flooding events.

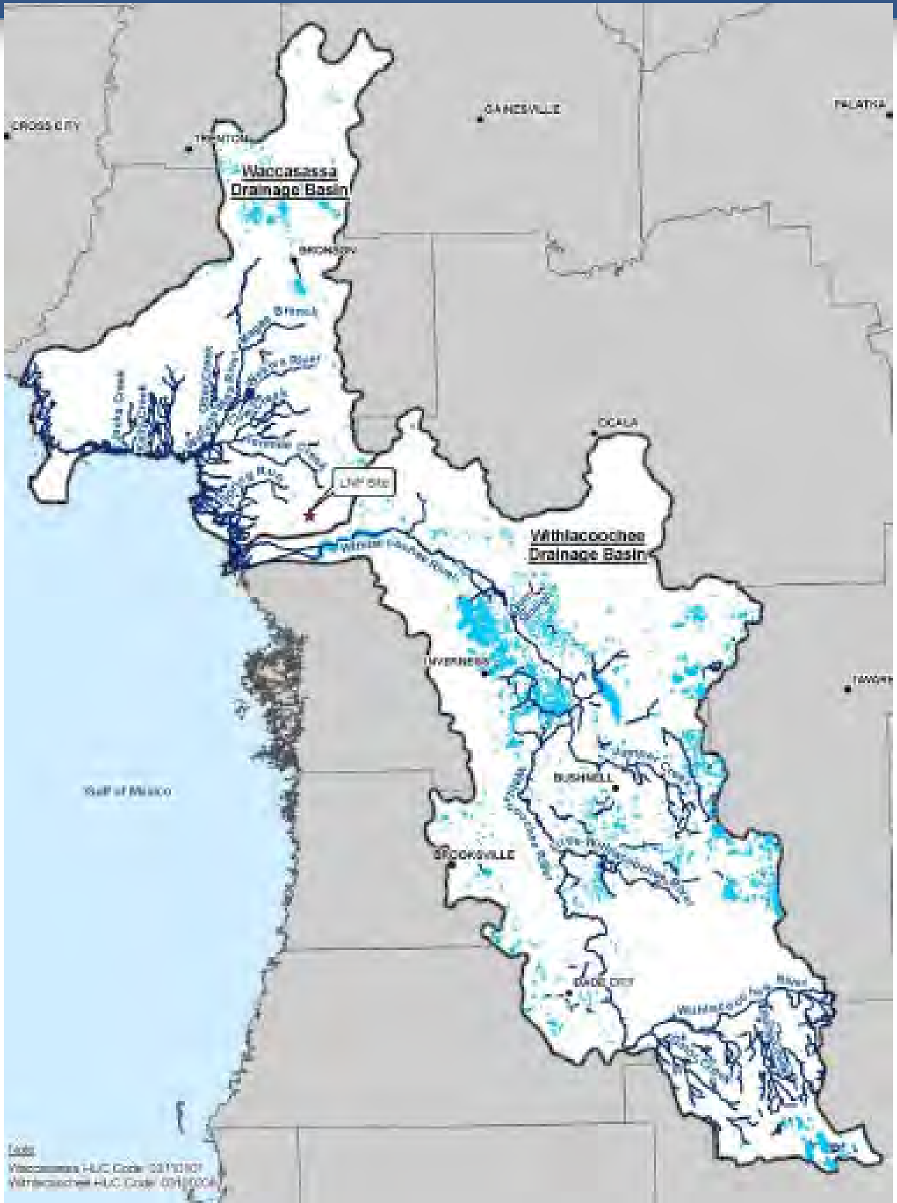
Site Location

NGG Think Fleet.

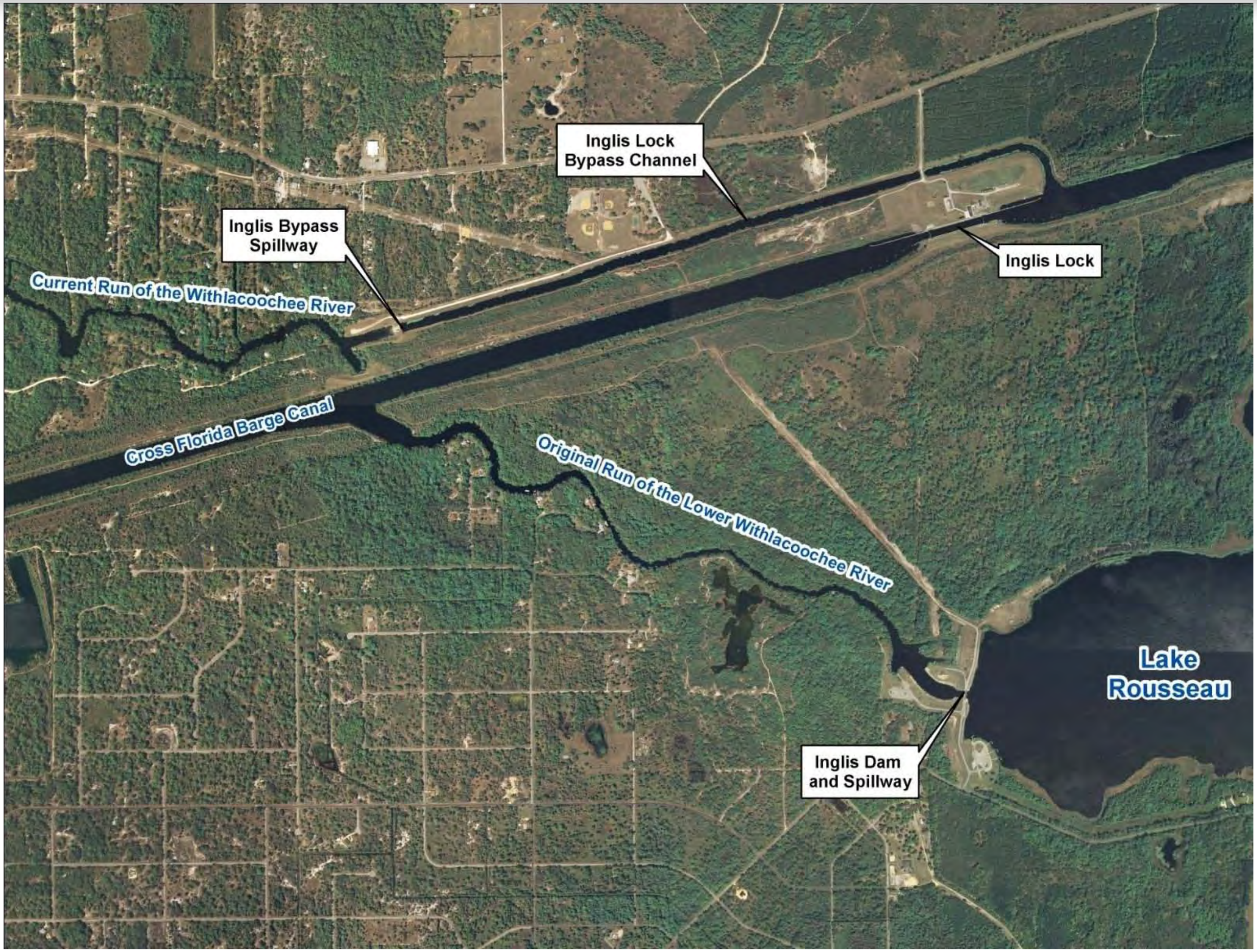
Progress Energy

Waccasassa & Withlacoochee Drainage Basins

- Located 8 miles from the Gulf of Mexico
- Site is primarily in the Waccasassa Drainage Basis
- Southernmost part of site in Withlacoochee Drainage Basin
- Located 3 miles north of Lake Rousseau
- Located north of the Lower Withlacoochee River
- No named surface water features onsite



Water Control Structures



Site Layout

- Elevation varies between 29 and 59 feet
- Design Plant Grade Elevation is 51 feet
- Makeup water source is the Gulf of Mexico

NGG Think Fleet.

Progress Energy

Design Basis Flood Consideration

	Elevation
Design Plant Grade	51
Local Probable Maximum Precipitation (PMP)	50.7
Probable Maximum Hurricane (PMH)	49.8
Probable Maximum Flood (PMF)	29.7
Potential Dam Failure	23.7
Probable Maximum Tsunami (PMT)	12.9

Local Probable Maximum Precipitation (PMP)

- During a PMP on the site, the runoff will drain as overland flow to the peripheral slopes and away from the safety-related structures.
- PMP Maximum Flood Elevation = 50.7 feet
- Flood elevation is below the Design Plant Grade Elevation.

Probable Maximum Flood (PMF)

- Flooding may occur in lower elevation areas near Lake Rousseau, the Withlacoochee River, and the CFBC
- No safety-related structures are adjacent to Lake Rousseau, the Withlacoochee River, or the CFBC (3 miles South and downslope of site)
- Maximum PMF in Lake Rousseau = 29.7 feet
- Potential Dam Failure (Inglis Dam) analysis shows maximum water elevation = 23.7 feet
- Design plant grade floor elevation = 51 feet

Probable Maximum Hurricane (PMH)

- SLOSH computer model by National Oceanic and Atmospheric Administration (NOAA) was used.
- PMH Maximum Surge Elevation = 47.7 feet
- Wind wave setup and runup = 2.1 feet
- PMH Maximum Flood Elevation = 47.7 + 2.1
  = 49.8 feet
- Below design plant grade elevation of 51 feet

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Progress Energy

Probable Maximum Tsunami (PMT)

- Most severe of the natural phenomena that have been historically reported or determined from geological and physical data for the site considered.

- Tsunami Analysis using the computer model FUNWAVE-TVD, developed at University of Delaware.

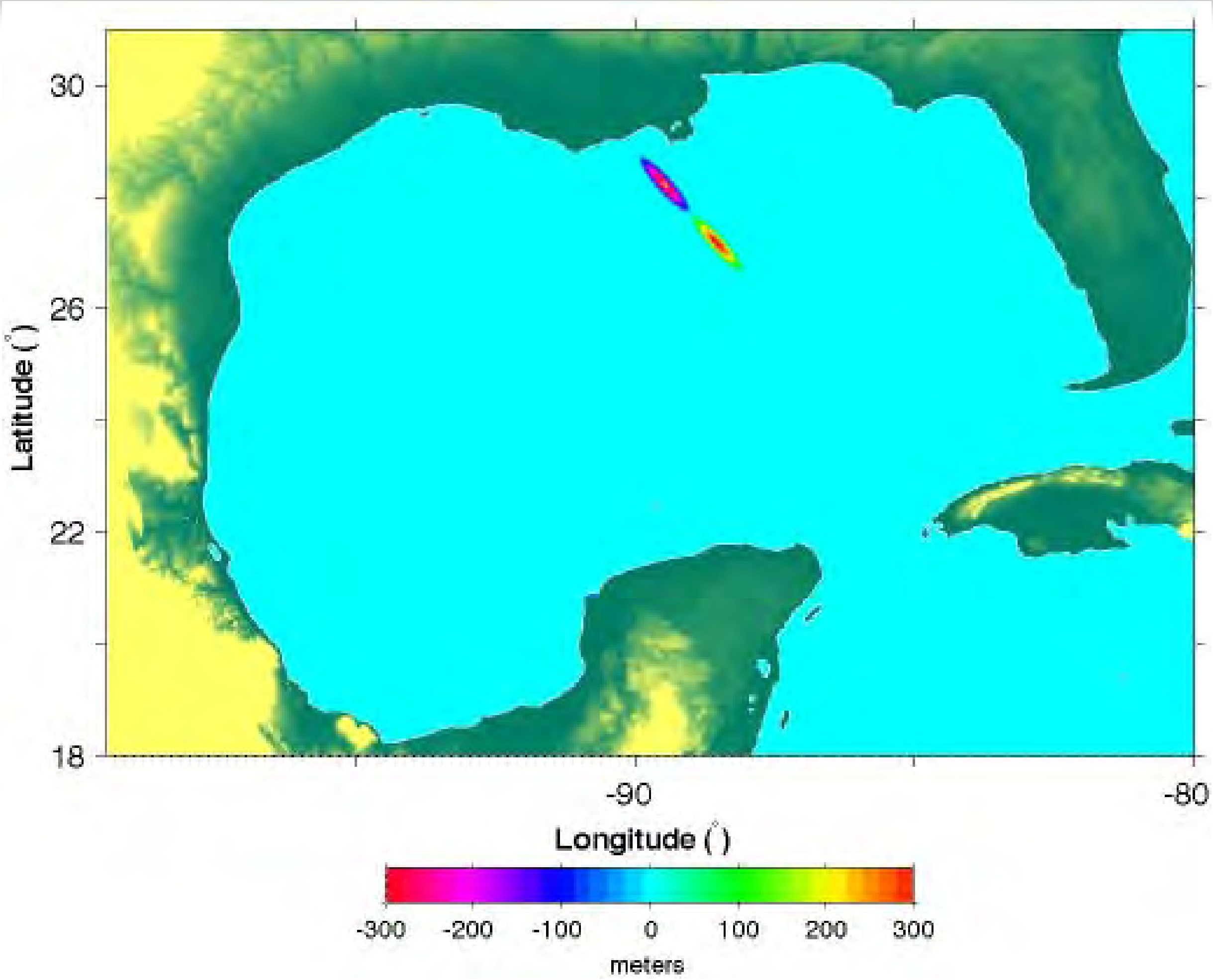
- Initial water level due to 10% exceedance high tide plus the long-term sea level rise.

Probable Maximum Tsunami (PMT)

Tsunami Sources Considered

- Venezuela Seismic Source (Seismic)
- Mississippi Canyon Landslide Source (Landslide)
- Florida Escarpment Landslide Source (Landslide)

Probable Maximum Tsunami (PMT)



Mississippi Canyon Land Slide: Initial Source

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Progress Energy

Probable Maximum Tsunami (PMT)

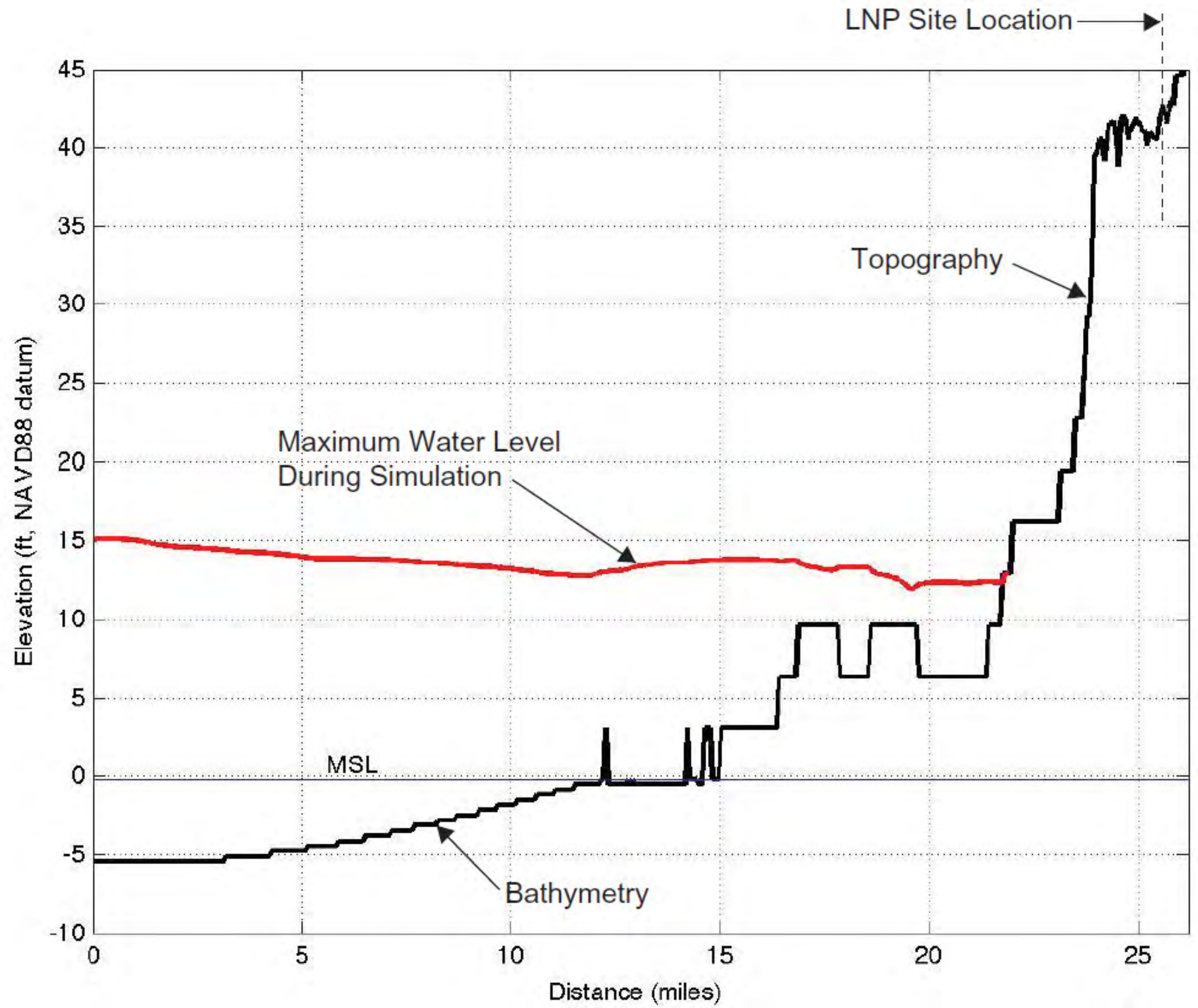
- Most severe PMT event is associated with the large scale Mississippi Canyon landslide event in the Gulf of Mexico.
- The maximum PMT runup elevation due to the Mississippi Canyon landslide was 12.94 feet.
- This maximum water level is below the Design Plant Grade elevation of 51 feet.

NGG Think Fleet.

Progress Energy

Probable Maximum Tsunami (PMT)

Mississippi Canyon Landslide Event Simulation, Static Source
Profile at Latitude = 29.075N



Groundwater

- Maximum groundwater elevations observed were >8 feet below design plant grade elevation

- DCD criteria for maximum groundwater elevation is 2 feet below design plant grade elevation

- Post-construction groundwater levels were evaluated

- Maximum groundwater elevations at safety-related structures were simulated to reach asymptotic conditions approximately 30 days after the beginning of the PMP design storm at approximately 44 feet (below the DCD criterion of 49 feet)

NGG Think Fleet.

Progress Energy

Accidental Release of Liquid Effluent

- No direct release to surface water
- Accidental release from effluent holdup tank (highest potential radioactive material inventory) directly to groundwater
- Examine radionuclide pathways to wells and groundwater re-surfacing in nearby river
- Methodology consistent with the guidance in BTP 11-6 (Same as VC Summer)

Accidental Release of Liquid Effluent

Results

- Accident concentrations meet 10 CFR 20 Appendix B drinking water Effluent Concentration Limits (ECLs)
- Contributions at well-receptor
  - Total contribution from all radionuclides is 0.7 percent of 10 CFR 20, Appendix B limit
- Contributions at Lower Withlacoochee River
  - Negligible after transport and dilution

U.S.NRC

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Levy Nuclear Plant Units 1 and 2

COL Application Review

ASE Section 2.4 – Hydrologic Engineering

October 18 - 19, 2011

Staff Review Team

- Technical Staff
  - Henry Jones (Hydrologic Engineering Branch)
  - Nebiyu Tiruneh (Hydrologic Engineering Branch)
  - Mark McBride (Hydrologic Engineering Branch)
  - Paul Thorne (Pacific Northwest National Laboratory)
  - Rajiv Prasad (PNNL)
  - Lyle Hibler (PNNL)
  - Lance Vail (PNNL)
  - Eric Geist (US Geologic Survey)
  - Patrick Lynett (University of Southern California)

- Project Management
  - Brian Anderson

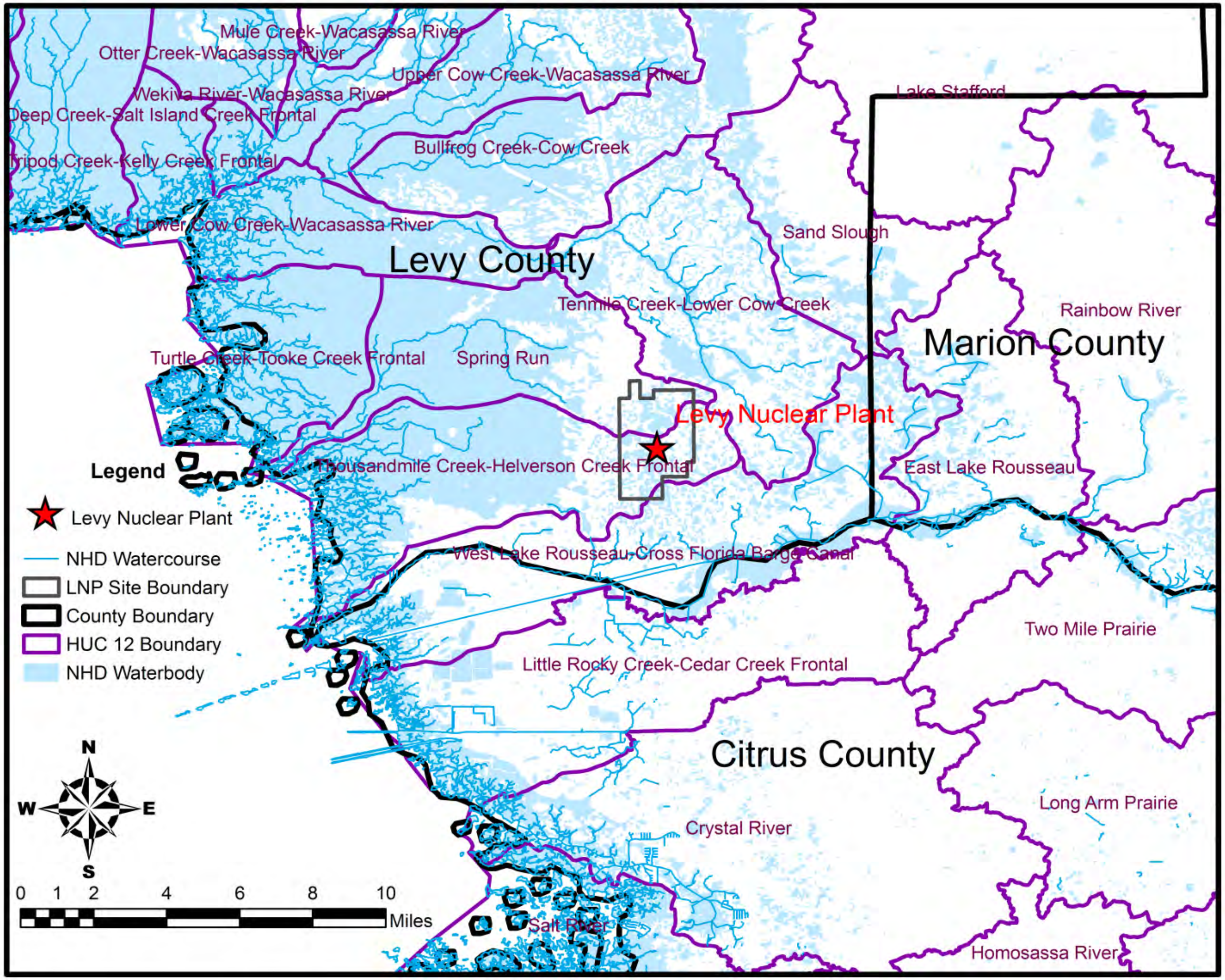
Staff Presentation Topics

- Hydrologic Description
- Floods
- Dam Failures
- Storm Surge
- Tsunami Hazards
- Groundwater
- Accidental Releases in Ground and Surface Waters

Hydrologic Description and Floods

- The scope of the staff's review included:
  - description of the site and facilities, description of the hydrosphere and hydrologic causal mechanisms
  - flood history with historical flood measurements for Withlacoochee River, flood design considerations, and site characteristics for local intense precipitation and drainage design
  - various flood causing mechanisms, characterization of site hydrologic features to determine the design basis flood and emergency measures
  - analysis of probable maximum flood on streams and rivers with appropriate considerations for estimations of probable maximum precipitation, precipitation losses, runoff, and coincident wind wave activity.
  - analysis of flooding from breach of dams with appropriate consideration of dam failure permutation and breach initiation mechanisms
  - procedures to be implemented in the event of emergency situations from the analysis of the design and resulting from an adverse hydrometeorological event

LNP Site Hydrology - Watersheds



Staff's Technical Evaluation - Hydrologic Description and Floods

- The staff reviewed information in the FSAR, RAI responses, and the applicant's simulation models to determine appropriate usage of input data
- The staff performed confirmatory modeling to determine the level of conservatism involved in the models used to estimate important design bases values, including:
  - Estimating the probable maximum flood in the Withlacoochee River Basin and the water surface elevations in Lake Rousseau using the computer simulation programs HEC-HMS and HEC-RAS
  - Estimating flooding from dam breach using the two conservatively estimated inflow hydrographs in HEC-RAS
- The staff performed independent analyses, including:
  - Analyzed peak streamflow data from USGS real-time and historical stream gauges and analyzed the records.
  - Estimated the local intense precipitation as the 1-hour, 2.6-square-km (1-square-mile) PMP using HMR 52.
  - Determined the effects of upstream dam breaches on water surface elevation in Lake Rousseau and downstream from the lake in CFBC

Staff's Technical Evaluation - Hydrologic Description and Floods

- The nominal plant grade floor elevation is 15.5 m (51 ft) NAVD88.
- Using HEC-HMS, the staff estimated the maximum water surface elevation in Lake Rousseau during upstream dam failures coincident with a PMF event in the Withlacoochee River Basin to be 9.1 m (30 ft) NGVD29 [8.79 m (28.9 ft) NAVD88]*.
- Using HEC-RAS, the staff estimated the maximum water surface elevation below Lake Rousseau under steady-state conditions to be 9.7 m (31.8 ft) NGVD29 [9.39 m (30.8 ft) NAVD88].
- The design basis flood elevation is 15.17 m (49.78 ft) NAVD88, which results from a probable maximum storm surge combined with wind-induced runup.

* Datum conversions made using NOAA VERTCON tool (http://www.ngs.noaa/cgi-bin/VERTCON/vert_con.prl)

Probable Maximum Storm Surge (PMSS) Flooding

- The Gulf of Mexico, located 13 km (8 miles) west of the LNP site, is the major hydrologic feature and source of hurricane storm surge near the LNP site.

- The applicant estimated the PMSS at the LNP site of 15.17 m (49.78 ft) NAVD88 using current NRC and Corps of Engineers guidance supplemented with more recently available data and conservative assumptions.

- The applicant stated that the nominal plant grade would be 15.5 m (51 ft) NAVD88, leaving a margin of 0.37 m (1.22 ft) NAVD88.

- Staff examined the methods and determined that the applicant has adequately addressed the effects of the PMSS on the water surface elevation at the LNP site.

Seiche Flooding

- Lake Rousseau [4.8 km (3 mi) southeast of the LNP site] maintains an operating pool elevation more than 6.1 m (20 ft) NAVD88 below plant grade floor elevation 15.5 m (51 ft) NAVD88.

- Limited fetch due to the long and narrow shape of Lake Rousseau suggests that waves set up under most extreme meteorological conditions on Lake Rousseau would not exceed approximately 1.8 m (6 ft) in height.

- Seiche runup and run-in induced by seismically generated tsunamis in the Gulf of Mexico, 3.94 m (12.94 ft) NAVD88, would not affect the site.

- Therefore, the staff agrees with the applicant's conclusion that meteorologically or seismically induced waves setup in the lake would not adversely affect the plant.

Probable Maximum Tsunami (PMT)

- The staff and applicant performed independent numerical modeling of three different types of tsunami sources to determine their impact on the Levy County site: (1) distant earthquake sources; (2) a regional earthquake source in the Gulf of Mexico; and (3) regional submarine landslide sources in the Gulf of Mexico.

- For all conditions, the most conservative source parameters were employed to provide an absolute upper limit. Therefore, most of the modeling focused on (3) which includes three GoM landslide sources: Mississippi Canyon, East breaks, Florida Escarpment.

- The applicant determined the PMT near the LNP site caused by the simulated Mississippi Canyon landslide event is 3.94 m (12.94 ft) NAVD88. In the staff's independent confirmatory analysis, this source results in a maximum water level of 6.1 m (20 ft) NAVD 88.

- In both cases, the PMT does not reach the Levy County site plant grade elevation of 15.5 m (51 ft) NAVD88.

Groundwater

- The staff's review focused on two issues:
  - Subsurface hydrostatic loading: Maximum groundwater level cannot exceed the DCD parameter of 14.6 m (48. ft) NAVD88
  - Direction and velocity of potential radionuclide movement in groundwater

- General hydrogeological conditions
  - Groundwater occurs in an unconsolidated surficial aquifer, and in the underlying Floridan aquifer, predominantly limestone
  - Groundwater flows freely between the two aquifers
  - Groundwater flows generally to the southwest
  - Groundwater flows downward from the surficial aquifer to the Floridan aquifer

- The applicant:
  - Investigated local hydrogeology and developed a conceptual model
  - Determined hydrological properties of aquifers
  - Developed a MODFLOW model to investigate maximum groundwater level

Staff's Technical Evaluation - Groundwater

- The staff independently reviewed the applicant's analysis, including:
  - Information presented in the FSAR and RAI responses
  - Calculations of tests of hydraulic conductivity.
  - Plausible groundwater radionuclide pathways.
  - The staff concluded that the applicant has adequately developed a conceptual model of groundwater, and addressed groundwater level and pathway issues.

- The staff performed confirmatory modeling of groundwater levels:
  - Reviewing applicant's model inputs and outputs, in particular as they reflected post-construction conditions.
  - Performing additional model runs to investigate parameter sensitivity.
  - The staff concluded that model assumptions were conservative.
  - The staff concluded that the maximum groundwater level would remain below the DCD parameter level of 14.6 m (48 ft) NAVD88.

Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters

- The applicant assumed:
  - Failure of an effluent holdup tank in the bottom floor of the auxiliary building
  - 80% of tank volume released (84,973 L, 22,400 gal)
  - Direct release to the Floridan Aquifer
  - Groundwater transport to (1) a well at the LNP site boundary 1.9 km (1.2 mi) distant, or (2) to the Withlacoochee River 6.9 km (4.3) mi distant

- The staff reviewed a postulated accidental release from the liquid waste management system and its potential effects on groundwater and surface water.
  - Applicant evaluated the ability of the groundwater and surface water environment to delay, disperse, dilute, or concentrate liquid effluent.
  - Applicant described the effects of postulated releases on known and likely future uses of water resources.

Staff's Technical Evaluation - Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters

- The staff independently reviewed the applicant's analysis, based on information in the FSAR and RAI responses, including:
  - Accidental release scenario and radionuclide transport pathways.
  - Conservatism of assumptions and parameters used in transport analysis.
  - Calculation methods for transport analysis.
  - Effects of pumping on transport analysis.
- The staff concluded that:
  - The release scenario and pathway analysis were acceptable.
  - Assuming direct release to the Floridan aquifer with no transit time through the containment building, dewatering structure, or surficial aquifer is conservative.
  - Parameter values used in the applicants "alternate analysis" were appropriately conservative.
  - Maximum activity concentrations at receptors would result in an effective dose less than 54 percent of the regulatory allowable activity based on the alternate analysis.

Conclusions

- The applicant has:
  - demonstrated that the site is suitable by satisfying the applicable regulatory requirements.
  - addressed the COL-specific information items identified in the respective sections of the AP1000 DCD (Rev.17).
  - performed the necessary hydrological analyses and determined the design basis flood as required with acceptable level of conservatism.
- The maximum flood level at LNP is estimated as the sum of:
  - the maximum PMH surge level (14.54 m [47.7 ft] NAVD88)
  - the initial rise (0.18 m [0.6 ft])
  - the maximum wave runup (0.45 m [1.48 ft]) or 15.17 m (49.78 ft) NAVD88.
- The LNP plant grade elevation is 15.54 m (51 ft) NAVD88, leaving a margin of 0.37 m (1.22 ft). The DCD requirement for maximum flood level is to be less than plant grade.

Conclusions (Continued)

- The maximum groundwater level is less than the DCD requirement of 0.6 m (2 ft) below grade [elevation 14.6 m (48. ft)]

- Radionuclide transport pathways in groundwater are satisfactorily defined

- Radionuclide activity at receptors resulting from an accidental release to groundwater would result in an effective dose less than regulatory limits

- There are no post-combined license activities.

Levy Nuclear Plant
FSAR 15 & 17
Radiological Consequences
Quality Assurance (QA)

Bob Kitchen - Manager

NGPP Licensing

FSAR CHAPTER 15
Accident Analysis

- DCD Incorporated by reference
- Standard Material Incorporated
- Site-specific X/Q values provided in Subsection 2.3.4 are bounded by the values in DCD Section 15A

Chapter 17 Quality Assurance

- DCD incorporated by reference
- Standard material incorporated
  - QAPD in COLA Part 11
  - Based on NEI 06-14A
- COLA development through COL issuance
  - Use existing Shearon Harris Nuclear Power Plant Unit 1 QA Program
  - Defined in the current revision of the Unit 1 FSAR

Presentation to the ACRS Subcommittee

Levy County Nuclear Power Plant
Units 1 and 2 COL Application Review

Chapter 15 – Accident Analysis

October 18-19, 2011

Staff Review Team

- Technical Staff
  - Michelle Hart, Siting and Accident Consequences Branch
- Project Manager
  - Don Habib

Levy County FSAR Chapter 15 – Accident Analysis

FSAR Section	Site-Specific Evaluations
15.0 Accident Analysis	• None*
15.1 Increase in Heat Removal from Primary System	• None*
15.2 Decrease in Heat Removal by the Secondary System	• None*
15.3 Decrease in Reactor Coolant System Flow Rate	• None*
15.4 Reactivity and Power Distribution Anomalies	• None*
15.5 Increase in Reactor Coolant Inventory	• None*
15.6 Decrease in Reactor Coolant Inventory	• None*
15.7 Radioactive Release from a Subsystem or Component	• LNP COL 15.7-1, Consequence of Liquid Waste Tank Failure
15.8 Anticipated Transients without Scram	• None*
15A Evaluation Models and Parameters for Analysis of Radiological Consequences of Accidents	• LNP COL 2.3-4, DBA Radiological Consequences Analyses
15B Removal of Airborne Activity from the Containment Atmosphere Following a LOCA	• None*

*This section is entirely IBR or IBR/Standard

DBA Radiological Consequences Analyses

- **Issue**
  - Appropriate incorporation by reference of the DBA dose analyses from the AP1000 DCD to thereby show compliance with
    - o Offsite dose factors in 10 CFR 52.79(a)(1)
    - o Control room dose criterion in GDC 19
    - o Technical support center (TSC) habitability requirements

- **Resolution**
  - **LNP COL 2.3-4**: Levy site characteristic short-term atmospheric dispersion (χ/Q) values are bounded by the values given in AP1000 DCD as site parameters
    - o χ/Q values are the only site-related DBA dose analysis input
    - o Dose is directly proportional to the χ/Q value for each time period
    - o Levy χ/Qs < AP1000 χ/Qs
    - o Levy DBA doses < AP1000 DBA doses
  - AP1000 DCD showed compliance with the offsite, control room and TSC dose criteria for all DBAs, therefore Levy also complies

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Levy County Nuclear Power Plant
Units 1 and 2 COL Application Review

Chapter 17 - Quality Assurance Program

October 18-19, 2011

Staff Review Team

- Technical Staff
  - Greg Galletti, Quality and Vendor Branch
  - Raju Patel, Quality and Vendor Branch

- Project Manager
  - Thomas Galletta

LEVY FSAR Chapter 17
Quality Assurance Program

FSAR Section	Site-Specific Evaluations
17.1 Quality Assurance During the Design and Construction Phases	• LNP COL 17.5-1 QAP prior to COL issuance
17.2 Quality Assurance During the Operations Phase	• None*
17.3 Quality Assurance During the Design, Procurement, Fabrication, Inspection, and/or Testing of Nuclear Power Plant Items	• None*
17.4 Design Reliability Assurance Program	• None*
17.5 Quality Assurance Program Description – New License Applicants	• LNP COL 17.5-1 QAP following COL issuance
17.6 Maintenance Rule Program	• None*

*This section is entirely IBR or IBR/Standard

QA Design and Construction Phases

- FSAR Section 17.1
- Prior to COL issuance - PEF is using Progress Energy's existing Nuclear QAP, for oversight of contractors.
- Staff inspected the program as it is being applied to Levy Nuclear Plant Units 1 and 2 and found it acceptable
  - Staff performed limited scope inspection April 12 - 16, 2010 at Progress Energy offices in Raleigh, NC
  - No violations were identified

QA Program Description

- FSAR Section 17.5
  - Following COL issuance – PEF will use the QAPD described in the COL FSAR.
    - COL FSAR QAPD is based on NEI Template 06-14A, Revision 7.
  - NRC staff used the requirements of Appendix B to 10 CFR Part 50 and the guidance in SRP Section 17.5 for evaluating the acceptability of the LNP COL FSAR Chapter 17.
  - The staff evaluated the QAPD and concluded:
    - The QAPD complies with the acceptance criteria in SRP Section 17.5 and with the commitments to applicable regulatory guidance.
    - The QAPD provides adequate guidance for the applicant to establish controls that, when properly implemented, complies with Appendix B.