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UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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ESBWR SUBCOMMITTEE

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THURSDAY

OCTOBER 20, 2016

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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 8:33 a.m., Peter C. Riccardella, Chairman, presiding.

COMMITTEE MEMBERS:

PETER C. RICCARDELLA, Chairman

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR., Member

MICHAEL L. CORRADINI, Member*

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

HAROLD B. RAY, Member

JOHN W. STETKAR, Member

MATTHEW W. SUNSERI, Member

DESIGNATED FEDERAL OFFICIAL:

GIRIJA S. SHUKLA

ALSO PRESENT:

MIKE ARCARO, GEH

GINA BORSH, Dominion

MANAS CHAKRAVORTY, NRO

JOHN COSTELLO, Dominion

JOHN DISOSWAY, Dominion

MICHAEL DUDEK, NRO

LANNY DUSEK, Fluor

ANGELOS FINDIKAKIS, Bechtel

ROBERT FITZPATRICK, NRR

JOSEPH GIACINTO, NRO

JAMES GILMER, NRO

VLADIMIR GRAIZER, NRO

ALIDAD HASHEMI, Bechtel

JOE HEGNER, Dominion

DAVID HINDS, GEH

JONATHAN LI, GEH*

TIM LUPOLD, NRO

JIM MARRONE, Bechtel

BRUCE MUSICO, NSIR

RYAN NOLAN, NRO

KEVIN QUINLAN, NRO

MARY RICHMOND, Bechtel

VIRGINIA RICHMOND, Public Participant*

ALICE STIEVE, NRO

CRAIG TALBOT, Bechtel

RAO TAMMARA, NRO

DINESH TANEJA, NRO

LUBEN TODOROVSKI, GEH

WEIJUN WANG, NRO

LARRY WHEELER, NRR

STEVE WILLIAMS, NRO

*Present via telephone

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P R O C E E D I N G S

8:33 a.m.

CHAIRMAN RICCARDELLA: Good morning. This meeting will come to order. This is a meeting of the Advisory Committee on Reactor Safeguards ESBWR Subcommittee. I am Pete Riccardella, Chairman of the subcommittee.

Subcommittee members in attendance are Ron Ballinger, Harold Ray, Matt Sunseri, John Stetkar, Jose March-Leuba, Walt Kirchner, and Charlie Brown. I believe we also have Mike Corradini on the phone.

MEMBER CORRADINI: Yes, you do.

CHAIRMAN RICCARDELLA: Okay, thank you, Mike.

Mr. Girija Shukla of the ACR staff is the Designated Federal Official for this meeting. The meeting will be open to the public.

This is the final subcommittee meeting on the North Anna Unit 3 combined license application. In this meeting, we will hear presentations from the NRC staff and Dominion Virginia Power on the North Anna 3 COL application and the staff's advanced final safety evaluation report.

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

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 meeting when addressing the subcommittee. The participants should first identify themselves and then speak with sufficient clarity and volume so that they may be readily heard.

A telephone bridge line has also been established for this meeting. To preclude interruption of the meeting, the phone line will be place on listen-in mode during the presentations and committee discussions.

Please silence your cell phones during

the meeting.

We will now proceed with the meeting. I call upon NRO management to begin.

MR. SHEA: Good morning. My name is Jim Shea. I am the NRC's new reactor licensee project manager for -- lead project manager for North Anna 3.

I first want to thank the ACRS BWR Subcommittee for this time to allow the staff to present its North Anna 3 safety review of the COLA.

The staff will be presenting its Phase 4 Advanced Safety Evaluation Review, which is a follow-on from the Phase 2 SER with open items which was completed with the full committee meeting on October 8, 2009.

Last month we had an information where the project staff brought to the committee an up-to-date status of the review and from that meeting we discussed how we closed all the Phase 2 open items and confirmatory items, et cetera, up to the point where we are now.

And I would just say that just to recap a few highlights from that meeting that in the past 18 months, the staff's primary focus for this review has been on the site-specific seismic

reevaluation, which that was influenced principally by two significant events, the Mineral, Virginia earthquake. We will talk a little bit later in the seismology section, and the Fukushima event happened all in the same year, as we know. And so that greatly influenced the direction of the review at that time.

Okay, so today's topics to be presented are principally based on the feedback that we got at that information meeting on September 22nd, just about a month ago. And the structure of today's meeting, I know we have this agenda and you probably won't even notice the slight variation that in just the last few days, Gina and I got together and decided what we thought was the most efficient way to cover all the topics that the subcommittee requested. And so I will skip -- there is a couple of intro slides we covered at last month's meeting that I will just skip right over that talk about some of the history of the dates of the application.

So, I will just go right to today's topics. And the way we split this up, from the staff's view is four panels. And we will start in the morning on all what we call the non-seismic

information that we are going to review and that includes the list that you see there.

And we will start with Dominion first on that. So, Panel 1 will include all these non-seismic topics. We will try to get that done, wrap it up on the first phase of today's meeting.

And then following that we have essentially two panels for the site-specific seismic information, a seismology panel and then we have a structural seismic 1 structure panel that will present their information on those two separate panels.

And then at the end, something that Dominion, they won't have a panel, obviously, on the DCD topics that were requested from last meeting. We will have a quick panel on those issues that were raised at the information meeting last month.

So, that is kind of the structure. So with that -- well, just one last thing I want to mention. From our point of view as projects -- and I brought this up in the information meeting where essentially based on the public review schedule letter that went out about a year ago, we are approximately three months ahead of that schedule

and I would attribute that to the fact that the staff, especially on the seismic issue -- there is other issues but the staff, along with Dominion staff worked very diligently on coming to resolution on the seismic issue over 18 months. And if you look at the history of that, there was, I would say it is approximately 30 public meetings that we held almost every other week, sometimes weekly in order to resolve all the issues, complete a couple of onsite critical audits, which we left those audits with no significant issues. We did have a tracking system that tracked because there are so many issues that we kept a tracking system that is part of those public meeting notes that anybody could review and see, all these significant issues that we addressed over this time period, very significant issues. And you will see that as Dominion presents their seismic and structural evaluations, along with the staff's review of the items.

So, with that, what I would like to do is -- oh, one last thing. So, the schedule we are on right now would give us a possibility of a hearing as early as the spring of 2017. So, that is kind of the track we are on.

And with that, I will turn it over to Gina from Dominion, Gina Borsh, and she will go through her Panel 1 non-seismic issues.

Yes, question?

MR. SHUKLA: Yes, this is Girija Shukla, the DFO for this meeting.

I just want to find out that normally when we have these kind of meetings we have half day for the applicants and half for the staff. But the way it is being presented, staff and Dominion will go back and forth to cover all these topics. So, this is a change to our regular practice. Thank you.

MR. SHEA: Thank you, Girija. Gina.

MS. BORSH: Good morning. I'm Gina Borsh from Dominion. I'm the licensing lead for the North Anna 3 project. Thank you for having us here again.

I just want to introduce Joe Hegner, our licensing manager. I know most of you all met him last month but Joe will just do some introductory remarks and then we will get going.

MR. HEGNER: Yes, good morning, everyone. My name is Joe Hegner. I'm the licensing manager for the North Anna 3 project. I will be

brief.

On behalf of Dominion and the North Anna 3 project, I want to express my appreciation to the subcommittee for meeting with us today. This is an important milestone for Dominion. It has been a very long and winding road to get to this point, if you have followed the history of our application. So, we are very pleased to be here today.

We brought a number of subject matter experts to talk about the various topics that were discussed at the planning meeting last month. We will be very mindful of the time because we know we have a lot of information to cover in a short period of time.

And with that, I will conclude and turn it back to Gina or Jim.

MS. RICHMOND: Oh, no. Okay, we are just having some technical difficulties here.

MS. BORSH: Would you like me to go ahead?

CHAIRMAN RICCARDELLA: No, we'll wait.

MS. BORSH: All right. So, in the interest of time, I am going to zip right through these.

Thank you, again, for having us. We appreciate being here and we are looking forward to presenting the results of our revision to the COLA.

So, this is the introduction presented, North Anna 3 site, the licensing milestones and the presentation topics.

Today we have presenters. Our subject matter experts are from the Dominion team. We will have people from Dominion, Bechtel, Fluor, and GEH presenting. And I will introduce the subject matter experts as they present because we have a number of them.

These are the slides that we showed you last month, the location of North Anna 3. You can see it is a little bit northwest of Richmond. This is the site layout. These were all slides we saw last week -- I mean, I'm sorry, last month. These are the milestones that we walked you through last month. Nothing has changed.

And so for presentation topics, so this morning we are going to be talking in this Panel 1 that Jim was talking about, we are going to be talking about flooding, groundwater, accidental releases, and then population density and hazardous chemical analyses that we have performed. We will

give you a brief summary of the evacuation time estimate information, which you guys had asked about last month.

And then this is where we will switch over. Then, we will skip down to finish the other non-seismic topics, which start with Chapters 11 and 12, the radwaste discharge piping, the hurricane missiles, electrical information about the switchyard, the departures and exemption requests that we have in. And then we will talk about zinc injection plant service water. Okay?

And then we will go back up and we will talk about seismic. We will talk about vibratory ground motion in Section 02.05.02 of the COLA and then we will talk about the seismic analyses and structural valuations.

So, that will be our day. Okay, any questions before we get started? Okay.

So, with that, I am going to turn this over to Craig Talbot from Bechtel. He is our SME and he is going to talk about flooding.

MR. TALBOT: Thank you very much. As Gina mentioned, I'm Craig Talbot with Bechtel Corporation. Go ahead to the next slide.

And the topics we will be discussing

here are we have three open items. It is Chapter 02.04. The first one deals with flooding. The last two deal with the ground water and accidental releases.

We will also talk about a revised layout that. It is for some adverse local intense precipitation conditions, a revised sheet flow analysis for the local intense precipitation. And then as I mentioned earlier, groundwater model and accidental release analysis. Next slide.

The first item here we have is an open item that was left over from the previous time. So, in this open item, staff was still reviewing RAI 02.04.02-3. And in that, there was a concern about a collection ditch and a 90 degree bend that was in that collection ditch just at a road crossing. And this location was right at the border between the Units 1 and 2 site and the Unit 3 site. The water levels there were very close to being able to go over into the Units 1 and 2 sites. So, there was some concern about analysis and some specific things to that.

The resolution to this RAI is that the site layout was changed such that we no longer have the 90 degree bend and the road crossing. And so

all of the adverse conditions that were discussed in that RAI now no longer exist. So, the resolution to this RAI and this open item was a change in the layout that eliminated the adverse conditions. Go to the next slide.

This here is the previous layout. I don't know, Gina, you can put your cursor along there. The road is right there where those blue lines are. That is where the 90 degree bend is. There was a road coming along there and there was a ditch alongside of it. It turned, and went under the road and into that canal that went into a storm water management basin. Next slide.

This shows the layout here. Now the road, you can see, goes around the storm water management basin. It doesn't cross behind it anymore. So, the ditch just goes straight into the storm water management basin without any 90 degree bend. So, all of those adverse conditions are gone.

The next item is, because of the layout change and other layout changes, we had to redo the local intense precipitation analysis. That analysis was redone. Water levels in the ditches, what we call the inundation levels remained well

below the DCD site parameter values of more than below grade.

In addition to that, we also looked at sheet flow depths, which are the depths of water on top of the grade. This is the water that is flowing towards the ditches. It is just a few inches deep but it has to get towards the ditches. So, we looked at those to make sure that those weren't causing any adverse conditions.

As the NRC reviewed those sheet flow analysis, they had some questions about that and issued an RAI, RAI 02.04.02-15 and asked us to specifically look at the effects of roof drainage on those sheet flow depths and then make a comparison of the depths to the entrances or penetrations into safety-related SSCs.

That RAI resulted in a more detailed analysis of the sheet flow depths. Next slide.

That more detailed analysis indicated that there were three locations where sheet flow depths, for a short period of time, were higher than the entrances to the control building and the reactor building. And depth indicated there.

And so then, as a result of that, commitments were made in the FSAR to place curbs or

to raise the threshold at these entrances to prevent that water from entering into those buildings during the local intense precipitation.

So, site grading the structure configuration as described in the FSAR preclude flooding into safety-related buildings.

That concludes the analysis or the discussion on flooding. Are there any questions?

CHAIRMAN RICCARDELLA: Does anybody have any questions?

MS. BORSH: Thank you, Craig. So, now Angelos Findikakis from Bechtel will talk about groundwater and accidental releases.

MR. FINDIKAKIS: Off and running. My name is Angelos Findikakis with Bechtel and I will be addressing the open items in Section 2.4.12 and 2.4.15

Starting with 2.4.12, the open items that we had was on the ground water model that was developed for the FSAR. And specifically, we had a request to demonstrate the impact of the drain site characteristics on the groundwater elevation for the model. Next slide, please.

I'm sorry. Could you hear what I said? Do I need to repeat?

COURT REPORTER: I could hear you through the other microphone. So, you're good.

MR. FINDIKAKIS: Okay. So, next slide, please, Gina.

So in response to this request and to address this open item, we first revised the groundwater model and by making some minor improvements to the calibration of the model and including any changes in configuration of the ESBWR Building.

And once the model was revised, we used to do a series of sensitivity analysis, simulations. Primarily, we looked at the three parameters, the conductance of the drains, the groundwater resource rate and the hydraulic conductivity of the materials in this area.

We performed a series of simulations looking at different combinations of these barometers and the conclusion that we reached was that for the most adverse combination of parameters that we could use, the maximum groundwater elevation was below the characteristic value described in the DCD. So, therefore, we concluded that this work basically addressed the open item in Section 2.12.

Moving into the next open item of Section 2.4.13, there we had the request to analyze radionuclide transport using, again, a more adverse combination of parameters, specifically, the maximum observed hydraulic conductivity and the median site-specific values of the adsorption coefficients of the materials or Kds.

So, in the response to this model again we performed additional analysis and if we move to the next slide, please. And maybe before getting into the specifics of the analysis that we did, I should stress that the design includes mitigating features that are acceptable in the BTP 11-6, which of course precludes the release of any liquid effluents.

However, in accordance with SRP 11.2, we performed and analysis of accidental releases of liquid effluents. And to do this, we have looked at the ranking of the different tanks and we performed the analysis for the condensate storage tank, which presumably provides the most adverse combination of nuclides. And following, again, NRC guidance, we assumed that 80 percent of the contents of this tank are released to the environment and instantaneously reaches the

groundwater.

And from there, we analyzed the transport and the pace, going to the next slide, Gina. And for this purpose, we used, again, the shortest pathway from the storage tank to the intake channel and based on the analysis that we performed, we found that the estimated maximum concentration of all the nuclides in the intake channel and basically in the concentration of these nuclides through the culvert that connects the intake channel with Lake Anna. Next slide, please.

So, the result of this analysis showed that using the maximum concentration of each nuclide and estimating the ratio of this maximum concentration of the corresponding effluent concentration limit. So, if we take these ratios and we add them up, the sum of this was less than unity, which basically demonstrate that the maximum dose exposure to the members of the public is within the limits of CFR 20.

So, with that, we concluded that we have addressed this open item. And that concludes my presentation. So, any questions?

MS. BORSH: Thank you.

CHAIRMAN RICCARDELLA: Are there any

questions on that?

MR. FINDIKAKIS: Thank you.

CHAIRMAN RICCARDELLA: Thank you.

MS. BORSH: Thank you, Angelos.

Okay, so now Mary is going to go back and talk about hazardous chemical analyses.

MS. RICHMOND: Good morning. I'm Mary Richmond with Bechtel.

Today I will first be presenting information related to SAR 2.2, nearby industrial transportation and military facilities.

SAR 2.2 identifies potential hazards in the site vicinity that may affect the safe designing siting of North Anna Unit 3.

Since the last ACRS meeting, there has been no hazardous industrial facilities identified at the 620-acre industrial development. The hazardous analysis was, however, updated to include newly identified onsite chemicals. But this was mainly due to ESBWR technology updates such as cooling tower chemistry and liquid hydrogen storage.

The determination of design base accidents included the consideration of several accident categories in Reg Guide 1.206. Two of

these accident categories were explosions. This is an accident category involving postulated scenarios where by, upon a complete tank rupture or failure an immediate detonation occurs.

On the flammable vapor cloud delayed ignition category, this accident category is, again a complete tank failure, however, in this case, instead of an immediate detonation, a vapor cloud is formed and travels towards the site's nearby safety-rated structures prior to ignition or detonation.

The analysis demonstrated that the blast effects would not exceed the peak over pressure of 1 psi of any safety-related structure, with the exception of the storage and transport of liquid hydrogen. Therefore, a more detailed analysis of liquid hydrogen storage and transport was performed.

With respect to the storage of liquid hydrogen, the analyses performed for both accident categories considered the capability of the safety-related structures. That is based on guidance and methodologies included in Reg Guide 1.91 and EPRI. The capabilities of the safety-related structures and the radwaste building to withstand blast

pressures greater than 1 psi was considered.

And in the case of the transport of liquid hydrogen, this analysis involved the performance of a probabilistic analysis to determine if the event is a design-based accident. Both analyses concluded that there was no design-based events. In the case of the storage, the distances were less than the distances from the liquid hydrogen storage to the nearest safety-related structure. In the case of the transport, it was less than ten to the minus six.

That concludes a review of the hazards.

MEMBER CORRADINI: Can you hear me?

CHAIRMAN RICCARDELLA: Yes, Mike.

MEMBER CORRADINI: I just wanted to get the --

CHAIRMAN RICCARDELLA: Mike.

MEMBER CORRADINI: Could you just put on the record the distances, please?

CHAIRMAN RICCARDELLA: Mike?

MEMBER CORRADINI: This Corradini, member of the ACRS.

MS. RICHMOND: You wanted the specific safe distances?

MEMBER CORRADINI: Yes, ma'am.

MS. RICHMOND: Okay. I can get you those.

MEMBER CORRADINI: What I am trying to understand is, so there was an assumption of a vapor cloud and a conduction event but the distances were sufficient not to exceed the over-pressurization limits?

MS. RICHMOND: Correct.

MEMBER CORRADINI: Okay, so I guess I am curious on what those distances are, please.

MS. RICHMOND: Okay, I will get you those.

MEMBER CORRADINI: Thank you.

CHAIRMAN RICCARDELLA: Thank you. Are there any other questions?

MS. BORSH: Okay, thank you, Mary. Thank you, Angelos.

So now Lanny Dusek from Fluor will be presenting on fiberglass-reinforced polyester piping.

MR. DUSEK: Good morning. For the plant service water system, an analysis of several options confirmed this flexion of fiberglass-reinforced polyester piping for the underground portions, below grade portions of this system.

So, to make sure that this was acceptable for use at North Anna 3, a number of criteria were accepted going from the design all the way through long-term monitoring to establish this.

So, the first three bullets there talk to what went into the design. So, we considered the seismic requirements, specific ASME and American Water Association standards, design loads like thrust and water hammer. And then in the procurement and storage, we have had storage and handling requirements that were in accordance with standards. And moving into construction, the proper use of construction techniques, use of slings, the backfill that is done to make sure that no undue stress is put on the pipe during installation. Finally, inspections, including visual examinations and the hydrostatic tests, would be performed. And then lastly, for the long-term, this pipe will be included in the NEI 09-14 program for underground piping and tank integrity.

Any questions?

CHAIRMAN RICCARDELLA: Is this a unique application? This is the first I have heard of reinforced fiberglass.

MR. DUSEK: No, it has been used elsewhere in the industry. There is some history of issues and so that is a result of some of the questions here is to make sure that those issues have been addressed. These criteria will take care of that.

MEMBER STETKAR: Lenny, where is this piping actually used in the system? Is it -- and let me get more specific. Is it on the PSWS supply from the pump house to the plant and the return to the cooling tower? Is it only the return to the cooling tower? Where is this piping used?

MR. DUSEK: Yes, let me make sure I have got a complete list and get back to you here within the meeting.

MEMBER STETKAR: Okay. Where I am going for is is it -- it is buried in soil. It is not an adopt.

MR. DUSEK: Right.

MEMBER STETKAR: It is directly in the soil. That is one of the reasons why you use it.

MR. DUSEK: Correct.

MEMBER STETKAR: The reason I am asking is that there is Table 9.2-2R in the FSAR, which indicates that the nominal operating temperature

for that piping is 88 degrees to 120 degrees Fahrenheit. I get the 88 degrees to 120 degrees if it is only on the return piping to the cooling tower, maybe. I don't get it if it is on the supply piping. It strikes me that the supply piping temperature would be a heck of a lot lower than 88 degrees, coming from the pump house into the plant.

So, if it is, indeed, in that stretch of the piping, I don't know anything about this material but I have no idea what happens to it if the temperature is like 45 degrees.

MR. DUSEK: Okay.

MEMBER STETKAR: Because the minimum temperature that you specify, I think, for your service water supply is something like 41, if I recall.

So, I kind of got curious about -- and what is the relevance of that temperature range?

MR. DUSEK: We have an expert that can be pulled in on the phone. I don't know if you want to take the time now or if you just want me to get with him and get those specific answers and get back to you.

MEMBER STETKAR: That's probably more -

- whatever is more efficient for you. I mean --

MR. DUSEK: Let's do that.

MEMBER STETKAR: It is on the record.

MR. DUSEK: Okay.

MEMBER CORRADINI: I seem to remember back when North Anna came up as the reference COLA back in 2009 the same question was asked. There may be something that Dominion put on the record relative to operating temperature band for these types of pipes.

I seem to remember, John, you asked the same question --

MEMBER STETKAR: You know my stuff from that meeting is buried somewhere in a closet in Arkansas. I couldn't find any of it. I'm trying to recreate stuff and I can't remember what I asked seven years ago.

MEMBER CORRADINI: Well, I'm actually quite shocked.

MEMBER STETKAR: We all get old. You know life is hell.

CHAIRMAN RICCARDELLA: Okay, so you will answer that question in the future and we will proceed.

MR. DUSEK: Yes.

MS. BORSH: Okay, thank you, Lanny.

So, now we are going to talk about population density. Mary is going to cover that again for us.

MS. RICHMOND: As Gina said, I will now be talking about population density, as requested by the ACRS planning meetings.

Population density information is found in SAR 2.1 Geography and Demography. The nearest population center towards North Anna is the city of Charlottesville, with a population of 45,049. This is greater than the criteria which is bigger than 25,000 residents for a population center.

The city of Charlottesville had a 2000 census population, as I said, 45,049. North Anna meets the requirement of 10 CFR 100.21(b). That is, the population center is at least one and one-third times the distance to the Unit 3 reactor building to the outer boundary of the LPZ. The LPZ for North Anna is the same as the LPZ for the existing units, which is a six-mile radius circle center at the Unit 1 containment building. Again, the city of Charlottesville is 36 miles west.

The population density surrounding the North Anna site was also looked at. The population

density, in this case, meets the Reg Guide 4.7 criterion. That is, as illustrated on the next slide, the 2000 population and the 2065 population are below the 500 person per square mile density criterion.

For reference, the purple line with the squares on it represents the 500-person per square mile density criterion and, as you can see, as discussed, both the 2000 census population and the 2065 population remain below this line.

And that's it for the population density. John is going to be talking a little bit about the EPZ and its relationship to that.

MR. COSTELLO: Thank you, Mary. John Costello with Dominion Emergency Preparedness. So, next slide, please.

So, since North Anna is an existing site, there have been evacuation time estimates for the 1980 census data, 1990, 2000, and 2010 census. The ESB application used the 2000 census data evacuation time estimate and then a new estimate was prepared for the application in 2008 and it was updated in 2013 with an evacuation time estimate based upon 2010 census data.

So, in 2011, a new EP rule was issued

but had a lot of information about evacuation time estimates. And on the slide are several of the bullets. I will draw your attention to the second one from the bottom, which says estimate EPZ population changes once a year. And this applies for the operating units 1 and 2.

The second bullet from the top -- oops, still on that slide. The second bullet from the top says for the COLA holder within 365 days or at least 365 days prior to fuel load, a review will be done. And both these two bullets factor into the last bullet -- sorry to have you jumping around -- the last bullet on this slide, which says if you exceed certain thresholds then you need to do new evacuation time estimates.

So, here is a picture of the North Anna Emergency Planning Zone, which is the wide circle with the greatest circumference is a 15-mile area. And that is included because that is a shadow evacuation because it is expected that if there were an evacuation that people who were outside the population directed to evacuate would spontaneously self-decide that they wish to leave the area. And this clogs the traffic networks, which effects the evacuation time estimate for the population within

the area for which evacuation was directed.

Within that ten mile area, you see a number of irregularly shaped and numbered zones. We call those protective action zones. You may be familiar with a more generic term of emergency response planning areas or ERPAs.

So, that is how, in this case, the Commonwealth of Virginia would communicate to the public what areas need to evacuate or shelter or shelter in place.

So, the 2010 EPZ population, that first column on the left are those numbered protective action zones. The second column is the 2000 census data for those protective action zones. And the column on the far right is the 2010 census data for population in those zones, coming up with a total of some 25,202 people in the ten-mile EPZ.

MEMBER CORRADINI: Can I ask a question? This is Corradini.

MR. COSTELLO: Yes.

MEMBER CORRADINI: Okay, so with the figure you have got on now with you various quadrants or ERPAs, are the population individuals required -- I'm sorry not required but are alerted based on area so that as the evacuation has to

occur, certain of these quadrants are all informed simultaneously? How does this work exactly?

MR. COSTELLO: So, the alert notification system would be activated by the Commonwealth and a message would be sent. It would provide these numbered areas which are available in public information brochures for people in the area.

The boundaries of these areas are roadways. They are waterways. They are jurisdictional boundaries between counties. So, there is something that can be communicated to the people so they can recognize what area is included within the evacuation order.

MEMBER CORRADINI: And this is -- I guess in Wisconsin this is a similar approach. But this is a state-by-state decision. So, it is not the same in other neighboring states. Is that correct?

MR. COSTELLO: Some licensees use a PAZ model or an ERPA model to communicate to the offsite agencies what areas warrant evacuation. Dominion uses a keyhole approach of an annulus and areas downwind to different distances and then the Commonwealth translates that into their protective

action zone and they make the decisions.

MEMBER CORRADINI: Oh, okay. So, the evacuation plan for the plant is the keyhole is what I guess I remember to be a traditional keyhole. And then you pass that information on and they overlay it onto these regions for their information to the public?

MR. COSTELLO: Correct.

MEMBER CORRADINI: Okay, thank you.

MEMBER MARCH-LEUBA: Just so being set by a project, we were talking about instrumentation, radiation monitors. Do you take input from any of the radiation monitors for this evacuation real-time?

MR. COSTELLO: So, I don't believe we have perimeter for the North Anna site. Basically, a decision on protective action is made based on plant status, minimum protective action for a general emergency, unless there are impediments to evacuation, hostile action, let's say, is to evacuate two miles in all directions and five miles downwind.

If a dose assessment, which may be supplemented with confirmatory readings from offsite monitoring teams to get a better dose

assessment, determines that evacuation thresholds, 1 rem total effective dose equivalent, 5 rems thyroid committed dose, are exceeded in areas that cause expanding that area, then it is expanded.

MEMBER MARCH-LEUBA: So, the evacuation is then based on plant status and the wind direction and the model. Correct?

MR. COSTELLO: The model uses the plant radiological parameters, the wind direction, wind speed, stability class, to form an estimate.

MEMBER MARCH-LEUBA: Okay, thank you.

CHAIRMAN RICCARDELLA: Does any of this change because of the addition of Unit 3 or is it essentially the same as you would have for Units 1 and 2?

MR. COSTELLO: It is essentially the same as for Units 1 and 2.

CHAIRMAN RICCARDELLA: Thank you.

MEMBER SUNSERI: John, do you know if there are any what I will call special use facilities, such as jails, hospitals, elderly care facilities that might require special attention for an evacuation?

MR. COSTELLO: Not within the North Anna ten-miles EPZ there are no custodial

facilities like that.

MEMBER SUNSERI: Thank you.

MEMBER CORRADINI: Corradini again. One last question about I think Member Kirchner asked. The model used is the NRC model, which is what I am familiar with, or does the plant have a separate modeling capability and then reports it? What is used for the -- given a plant status -- the estimate?

MR. COSTELLO: Currently, the Dominion fleet uses a model known was meteorological information and dose assessment system. NRC uses a model called RASCAL, as does the Commonwealth of Virginia. So, the results of those models are discussed in an emergency operations facility to make sure that they are within alignment.

MEMBER CORRADINI: Okay, thank you very much.

MR. COSTELLO: I will add or at least that we understand why there are differences in the results based on model.

Okay, so the population change. So, based on the sensitivity study --

MEMBER BROWN: Could I --

MR. COSTELLO: I'm sorry, Mr. Brown.

MEMBER BROWN: So, if you have something occurring -- I'm trying to get a handle on -- you are talking about three models, it sounded like. There was an NRC model, there was your model, and then you mentioned another one. And they are all available and you balance them to see what -- which ones do you use to make your decisions?

MR. COSTELLO: The licensee will use the meteorological information --

MEMBER BROWN: They will use Dominion's model.

MR. COSTELLO: And the decision-makers, because we only recommend, would be the offsite agencies, the Commonwealth of Virginia, in this case. And they would use the RASCAL model, which the NRC also uses. They use the same model. And they would use that to inform their decision.

MEMBER BROWN: So, people have to wait to decide whether they are going to -- I mean --

MR. COSTELLO: NRC regulations requires that the licensee expeditiously, within 15 minutes, for instance, of declaring a general emergency or exceeding thresholds, to deliver that recommendation to the offsite agencies.

The outside agencies have to make a decision. And once they make a decision, they have a similar brief period of time to execute an evacuation announcement for the public.

MEMBER BROWN: And so Dominion does not do that. I'm just trying to get calibrated here a little bit.

MR. COSTELLO: That's correct. The emergency alerting system, the federal system for notifying the public with integrated radio, television, reverse 911 --

MEMBER BROWN: That's a state function -- excuse me -- responsibility, then.

MR. COSTELLO: That is correct.

MEMBER BROWN: Okay, thank you. Thanks for the calibration. Let's put it that way. I have been to North Anna so I like to fish over by the plant. I'm just kidding.

MR. COSTELLO: It's all good. It's all good.

So, one of the things the regulation required is to determine when a new evacuation time estimate is required. So, a sensitivity analysis was done based on increases of population that might cause you to have to do new evacuation time

estimate. And this study determined that it would require a 150 percent increase in the population or an 85 percent decrease in the population, which I said was about 25,000 people, to match these thresholds.

And because the licensee for Unit 1 and Unit 2, per regulation, is required to do an estimate periodically, we know what these changes have been since the 2010 census evacuation time estimate and they are on the order of four to six percent, well below a threshold that would require doing new evacuation time estimate.

And on this next slide, you see the way this is done we look at different scenarios for evacuation, summer, winter, mid-day, mid-week, weekend, rain, snow, good weather, to see what the bounding evacuation time estimate is, which is highlighted on this slide, the winter mid-week, mid-day snow. These are the greatest evacuation time estimates for the zones of interest, a two-mile area, a five-mile area, and a ten-mile area. So, more than 30 minutes' increase or decrease in these times due to a population change is what would trigger an evacuation time estimate update.

MEMBER CORRADINI: So Corradini,

Member, again. You have one highlighted, which is apparently the longest.

MR. COSTELLO: Correct.

MEMBER CORRADINI: Okay.

CHAIRMAN RICCARDELLA: Mike, are you still there? Hello?

MEMBER STETKAR: Mike, if you are speaking, we can't hear you. This is to alert you that you are silent.

MEMBER CORRADINI: I'm not silent. I am online.

CHAIRMAN RICCARDELLA: Now we hear you again.

MEMBER CORRADINI: Okay. Theron is playing games. No.

So my question goes like this. I seem to remember being in Richmond at Dominion during a freezing rainstorm, where you had three inches of ice on the roads and everything. And both the plants, Surry and North Anna, had to shut down.

So, please point to me which of these estimates deal with a freezing rain.

MR. COSTELLO: So, the regulatory guidance by which the evacuation time estimates needs to be performed outlines these various

scenarios that need to be run. There is also a special events scenario and a road impact scenario, which are at the bottom of the slide, which are not used for determining a threshold for an update.

The closest thing to that freezing rain/ice situation would be the highlighted winder mid-week, mid-day snow and the winter weekend mid-day road impacted, which is the one on the bottom, bottom row.

So, as far as this once in a hundred year ice storm, I don't think that was something that was within the guidance.

MEMBER CORRADINI: Right but although it is not in the guidance, which I will admit, it happens. And I seem to remember it paralyzed the Richmond area and surrounding area quite extensively.

So, how does one do some sort of benchmarking validation checking so that something that actually occurs you can tell fits within the umbrella of the parameters of your estimate? This is not an area that I understand it is just that I remember being trapped for two days in Richmond because the airports were closed and everything.

MR. COSTELLO: I'd like to table that

and we can provide an answer at some other time.

MEMBER CORRADINI: Thank you.

MR. COSTELLO: Thank you, sir.

MEMBER MARCH-LEUBA: Is there a criteria number you are trying to achieve?

MR. COSTELLO: There is not a specific number or threshold that allows this. What this is intended to do is to inform a licensee's thought process in developing a recommendation and then to inform the decision-makers, the offsite agencies, about potential traffic management strategies that they might use to try and reduce the time, if it is too much. So, they make their decisions based on this. It may be better to shelter people in place than to evacuate if the evacuation time is too long and they would be on the road during the ruling.

MEMBER MARCH-LEUBA: I was going to comment that those ice storms in the south are not once in a hundred years. You have lived through them. I have lived through them, too.

So, knowing that, you would consider shelter in place.

MR. COSTELLO: Absolutely.

MEMBER MARCH-LEUBA: When you have those ice storms, you cannot walk.

MEMBER CORRADINI: I concur.

MR. COSTELLO: Okay, so we'll move onto the final slide, then.

All right to conclude, the emergency planning standard, 50.47(b)(10) for protective measures or protective actions for licensee employees, emergency workers and for the offsite agencies requires evacuation time estimates to be developed. They have. It requires licensees to update these evacuation time estimates on a decennial basis or when required by exceeding threshold. We have a system for that. And the guidelines for choosing what recommendations we make and we provide this information also to the offsite response agencies so they can make decisions in the best interest of the public.

Any other questions?

CHAIRMAN RICCARDELLA: Are there any questions? Yes.

MEMBER KIRCHNER: While Mary is still here, may I ask a question? Delayed ignition here, not on your slides, hazard chemicals analysis. I was just struck by the transport waving off transport as being a design-basis event. Where is the basis for it being ten to the minus sixth, an

accident with a delivery truck? What is the basis for that?

MS. RICHMOND: The basis is determined -- there is a design-basis of that which is probably a ten to the minus seven internal and external events. And if there is conservative assumptions into the model ten to the minus sixth per year is acceptable. So and the analysis performed by GE concluded that it is not a design-based accident with the probability being less than ten to the minus six per year, based on their assumptions in their model.

MEMBER KIRCHNER: Just intuitively, I'm not an expert in this area, that sounds like it is as low as an airplane crash. And our experience with truck fires is a much higher frequency than that, I think.

MEMBER MARCH-LEUBA: Is that ten to the minus sixth a probability of a fire accident that exceeds the 1 psi limit. Correct?

MS. RICHMOND: Correct.

MEMBER KIRCHNER: Oh, okay.

MS. RICHMOND: Actually, I will go back to the safe distances first, if I could, so I can get that on the record.

MEMBER KIRCHNER: Okay.

MS. RICHMOND: We looked that up for the storage of liquid hydrogen. The safe distance for the immediate that measurement was 495 feet. And for the delayed ignition of that was 677 feet for both the storage. And those numbers take into account the ability of the safety-related structures to withstand greater than 1 psi.

So, for the transport of liquid hydrogen --

MS. BORSH: We need to get -- open the line for GEH, the person who did the PRA. I think that would be most helpful for you all to talk to John about.

MEMBER MARCH-LEUBA: While we wait, have you considered leakages of natural gas pipes? Do you have a natural gas pipe feed there?

MS. RICHMOND: At the North Anna site, no.

MEMBER MARCH-LEUBA: I'm not talking about the major pipeline. I'm talking about going to your water heater. You have seen pictures from places where natural gas starts leaking into our building and it ignites the whole -- I mean it kills hundreds of people. I have been in one of

those.

MEMBER KIRCHNER: But those are pipelines.

MEMBER MARCH-LEUBA: The one person let me know was a track that killed 1,500 people because it happened to leak next to a campground and a beach. But do you have gas leakages, natural gas?

MS. RICHMOND: We do look on whenever we do a survey of the internal and external events, pipelines is something that we map and we make sure there is no pipelines within the vicinity of the site that could cause an issue. And if there is, then we do an analysis to make sure a detonation or an explosion from that pipeline is not going to cause a problem at the facility.

MEMBER MARCH-LEUBA: So, you do not have natural gas feed into the plant?

MS. RICHMOND: No, not for the North Anna site.

MEMBER MARCH-LEUBA: Oh.

MS. BORSH: Mike, would you like to say something about the PRA piece?

CHAIRMAN RICCARDELLA: Just a question on this liquid hydrogen question. This seems to me

to be a DCD issue, right? It is not North Anna plant-specific is it?

MR. ARCARO: This is Mike Arcaro, DEH. While we are waiting for our PRA expert, let me give you some background on the hydrogen storage and the transport. That is site-specific. The way ESBWR considered that was a site-specific application. So, the hydrogen storage volume is mostly based on hydrogen chemistry, which is an option system. But the PRA that was done for the transport condition for the 13,000 gallons, the transport tank is the assumptions and the inputs are in the FSAR. In Chapter 2, there is a table in the back that gives you the considerations, how we assume conservative values to get the ten to the minus sixth values. So, we considered, the analysis considered both instantaneous conditions, combustion and pool fires. And you ran through the different probabilities, the transport issue. We looked at conservatisms on the route of the truck at the site. We looked at the different scenarios. The consideration is the instantaneous explosion, whereas, a pool fire was considered as not part of the design-basis. So, we ran through those.

One of the considerations that was

conservative was we increased the probability of a small leak. And if you have a large leak, the chances are less that you will have an instantaneous explosion. You will have more of a pool fire. So, one of the conservatives which you will see in the table is that we did that. So, we went through the different values. We came up with ten to the minus sixth for the risk of this. Some of the inputs, some of the insights that we got from the PRA we added to the design of the system. So, in the system design we will consider things like gravel bed under the tanks. We will consider the trek route. One of the human factors issues was backing up the truck. There was quite a few issues with that. So, in the final design, it will be running the truck straight through without backing it up. So, a lot of that is in the FSAR right now.

CHAIRMAN RICCARDELLA: Thank you. So, are we still waiting for the PRA expert?

MR. LI: This is Jonathan Li from Hitachi. I am online right now.

MS. BORSH: Hi, Jonathan. Did you hear the question that was asked about the PRA and ten to the minus sixth, Jonathan?

MR. LI: Yes, so I think first when you can understand the use of our information, we did a PRA analysis for other scenarios and since we are following Reg Guide 1.91 approach. So, others, we didn't credit because the final usage is simply uses transportation route risk because this is the only one that is below one to the minus sixth. So, we credited this one.

The other one, like the storage and the other hazards, PRA cannot support it. So, it has to rely on the deterministic design, according to the methods.

So, the Bechtel analysis will support, even though the risk number for other, especially storage, may not be below one to the minus sixth, something like that.

So, that is the study. So, PRA analysis supporting this delivery truck risk is very conservative and you can see it is fully complying with the Reg Guide 1.91. And when the leak frequency is below one to the minus sixth, we say only that case was using PRA results.

MEMBER KIRCHNER: So, my question is, is that ten to the minus sixth, in reference to what, a leak?

MR. LI: If you go to -- let me see which page. Page 2-144 of the North Anna 3 FSAR, the one below one to the minus sixth, the frequency integrity is the hydrogen leak frequency. It is not even detonation. So, that is the frequency, you know 2.31 E-7 per year. And that number quoted, which is below one to the minus sixth. And that complies with Reg Guide 1.91 steps -- method. And we can say, for this case, it is not needed to be considered as something we need to analyze further.

MEMBER KIRCHNER: With three significant figures, 2.31. That is just a comment.

MR. LI: Okay.

MEMBER STETKAR: Jonathan, this is John Stetkar. You said something that troubled me and I want to follow-up on that. I think that I heard you say that you can't handle in the PRA detonations or large fires at the hydrogen storage facility. Did I hear you correctly?

MR. LI: No --

MS. BORSH: Jonathan, this is Gina. Hold on one second. I think it is going to be easier for Mike to answer that question.

MR. LI: Go ahead.

MEMBER STETKAR: Never mine. Mike?

MR. ARCARO: The methods in the Reg Guide is once you do the screening for the one percent, the 1 psi, you go to the next step, which is you figure out what the actual pressure is at the nearest safety-related structure.

So, what we saw, based on the ALOHA analysis is for the storage tanks, for the stationary storage tanks, the distance, if it was an explosion at the tank, was 490 some feet. And if it was a traveling cloud, the delayed vapor, it was 677 feet.

The distance to the fuel building, the nearest safety-related structure is 750 feet. The distance to the rad waste building is 740 feet. We didn't have analysis for the rad waste building at the time. So, we added an ITAC to say that the rad waste building walls will be able to stand the 3 psi rating of the explosion at the tank. So, that is how we didn't have to go to the PRA for that scenario because we met those requirements.

MEMBER STETKAR: Would a detonation at the hydrogen storage facility disrupt offsite power supplies and could it damage the turbine building?

MR. ARCARO: So, Mike Arcaro again,

GEH. Jonathan could probably answer that. But the short answer is we did look at the impacts on the core melt frequency and the parameters associated with that. That was shown to be minimal, as far as the effect on offsite power. I think the effect on the fuel building would be a reactor trip and the --

MEMBER STETKAR: I'm sorry, I didn't ask about the fuel building. I asked specifically about offsite power and the turbine building.

MR. LI: Yes, so this is Jonathan Li from GE Hitachi again.

Mike, I think the question is good. We did look at the CCDP conditional core damage probability and the conditional large release frequency probability. And the results, even though for PRA perspective, because we are limited by Reg Guide 1.91, the frequency tried to take credit. So, we tried to use this credit, as Mike said, that we used deterministic way to analyze it to develop a consent. So the question on the offsite power is the CCDP we do have the value and for this purpose, the consequence and the frequency combined is very low. So, even though we may not be able to use Reg Guide 1.91 to take more credit

for PRA side but the final consequence of the core damage frequency and the large release frequency, based on these leak frequency and the detonation and CCDP or loss of that power is very low. So, the risk increase is manageable.

MEMBER KIRCHNER: May we go to slide number five and just see where this hydrogen storage facility is on the plan view of the site?

MEMBER STETKAR: The answer is not using it.

MR. ARCARO: This is Mike Arcaro, GEH. You can see the hydrogen storage and the oxygen storage facilities over by the permanent access point, the vehicle permanent access point. It is kind of in the middle of the slide there.

MEMBER KIRCHNER: Then to John's question, it looks like you have got the radwaste building and other -- and the turbine generator building between this point and the switchyards.

MEMBER STETKAR: No, the switchyard is due north.

MEMBER KIRCHNER: Yes, that's what I --

MEMBER STETKAR: The turbine building is somewhat protected.

MEMBER KIRCHNER: Yes, that's my point.

MEMBER STETKAR: That's good.

MEMBER MARCH-LEUBA: What is this?

MEMBER KIRCHNER: This looks like the offsite tower at the very top.

MEMBER STETKAR: The switchyard is that stuff. It says switchyard.

MEMBER MARCH-LEUBA: Oh, this is switchyard?

MEMBER STETKAR: Yes.

MEMBER STETKAR: Up there next to the switchyard.

MEMBER KIRCHNER: So, you wouldn't use the temporary access point for hydrogen delivery. You would use the permanent --

MR. ARCARO: Right. That's correct.

MEMBER KIRCHNER: It would come in the area of the permanent.

MS. RICHMOND: And they are doing a circle around it so there is no backing up with the truck.

MEMBER KIRCHNER: Okay, thank you.

MEMBER STETKAR: And the reason I ask these questions is that we have had these questions for several new plant designs where the core damage frequency and the large release frequency are

exceedingly small. And therefore, screening out an external hazard at the nominal out-of-date regulatory guidance of 1E to the minus six, you could be screening out if that leads directly to core damage -- this doesn't, obviously, but if it does it could be oh, a factor of 50 to 100 times higher than all other contributions combined. Because we have seen -- I don't know what the current snapshot of the ESBWR core damage frequency is but we have seen some really, really small numbers back when we were looking at the DCD.

So, just simply saying well the regulatory guidance allows to screen out at ten to the minus six initiating even frequency is -- you might be following the regulatory guidance but in risk space, you might be ignoring a heck of a large contribution to the risk. I don't think that is the case here because of the configuration but it is why I ask these questions and why my eyes glaze over when people say well we thought the Reg Guide and we threw it away. We have been working with the NRC staff -- trying to work with the NRC staff to get changes to those fixed numerical screening criteria, especially for new plant designs for a couple of years.

So, thanks. That helps. This helps me more than anything else.

CHAIRMAN RICCARDELLA: Thank you.

MEMBER STETKAR: Now go on. If you are talking about -- I have a semi-related question and I didn't know when to bring it up. So, I'm going to bring it up now.

CHAIRMAN RICCARDELLA: Just another sort of a bookkeeping question on this issue. It was mentioned that while this is a plant-specific issue it is not a DCD issue. But was the same question addressed for Fermi in the Reference COLA?

MEMBER CORRADINI: Yes.

CHAIRMAN RICCARDELLA: Okay.

MEMBER CORRADINI: I'm not sure if they used hydrogen chemistry in Fermi, though. Because if I understand the answer of Dominion that the hydrogen supply is higher here because they are using hydrogen chemistry, I don't remember that Fermi used hydrogen chemistry.

MEMBER STETKAR: Mike, they would still have a big tank with evaporators and stuff because they still need hydrogen for the generator.

MEMBER CORRADINI: Right. But I guess to answer Pete's question, I thought the capacity

was different here. Maybe I'm wrong.

MS. BORSH: Okay, go ahead, Mike.

MR. ARCARO: Mike Arcaro, GEH. Fermi did use hydrogen water chemistry.

MEMBER CORRADINI: Okay, sorry. My mistake.

MR. ARCARO: They didn't do the zinc injection, which is something North Anna did.

MEMBER CORRADINI: Okay, thank you. That was my mistake.

MEMBER STETKAR: Are we done on hydrogen?

Keep that up for a moment, if you will.

MS. BORSH: May I ask about hydrogen? So, Mr. Corradini, this is Gina Borsh.

MEMBER CORRADINI: Mary gave you the safe distances. Is that a closed item now or is there more information that we need to get to you?

MEMBER CORRADINI: No, I took the notes. Thank you very much. I got it, thank you.

MS. BORSH: Okay, I just wanted to confirm. Thank you.

Yes, sir?

MEMBER STETKAR: And you have to forgive me because, as I said, I can't find my

notes from whenever the heck it was that we looked at this the first time around. So, I don't know if I am repeating myself or whether I am sandbagging you with new comments that I should have made seven years ago.

When I look at Appendix 9(a) of the FSAR, which is the fire hazards analysis, I find that there is a statement that said a detailed fire hazards analysis of the yard area that is outside of the scope of the certified design cannot be completed when cable routing is performed during final design.

So, if I then go to all of the tables for a large number of those structures that you see on this slide, there are entries in those tables that just say to be determined during detailed design. The reason I bring it up now is one of those happens to be the hydrogen storage area but there are many other buildings.

My question is well, of course, the fire hazards analysis for any, let me say every, location in the plant, including all of the certified design locations, has to be reexamined once you build the plant and actually figure out the configuration of cables and combustible

loadings in the plant. So, saying that we can't do anything until we build the plant doesn't really persuade me very much.

And furthermore, in my perspective, one of the benefits from doing the fire hazards analysis, especially right now, is that you might learn something from it in terms of gee, maybe we don't want to run cables through a particular area. It can be used to inform your final design and cable routing. There are people who have done fire studies on plants that have been retrofit, for example, did the fire study after they did the retrofit and said gee, I wish I knew that; I wouldn't have routed the cables through that particular area.

So my question is why didn't you do a fire hazards analysis for -- and I don't want to list all of the buildings, I counted them out in the -- the so-called yard buildings?

And I'm not talking necessarily about a risk assessment of fires at the moment. I am just talking about fundamental a fire hazards analysis to find out what is in a particular fire zone because you have all the fire areas laid out. I mean it is not something we know where the areas

are. If you have a fire in there, take the worst fire that you typically do, burn up everything in there, what are the consequences from that?

MR. ARCARO: Yes, this is Mike Arcaro, GEH. I'm also the fire protection engineer for the ESBWR.

There is a COL item for doing the fire hazard analysis for site-specific areas. So, it is covered. You know all the standard plant areas, the fire hazard analysis has been complete. So, we are talking areas, service water pump building, areas like that.

MEMBER STETKAR: We are talking about, to get it on the record, the service water building, the diesel fuel oil transfer phone house, the makeup water building, the circulating water pump house, the station water intake building, the hydrogen storage area, the oxygen storage area, the dry cooling tower, the dry cooling tower electrical buildings -- there is two of them, the hybrid cooling tower, the hybrid cooling tower electrical building, the electrical building in the yard, the intermediate switchyard control house, and the Unit 3 well houses. So, we have that on the record. It is that stuff that you haven't done a fire hazards

analysis on.

MR. ARCARO: That's correct.

MEMBER STETKAR: So, don't say that you have done it.

MR. ARCARO: We have not done the site-specific --

MEMBER STETKAR: Okay and yet this is a site-specific COL. So, my question is, for the site-specific COL, why didn't you do a site-specific fire hazards analysis for the site-specific buildings in the site-specific COL.

MR. ARCARO: I'm going to have to take that back.

MEMBER STETKAR: Okay, thank you.

CHAIRMAN RICCARDELLA: Okay, I think we're done with the Dominion portion of the panel and I think we have the staff -- I'm sorry.

MS. BORSH: This is Gina Borsh again. What we had planned to do was move to Part 3 of the PowerPoint presentations and finish up the other, the few non-seismic sections that were going to be at the end of the day because we thought, Jim and I thought, that would be the most efficient way to handle them.

So, what we would like to do, if you

all are willing, is switch over to Part 3 and start talking about radwaste discharge piping, which starts on page 124, essentially.

CHAIRMAN RICCARDELLA: We are jumping to the end.

MS. BORSH: Yes, if that is appropriate. Thank you.

Jonathan, thank you. So, Thereon, we can put the phone back on mute.

So, in your slides, it should be page 124. Oh, I'm sorry you are looking on your electronic copy. So, it should be page 50. We had to break up the file because it was too large.

Okay, so Lanny Dusek from Fluor is going to talk about radwaste discharge piping, briefly, and we will keep going.

MR. DUSEK: Okay. The point is some changes that were made in regard to radwaste discharge is for construction simplification but still keeping in mind the requirements to minimize contamination of the site in the environment. And one point to make right up front is that the operational goal for Unit 3 is to be a zero liquid release plant. So, in the FSAR Rev. 2, there were a couple of areas there in Section 11.2 and 12.3

that talked about the radioactive releases being discharged to a circulating water system and then referring them to the cooling tower blowdown line running that underground due to potential for radioactive content.

Okay, so construction simplification was we broke out a separate line for liquid waste management system, a discharge from that, and separated it from the circulated water cooling tower blowdown where you don't have to worry about the contamination in that line. So, what was done in FSAR Rev. 9. Next slide.

Okay, so that resulted in departure and also an exemption. So, in FSAR Section 11.2, we now say that the radioactive releases will be discharged using that new line with liquid radwaste definitely discharge pipeline. Then, it is going to go to the canal, rather than into the circulating water system, the cooling tower blowdown line.

And we then specified 12.3 that because we have now got this radioactive line, potentially radioactive, that it will be run underground and meets the requirements of 10 CFR 20.1406, which looks to the future for license termination. Next

slide.

And then the Exemption 4 that we took against Tier 1 was we revised the design description there that used to refer to release to the environment via the circulating water system. We are not doing that anymore. We are discharging to the environment using the new liquid radwaste effluent discharge pipeline. It goes right to the discharge canal.

Any questions? Okay, thank you.

MS. BORSH: Okay, so let's go on and do hurricane missiles. Okay, Lanny.

MR. DUSEK: So, the main driver for addressing this is in the DCD, the ESBWR DCD. When it was reviewed, this Reg Guide had not been issued yet. So, the hurricane missiles that were calculated and are in the ESBWR DCD are different, once you applied the Reg Guide 1.221. So, that is what we are going to talk about. Move to the next slide.

So Reg Guide 1.221 was issued in October of 2011. And so we have got a series of slides here to kind of bound and bring in what we are talking about. And on the wind speeds themselves, if you applied 1.221, the hurricane

wind speeds at the site at North Anna are bounded by the tornado wind speeds in the DCD. So, you can see the 140 compared to 330.

So, for seismic Cat 1 structures, they are designed for both tornado and hurricane winds. And so this new calculation with the Reg Guide for hurricane winds came up with winds that were less than a tornado. So, it was bounded. Okay, next slide.

Then looking at the missiles that are generated by this hurricane wind using Reg Guide 1.221 calculations, when you see in this table here, that if you compare the different classes of missiles that the tornado missile velocities are higher or bound the hurricane missile velocities. Again, this is for consideration of seismic Cat 1 structures. Next slide.

Okay, when now we move to RTNSS structures, the bounding changes because they are not designed for tornado winds, they are designed for hurricane winds. And so when we look at the wind speeds just themselves, they are still bounded. So, you see 140 compared to the DCD wind speed of 195. But then when you get into the missiles and because the way that they are

calculated changing, they are not bounded in every case. So, if you see in the bottom table there, that really shows where the DCD hurricane missile velocities are in the second column. The third column shows the hurricane missile velocities calculated using Reg Guide 1.221. And you can see that there are some places that aren't bounded. So, the approach then is to say we are committing to taking the most limiting case and making that our standard for the site. So, the limiting missile velocities that are used now in the FSAR are on the right-hand column. Next slide.

MEMBER STETKAR: Lanny, before you -- well, it's on the next slide. I lost track.

MR. DUSEK: It just really gets into the departure in the example.

MEMBER STETKAR: Let me ask my question here. I know what you did and that's fine. That's good.

My question was -- and I'm not sure if I have stumbled over this before but I did here and I was going to ask the staff about it but you are up first. I understand that seismic category 1 structures look at both tornado and hurricane missiles and take the more bounding of the two.

Right?

You made a statement here and the staff, in the SER, echoes it in writing that non-seismic Category 1 structures are designed for hurricane missiles but not tornado missiles. So, you had to look at hurricane missiles for the RTNSS structures because they are not Category 1. And when you did that, you discovered that, indeed, the hurricane-hurled automobile was more energetic than the tornado hurled. Well, you didn't look at the tornado-hurled automobile.

MR. DUSEK: Correct.

MEMBER STETKAR: But the site-specific hurricane wind speed hurled automobile was more energetic than the DCD hurricane-hurled wind speed automobile --

MR. DUSEK: Correct.

MEMBER STETKAR: -- if I said that correctly.

Now, my question is what is the basis for saying that I have to look only at hurricane missiles for a non-seismic Category 1 RTNSS structure? And the thing that came to mind is suppose I have got this plant in the middle of Kansas, say, where my hurricane wind speeds are

probably close to zero. Does that mean that my RTNSS structures do not have to be designed for any missiles whatsoever, despite the fact that they are in the middle of Kansas?

And if that is true, what part of the regulatory guidance allows us to do this? That was going to be my question to the staff. Do you know where that comes from? If you don't, I will put the staff on the line.

MR. DUSEK: I do not know that.

MEMBER STETKAR: Okay, staff, when you come up, you are going to get asked this question because to me, it sounds kind of strange.

Thanks.

MR. DUSEK: Sure.

MEMBER STETKAR: I'm sure you followed the guidance. I'm not questioning what you did. And I'm glad that you took a look at the site-specific stuff. That's good. I am just really curious about how we walked ourselves collectively as regulators into this type of situation.

MS. BORSH: Thank you, Lanny. And so now Mike Arcaro is going to talk about zinc injection briefly.

MR. ARCARO: Okay, thank you. Mike

Arcaro, GEH. This zinc injection, like I said earlier, was elected as an optional system by the Dominion for North Anna. It is going to be available at startup to provide a defense-in-depth with hydro-water chemistry Innovo Chem. The zinc injection system continuously injects small amounts of depleted zinc oxide pellets using the feed pumps as a driving force. It is a passive system. The idea is it reduces the occupational exposure to plant personnel by performing a protective layer. It inhibits the soluble cobalt-60. And not so much an issue with ESBWR because of enhancements in materials and the lack of the recirc piping but it still would be beneficial because of the under vessel lower plenum area and the reactor water cleanup shutdown cooling system piping.

So, zinc injection system is added for dose rate reductions in the North Anna 3 plant.

Any questions?

MS. BORSH: Okay, thank you, Mike. And now John Disosway from Dominion is going to talk about the two departures and exemptions we have regarding electrical.

John.

MR. DISOSWAY: Good morning. I'm John

Disosway from Dominion. Next slide, Gina.

So, we have two items this morning to talk about in the switchyard at North Anna. First, the surge protection departure and then the revised switchyard configuration departure and prevention. Next slide, please.

So, the DCD references Reg Guide 1.204, which provides guidelines for lightening protection for nuclear power plants. That references four IEEE documents, three of which the North Anna switchyard complies with. The fourth, IEEE C62.23, the application guide for surge protection of electric generating plants, there are several recommendations within that that the North Anna switchyard does not directly comply with.

The North Anna switchyard was designed and constructed in the 1970s Dominion Electric Transmission Standards. This predated the issue of IEEE C62.23 and Reg Guide 1.204 by about two decades. As a result, the North Anna switchyard design conforms to most of the requirements given in Reg Guide 1.204 but several of the recommendations given in IEEE C62.23 we do not directly comply with.

Specific design features of the North

Anna switchyard provide equivalent protection as those recommendations that the switchyard at North Anna does not directly comply with. The result of this is that the offsite power system and switchyard at North Anna meet the interface requirements given in the DCD and the departure does not affect the DCD design functions or performance characteristics. Next slide, please.

All right for the revised switchyard configuration, the DCD locates the main generator circuit breaker and associated motor-operated disconnect switches in the transformer yard that is adjacent to the turbine building. Because of space limitation problems at the North Anna site, these components have been moved to a location we call the intermediate switchyard. There is no change in the electrical connection, the design or configuration of these devices. Therefore, the switchyard design continues to meet the interface requirements in the DCD and departure does not affect DCD design functions or performance requirements. Next slide, please.

In this slide you can see at the area of location, the main generator circuit breaker with the motor-operated disconnects on either side.

This is the DCD configuration. And in the larger drawing for the DCD, that is located in the transformer yard. Next slide.

This is the FSAR figure for North Anna and you can see the same devices in the same electrical location, the same configuration but we have put them physically inside a box that we call the intermediate switchyard. This is a physical location change only. Any questions?

MEMBER STETKAR: Yes, many. You characterized this as a physical location because of where you have drawn your dotted lines. In fact, it is a functionally different configuration and one that ought to be evaluated in the site-specific PRA. So, I will telegraph that.

The functional difference is that you have introduced a 500 kV circuit breaker that you see there, that little box. And you have introduced three single-phase 500 kV to 230 kV transformers --

MR. DISOSWAY: Yes.

MEMBER STETKAR: -- the intermediate transformer that is shown there. Those do not exist in the certified design. If you go back to the previous slide, you don't see those things

there. So, that is new.

My question is why did you do that.

MR. DISOSWAY: We did that for the reason that the reserve auxiliary transformers and the station auxiliary transformers are to be the same design at North Anna Unit 3.

MEMBER STETKAR: Okay, is that your decision?

MR. DISOSWAY: Yes.

MEMBER STETKAR: Okay, that is your decision. That is not the certified design decision because the certified design specifies no voltages and it could conceivably allow different voltage transformers. That could be the same power rating but they could be different voltages.

MR. DISOSWAY: Yes, that's correct.

MEMBER STETKAR: Okay, so that is your decision to put that transformer in there.

MR. DISOSWAY: Yes. Yes, so --

MEMBER STETKAR: Okay. Now, if I look at this and I look at all of the words that I see, they all talk about these are space limitation. To me, this is a functionally different electrical configuration. In particular, if I fail any one of those three single phase transformers or that

little box circuit breaker there, I lose, without the possibility of recovery, the power supply from my 500 kV transmission switchyard back into the plant, my so-called normal preferred power supply.

I didn't have those failure modes in the certified design because the certified design has that arrow that goes out the top here to the normal preferred power supply.

So, I have added now three transformers, in fact two motor-operated disconnects and a circuit breaker that can disable, without possibility of recovery at least under risk assessment of 24-hour mission time, my 500 kV preferred power supply. I have also separated, though my power supplies into a 500 kV source and a 230 kV source. In principle, the 230 kV source can be out of service during plant power operation because it could be. I don't know whether it ever is but it could be electrically. It could be electrically. 500 kV, obviously, can't be out of service during plant power operation because that is where you are generating into.

So now, you are making claims that this doesn't change anything from the certified design and I claim that it changes a lot. So, have you

evaluated this in your plant-specific COL PRA? I looked for that and you didn't.

So my question is why didn't you? That is a long way around trying to get the basis for -- I have some numbers that I put in there. If we get into the PRA, I know what the contributions from these things would be. I don't particularly want to argue about numbers right at the moment.

MR. DISOSWAY: All right.

MEMBER STETKAR: But my fundamental question is why hasn't this been evaluated in terms of its contribution to risk? Because it is an additional contribution. It could be an additional contribution.

MR. DISOSWAY: We will take that question.

MEMBER STETKAR: Okay. The other -- I'm going to grill the staff on this because the staff parrots back your notion that this is done simply because of space limitations. It is done fundamentally because you want to have all four of those transformers and probably a spare at the plant so you can switch them out. I mean I understand the operational kind of design construction reason for doing this but it is not

space-related. It is electrically related because you want the OATs and the RATs to be identical transformers. And you get some benefits from doing that. The drawback is you might have a risk increase. How big, I don't know.

MS. BORSH: We'll take it back.

MEMBER STETKAR: Okay, thanks.

By the way, while we are on this because you don't show the switchyard configurations here, do you have analyses to show that any one of the four 500 kV lines can feed all of the plant loads for all three units? Because the 500 kV switchyard feeds into the -- I don't know the configuration between 1 and 2 but I am assuming the plant loads for those are fed from the 34.5 kV stuff. Is that true?

MR. DISOSWAY: The reserve loads are fed from the 34.5 yard for Units 1 and 2.

MEMBER STETKAR: So, if I get down to one -- if I have a loss of offsite power, let's say and I restore power from one of the 500 kV lines and I wind up tripping all three of the units at the site, can any one of those four lines handle the post-trip loads on all three units?

MR. DISOSWAY: I can't give you a

specific answer for units one and two right now. I haven't looked at that in a while. I will have to get back to you.

MEMBER STETKAR: Okay, yes, because I saw the load flows that you did in terms of transients but all of those were on essentially power generation type stability analysis. So, I was curious about that because I have no idea what the capacity of the lines are. I have a suspicion but I wanted to see if you had looked at it.

Let me look through my notes here. If I look at the plot plan in the intermedia switchyard, I see a little box that says control house. Is that the control house for the 230 and 500 kV switchyards or is it only the control house for this intermedia switchyard?

MR. DISOSWAY: That is only the control house for the intermediate switchyard.

MEMBER STETKAR: I noticed that you routed your control, I think, cables. I couldn't quite tell where the cables are routed. They seem to be all be routed this physical location and then kind of go out from there. So, for example, I was curious if you have a separate 230 kV switchyard why are the control cables for that switchyard

routed through here? I can understand why the 500 might go through here because this is sort of the pinch point for the 500 kV supply. So, I don't particularly care whether it goes through or around here. But I was curious why the control cables for the 230 kV switchyard go through here, if they do.

MR. DISOSWAY: Well the control cables for the existing 230 kV switchyard do not go through this location. So, this is a new location we are creating for North Anna Unit 3.

MEMBER STETKAR: Yes but for example, if I want to -- can people inside the plant operate the 230 kV circuit breakers? I'm talking the 230 kV out here.

MR. DISOSWAY: I understand. Generally, we cull electric transmission and that is a combined function between station operations and electric transmission and they are operated from the switchyard. Can they be? I don't have a specific answer.

MEMBER STETKAR: Yes, I am talking about main control room operators from the panel.

MR. DISOSWAY: They actually can be but on the control board, my recollection is no, that they are typically operated by electric

transmission in the switchyard.

MEMBER STETKAR: Okay so any of those so-called control cables would be status monitoring the breaker positions and things like that, not actual operating.

MR. DISOSWAY: Yes, we do have signal back from the control room --

MEMBER STETKAR: Yes, I'm sure you do. Okay.

MR. DISOSWAY: -- from the control house.

MEMBER STETKAR: I'm sorry on this. This is something new and it is one of the few things I read.

Let me just check here. I think those are all of the kind of salient questions I have. Thanks for bearing with me.

MR. DISOSWAY: Thank you.

MEMBER STETKAR: But I would really appreciate some feedback on why you didn't put it in the PRA.

MS. BORSH: We will get back with you on that.

CHAIRMAN RICCARDELLA: So, we are done now with the North Anna part of the non-seismic

agenda?

MS. BORSH: We could be. The only thing --

MR. DISOSWAY: Yes, we do have a response on the fiberglass-reinforced polyester pipe. Then if you want to close it.

MS. BORSH: Okay, and then I have something on fire hazard analysis, too. So, whatever you prefer Dr. Riccardella.

CHAIRMAN RICCARDELLA: No, let's address these and then we will take a break and then have the staff come up. So, we will address these questions -- your response.

MS. BORSH: All right, Lanny, you want to go first?

MR. DUSEK: All right, so going back to the SRP the concern was what low temperature conditions are. And so when we look at the standards for design, the ASME rules for fiberglass-reinforced polyester pipe, it is minimum temperature of negative 20 degrees. That is very low.

CHAIRMAN RICCARDELLA: In general, that is high temperature.

MEMBER STETKAR: I thought that was the

case but I got curious because in the COL FSAR now they specify a nominal temperature range for it and I don't know how that is treated in terms of anything.

MR. DUSEK: Right. Okay but it is low as far as the question of how much is buried. It is both the intake and discharge.

MEMBER STETKAR: It is both the intake -- yes, I suspected it was.

MR. DUSEK: So, you are correct there and it is all direct buried piping.

MEMBER STETKAR: Okay, you may want to look at that 88 to 100. I have no idea how that is interpreted in terms of anything but it is a number in the FSAR. And as I said, I have no idea how anybody interprets those numbers going forward.

MR. DUSEK: Yes, it turns out that the 88 degrees is the maximum inlet temperature on the cold leg side, the supply side.

MEMBER STETKAR: Yes, it is.

CHAIRMAN RICCARDELLA: It probably is because you are concerned about the high temperature on this piping, not the low temperature.

MR. DUSEK: Correct.

MEMBER STETKAR: I got it. It just says the only temperature that shows up is nominal operating temperatures is 88 to 120. And I didn't want anybody to get walked into a situation where you had to somehow heat trace the supply line to keep it at that temperature, where some inspector might interpret that you need to somehow.

MR. DUSEK: Okay, thank you.

MS. BORSH: Okay, Dr. Stetkar, you were asking about fire hazards analysis and why didn't we do basically some sort of interim analysis. Okay and so I went back and was looking at Reg Guide 1.26 and basically we certainly could have done some -- probably in several of those areas we could have done some sort of interim analysis but when you look at the guidance in Reg Guide 1.26 about what is required to be in the COLA, the section on fire protection recognizes that we won't have -- we, the licensee/applicants won't have all of the information that we need for completing lots of things, but in particular here, fire hazards analysis work and fire protection program requirements. And so it does recognize that we won't have -- and this is in item -- what page is this -- that we won't be able to do the final fire

hazards analysis at this point in the process. And it basically allows us to submit the COLA without that information. And it is on Reg Guide 1.206 page C3.1-120. So, that is --

MEMBER STETKAR: I'm a slow writer. C3.1-120?

MS. BORSH: Yes.

MEMBER STETKAR: Thank you.

MS. BORSH: And it is item 4 in that list. So, it is not that we could have done an interim analysis for some of these areas but we did not and that was why because the guidance gave us an allowance for submitting the final analysis later.

MEMBER STETKAR: Now, it is again, just on the record, it is very curious to me because I view all of the certified design fire hazards analyses to be so-called interim analyses for precisely the same reason. And we have had many discussions in the past about this notion of postponing things. Some people call them design acceptance criteria, ITAAC, postponing that information from the COL FSAR to sometime later.

I observed previously and I still believe that it is a useful activity to perform

those fire hazards analyses as early as possible because you might learn something from them.

MS. BORSH: And I certainly made a note of that. Thank you.

MEMBER STETKAR: But thanks for the reference because I searched a bunch of places and I couldn't find it. So, thanks.

CHAIRMAN RICCARDELLA: So, we're running it looks a little bit behind but not too bad. So, let's take a break now until 10:30 on that clock, a ten-minute break. And after that we will have the staff come up to cover their part of these non-seismic questions.

(Whereupon, the above-entitled matter went off the record at 10:17 a.m. and resumed at 10:33 a.m.)

MR. SHEA: All right, this is Jim Shea from the staff again. I just want for the NRC Panel 1 presenters, you can see the names here. You know we will go through them. Rao is going to talk about -- and we put it in order of FSAR. So, Rao Tammara, Bruce Musico on the evacuation time. Kevin Quinlan is doing the gas releases, accident releases. Joe Giacinto is going to be talking about the flooding and Bob Fitzpatrick -- we are

going to bring them up after these first four guys. Bob Fitzpatrick is looking at the electrical. Steve Williams is talking about the radwaste discharge line. Ryan Nolan is going to talk about the Chapter 19 departure on the hurricane missiles. And I get to do the fiberglass reinforced piping. And with that, we will go to Rao.

MEMBER STETKAR: Before we do that, I have kind of a broader question. I wanted to wait for you guys to come up before I asked it. For this meeting, we received the version of the safety evaluation report. It doesn't have a date on it but it was sent to us in the middle of September, September 15th. I'm assuming that is the current version. Is that correct?

MR. SHEA: Yes, that is the Phase 4 Advanced Final SER.

MEMBER STETKAR: Okay.

MR. SHEA: And it is on the public website.

MEMBER STETKAR: Good. We also received Revision 9 of the COL FSAR and that actually has a date on it. It is dated June of this year.

As I read through things, I noticed

that the safety evaluation report, almost all of the chapters, refer explicitly to Revision 8 of the COL FSAR, which is based on Revision 10 of the ESBWR DCD. Four chapters, as best as I can tell, and I found other sections of chapters, refer explicitly to Revision 7 of the COL FSAR, which is based on Revision 9 of the DCD.

So my question is, not so much for the subcommittee meetings but for the full committee, what is the ACRS being asked to review. Because in the SER, you make many references to COL whatever you call them -- confirmatory items that need to be checked in the next issuance of the FSAR, which we have already.

So, in terms of finality of the ACRS review, how can we review your safety evaluation report?

MR. SHEA: Well, I mean to follow the logic -- really there is some logic there. Most of the evaluation for the Advanced Final SER most of it, again, is incorporated by reference from the DCD Revision 10. And a lot of that was done under Revision 8 at FSAR and was completed. And so there is no reason to revisit that under Revision 9 of the FSAR.

So what you will see in these Advanced Final SERs, you will see some confirmatory items. There is not a lot. Most of them are in chapter -- well, in fact Chapter 3, we did all the confirmatory items before we submitted it as the final but you will see in that chapter, for example, that was based on Revision 9 because most of the changes from Revision 8 to Revision 9 stem from the seismic evaluation.

There is a couple other chapters, and Chapter 4 is similar to that, there is again an update to that and there is confirmatory items and that is going to be based on, again, the Revision 9. So, any place where it says still valid was Revision 8.

MEMBER STETKAR: I'm sorry. The first sentence in Section 3.1 of Chapter 3, I will quote this, Section 3.1 Conformance with NRC General Design Criteria of the North Anna 3 Combined License Final Safety Analysis Report Revision 8 -- not Revision 9 -- Revision 8.

MR. SHEA: Right.

MEMBER STETKAR: So, your statement that Chapter 3 refers to Revision 9 is inconsistent.

MR. SHEA: My mistake. Chapter 3 seismic section. So, that is particularly --

MEMBER STETKAR: Only seismic sections.

MR. SHEA: Yes.

MEMBER STETKAR: And in other places, I found parts of some chapters refer to Revision 8. Parts of some chapters refer to Revision 7.

So, you are asking -- the reason I raise this is you are asking the ACRS to write a final letter on the safety evaluation of North Anna Unit 3. That is our final letter. Finality of an ACRS letter implies finality of the supporting information. This doesn't seem final to me.

MR. SHEA: Well, again, the logic was that those reviews were done under Revision 8 and completed and no changes were done since that time. And Revision 8 came in June of 2014. So, therefore, most of that information was final at that point. And the only thing that changed between Revision 8 and Revision 9 now is all the more recent RAIs that have occurred over the last 18 months, which we discussed at the last info meeting, which there were a number of chapters that do confirmatory items based on changes of information from Revision 8 of the FSAR to Revision

9.

I mean it could be a simple matter. If you feel like we should have everything -- I have had that question before and I have kind of debated in my head which way we should do it. I could change everything to Revision 9 but it doesn't change the fact that the information that you are reading when it says Revision is based on that Revision 8 FSAR. I could just simply go through it and change it.

MEMBER STETKAR: Which we don't have. We have Revision 9.

MR. SHEA: Well, okay.

MEMBER STETKAR: My question is --

MR. SHEA: Well, Revision 9 in those particular did not change. You will see the change bars in the --

MEMBER STETKAR: I have looked at Revision 9 and, indeed, I see change bars in the margin. I'm not capable of reading every page of the COL FSAR and every page of the SER, despite how much I try to read. And comparing back and forth to see exactly what changes were made in Revision 9 of the FSAR and whether they are consistent with the confirmatory items in the SER --

MR. SHEA: Well that kind of confirms the process which we used. You are telling me so when you look at our SER and we said Revision 8, you can bank on the fact that that was what was confirmed on Revision 8. Anything in Revision 9 was something that has been updated since.

So to me, that is a clear understanding of what was done, rather than just change everything to generically Revision 9, which we could do that if that is what the committee wants us to do.

MEMBER STETKAR: Has Revision 9 been filed on the docket?

MR. SHEA: Yes.

MEMBER STETKAR: Okay.

MR. SHEA: It just went public last week.

MEMBER STETKAR: Rather than discuss this, the problem is you are slotted for an ACRS full committee meeting in two weeks from now. ACRS full committee needs their material 30 days before the meeting. So, the only thing that the ACRS has to review is what we have in front of us right now, which is this version of the SER and Revision 9 of the Final Safety Analysis Report.

MR. SHEA: Right.

MEMBER STETKAR: And those are not --

MR. SHEA: Anything that says Revision 8 is going to be exactly the same as what the FSAR has in Revision 9. There is no changes.

MEMBER STETKAR: There are changes. Because I don't have Revision 8 of the FSAR, I do have Revision 9 of the FSAR and I know that there are change bars in some sections of that document.

MR. SHEA: There is also, Dominion put in front of every chapter, they put all the different changes based on Rev. 9. There is a history going all the way back to Rev. 0.

MEMBER STETKAR: Okay.

MR. SHEA: And so if there is a concern or a question on any particular item, you can just simply go to that Revision 9 front of the chapter and it gives you exactly what has changed.

MEMBER STETKAR: I think --

MR. SHEA: It gives you a roadmap.

MEMBER STETKAR: I have kind of raised the question. We probably have spent too much -- I think we probably should have some offline discussions about when it is we come to the full committee and what comes to the full committee.

Because on the record, my concern is that I don't think that the ACRS wants to be put in a position where we are looking at things that aren't referring to one another consistently. And I don't know whether they are inconsistencies because I said I can't read every page in both of those documents to cross-reference the confirmatory --

MR. SHEA: Well, I can tell you I did and I made it very consistent and confirmed everything that was in those SERs. I personally confirmed everything, including what Rev. --

MEMBER STETKAR: In Rev. 9.

MR. SHEA: Yes, in Rev. 9. We are doing that. We are also getting backup from the staff. What I do is I confirm it and I send it to the staff for their review, for the changes in Rev. 9, for the Final FSAR. That is what will be reflected in the FSAR will be the fact that I actually confirmed each one of the changes. There isn't that many. There is not a whole lot. And then the staff will take a look at those changes also and agree or disagree and give me the background.

MEMBER STETKAR: We should probably discuss this more offline. I just wanted to --

MR. DUDEK: Mr. Stetkar, this is Michael Dudek. We understand your concern and we will work with Girija to address your concerns offline.

MEMBER STETKAR: Okay, thanks.

MEMBER BROWN: I had one question relative to this also. Not the FSAR but what Rev. level of the DCD is reflected in your all's SER? Is it Rev. 8, Rev. 9, or Rev. 10, and which one is the FSAR done to?

MR. SHEA: Everything -- in fact, that is a good question. Everything is or should reflect the Rev. 10, the final DCD. And that is what it does, as far as I understand.

Now, there are places and you will see in these SERs some of it is a history of the reviewer's review and they will go back -- in fact, there is a good case of that on this entire idea of the plastic piping. There is a number of RAIs that discuss Rev. 0 of the ESBWR DCD. That is just the fact that, at that time, that is what was reviewed.

Now, by the time the conclusion is made, the conclusion is based on the Revision 10 of the DCD and basically the staff safety evaluation,

as reflected in FSAR and NUREG-1966. So, that is very consistent throughout. If you see -- maybe I missed something but that is the way I reviewed all these SERs when I did my PM review and that is the way it should be. That is the way it is reflected as far as I know in the Advanced Final SER.

Now, as we go through this FSAR, part of the process of the FSAR is it is, again, another shot for the staff, for the projects group. And for North Anna, we give them a review of that to do what we call a fact check of the information because they have already done that through the AFSA but we do it again one more time before we final the FSAR.

So, that is kind of the process. But like you said, Mike said, we can discuss this offline how you want to --

MEMBER STETKAR: Charlie, I didn't read Chapter 7 because I ran out of gas. I noticed the SER is really long. It is one page for Chapter 7.

MEMBER BROWN: For this SER.

MEMBER STETKAR: Well, the SER. There is only one.

MEMBER BROWN: Yes, well that is because they incorporated it by reference. But I

am trying to figure out what that reference --

MEMBER STETKAR: Charlie, let me finish here.

MEMBER BROWN: Oh, I'm sorry.

MEMBER STETKAR: The SER explicitly for Chapter 7 refers to Revision 7 of the FSAR, which is based on Revision 9 of the DCD. So, it is too old, two revisions previously of the FSAR and one revision previous of the DCD.

Now, I don't if anything changed.

MEMBER BROWN: Where did you find that? I looked at the FSAR.

MEMBER STETKAR: No, not the FSAR, the safety evaluation report. We have the staff up front here. So, it is the safety evaluation Chapter 7. I just pulled it up. I didn't know how long it was because I hadn't read it. It is one page. I have now read it.

It is three paragraphs and it explicitly refers -- the third paragraph says Chapter 7 of the North Anna Unit 3 Combined License Final Safety Analysis Report Revision 7 incorporates by reference with no departures or supplements Chapter 7 Instrumentation and Control Systems of the ESBWR Design Control Document

Revision 9. That is one previous revision of the DCD and two previous revisions of the FSAR.

Now, if nothing has changed, that's fine. But I don't think that ACRS members ought to be asked to go back and do that tracing.

MR. SHEA: Well you might have found a case where that is incorrect. It should have been updated to Revision 10 because that is really the reference. And it should say the FSER related to Revision 10 --

MEMBER BROWN: You said SER or are you saying AR?

MR. SHEA: The FSER.

MEMBER STETKAR: Thank you.

MR. SHEA: The staff FSER for the DCD as reflected in NUREG-1966, which is actually there is a revision to that, Revision 1 based on the supplement, but anyway --

So, that could be an oversight on our part. You have got to remember that particular SER was completed in like June of 2014 or something.

MEMBER BROWN: April 2014. That is the version I got.

MR. SHEA: In that particular case, that was one of the first SERs that were completed

after Phase 2. That, with three other ones, I forget them right off the top of my head, but they didn't have any open items. No issues. And so it was published.

Anyway, so we have got to move on. And we can, like you said, talk about this.

MEMBER BROWN: No, we're not going to move yet because I want to make sure I understand something.

MR. SHEA: All right.

MEMBER BROWN: I was trying to track -- I mean I asked a question about the Chapter 7 stuff because back when we first did the initial certification, Rev. 6 was what was presented to us. We had a number of discussions and feedback, including a magic email I got, finally, by the time we got around to 2010 from Skip Butler, the I&C guy, which told me what changes they were making and how some of the watch guard towers and a few other things we were supposed to execute.

So, I have gone back and tried to recreate and track that up through Rev. 7. I don't have Rev. 8 of the DCD. Of course, I have got a markup of Chapter 7, theoretically, but I don't have the final, and I have 9 and 10. So, I have

been trying to track that to make sure there is consistency with the requirements.

There was one thing that he said was going to be done that I have not been able to find in any of the versions, including the markup. So that was, in terms of what happens when a TLU locks up in the thing. So, that is fundamentally I found everything, for the most part, except I don't have the final Rev. 8 to say were there any changes from what we agreed to when we did the initial letter on our certification that was going to be reflected in Rev. 8. I never go that and, therefore, I don't really know that 9 and 10 conform to Rev. 8.

So, that is the difficulty I have right now with the Chapter 7 stuff. That is just another wrinkle in this what Rev. level that we are dealing with. That's all.

MR. SHEA: All the information is out there. I mean I would try Google Rev. 8. You will find it.

MEMBER BROWN: I'm not going to Google anything. Jesus Christ, I have spent five days trying to find all this stuff and went back to 2009 and 2010 trying to get the information.

MR. SHEA: I can help you get whatever

information that you need through Girija and I can get it to you a lot quicker than wasting time five days looking for it.

MEMBER BROWN: If I could get Rev. 8, that would be nice. I can at least go back and look at that.

MR. SHEA: We can get that for you, no problem.

Anyway, is there anything else? My boss is telling me I have to move on.

CHAIRMAN RICCARDELLA: I think maybe a lunchtime we should have a discussion about this and see if it is ready for full committee in November.

MR. SHEA: All right. So, we will move on to the first slide for Rao.

MR. TAMMARA: My name is Rao Tammara. I am the technical reviewer for the Sections 2.1 and 2.2. Section 2.1 deals with the geography and demography but the major subsections of the 2.1 are site location in the description, exclusion area authority and control, and the third one is population distribution.

But the site location describes the items which have to be covered. In that sub-bullet

section exclusion area, I have listed out the areas which need to be addressed in that section. Population distribution also includes the projections of the population density and low population zone, population distribution, population center distance are covered in the population distribution.

Since the North Anna has got the permit for the early site permit, all the site-specific information pertaining to these sub-sections have been presented as a part of the early site permit application. Therefore, the COL, as per the DCD, the COL will address these items by referencing the ESP because the ESP has the finality in the approval. But since the SER staff members would like to look at our population distribution, ESP figure 2.-14 shows the population density assuming the plant approval of 2020 and within five years from the approval date within 20 miles from the site. The population distribution is within 500 people per square mile. And by looking at the operational period for 40 years, they are also looking at the density projection for the entire operational period for the 2065, which is also under 500 people per square mile.

So, it complies -- not complies but it meets the regulatory guidance -- not regulatory -- the guidance provided in the Reg Guide 4.7. Next slide, please.

Section 2.2 addresses the nearby industrial transportation and the military facilities. Those include the maps and descriptions of the facilities, descriptions of the products and the materials, and also the projection of industrial growth in the area.

But these site-specific information, as I mentioned to you, has had the finality as a part of the site permit. Therefore, it is not addressing specifically for the COL but it is mainly by reference in the ESP the COL application has been provided within the reference. Next slide, please.

Only supplemental information, what changes have been proposed has been documented in the COL as a supplemental information to the ESP. The supplemental information included a gasoline delivery truck impact and there is a hydrogen storage tank which was not evaluated previously has been evaluated. And an evaluation there are two 6,000 hydrogen storage tanks they have evaluated.

And also they have evaluated the transportation of 13,000 gallon tanker truck of hydrogen, those impacts for the COL.

This is the additional and supplemental information in addition to the whatever they have covered in the ESP or whatever they have been granted the approval for the -- as a part of early site permit application.

Staff has reviewed the analyses for these supplemental information and the evaluations and have also performed the independent calculations and confirmed the results are acceptable and within the confirm the results and conclusions of the applicant.

In addition to that, the control room habitability has been also addressed as a part of Chapter 6. Next slide please.

And the table used the chemicals analyzed and the distance to the control room and also the concentration in the control room. And it has been confirmed that none of the chemicals exceed the limiting concentration in the control room.

So, based upon the analyses and the RAI review, staff found the applicant's conclusion to

be acceptable and the evaluations are in accordance with the guidance found in NUREG-0800 Section 2.23 and also meets the regulatory requirements of 10 CFR Part 100.23. This is my presentation.

MR. SHEA: Bruce.

MR. MUSICO: Oh, okay. I was waiting for questions. Good morning.

MR. TAMMARA: Any questions?

MEMBER STETKAR: Anytime there is five seconds of silence, you want to run as quickly as possible.

MR. MUSICO: I'll remember that. Not when Dana Powers is here, though.

My name is Bruce Musico. I am a senior emergency preparedness specialist within the NRC's Office of Nuclear Security and Incident Response. That's NSIR, N-S-I-R, not NRO.

I did the review of the application, the COL application and I have been involved in this process reviewing the North Anna applications over a period of almost ten years, starting with the early site permit application or the ESP application, which I came in, I believe, in 2007 -- 2003. It's been that long. I was the reviewer of that.

That application came in with a major features emergency plan pursuant to our regulations and guidance at the time and we reviewed it against -- I reviewed it against Supplement 2 to NUREG-0654. That we issued the early site permit to North Anna and in '09 -- what -- the COL application the initial one that came in 2007. Thank you. That came in and I was also the reviewer of that, which incorporated by reference the early site permit that we issued supporting the site.

The safety evaluation with open items, which is dated June 17, 2009, that was a version of the SER that I presented before in '09, I believe with Gina at the time, and that included six open items, six emergency planning open items and an additional common open item having to do with the completion of the SER for the ESBWR design in support of the certification.

After our presentation, the ACRS issued a letter. It is October 23, 2009 in which they had three basic conclusions and recommendations, the second of which said the completion of the ESBWR design certification SER with no open items is a major activity that remains to be resolved for the

North Anna COL. It was subsequently resolved. That was the ESBWR DCD.

I was also the reviewer of the emergency planning information in the ESBWR DCD and that item was resolved, which closed out one of the open items that was in Section 13.3 of the FSER for the safety evaluation with open items. There were six additional emergency planning and related open items that were subsequently closed after the ACRS meeting and they were adequately resolved in the subsequent SERs that we worked on. That satisfied item 3 of the ACRS's letter October 23, 2009 under conclusions and recommendations number 3, which says we will review the resolution of North Anna COL open items when the final North Anna SER is issued by the staff. So, we are sort of at that point now.

So, I just wanted to close that out that there were a number of EP, emergency planning open items in the prior safety evaluation with open items that have been closed out and are reflected in this current advanced safety evaluation.

Let me see. One other just minor note is that the safety evaluation with open items was a first of a kind for us, as well as for the

applicant. They were, essentially, the guinea pig in the Parts 52 licensing process in which they submitted the COL application as well as the ESP application to basically test the system and we had lessons learned as a result of that.

One of the lessons learned that the staff had, that I had, was that the -- it is a slight one -- the format that was reflected in the June 17, 2009 safety evaluation with open items for Section 13.3 Emergency Planning was slightly revised and improved in the current advanced safety evaluation report. In addition, there were some important issues that came about, important subjects that came about between '09 and currently consisting of, first of all, the Fukushima accident. And in the safety evaluation report that we are talking about today, it does reflect the Fukushima Near-Term Task Force Recommendation 9.3 which deal with emergency planning. This was not reflected in the '09 version because Fukushima had not occurred at that time. But it was a substantial event and it is reflected completely in the EP section, specifically Near-Term Task Force 9.3 had two issues with respect to emergency planning. One was for the eventual licensee to

develop a staffing assessment to address multi-unit accidents at the site. And we have proposed -- they proposed and we have also proposed a license condition in the safety evaluation report that addresses that.

In addition to that, they are required to develop a communications assessment with respect to the loss of offsite power, backup power and such. And these are direct recommendations from the Near-Term Task Force 9.3 in response to the Fukushima event. And those are reflected in detail in the safety evaluation report. And you can read all about those as far as the basis for them and what we are proposing.

Now, the proposal that we have to address Near-Term Task Force 9.3, including the license conditions, are consistent with what we are doing for all of the other COL applications. You will see a slight variation in the proposed license conditions in the current advanced safety evaluation report and there will a slight variation with respect to the actual proposed license because we are trying to be consistent with all of the applications. But from a substantive standpoint, there is really no change.

The second event or the second issue that came up between 2009 and currently is there was an emergency planning EP rulemaking that took place in the year 2011. It is commonly referred to as EP enhancements and that was referred to in the prior Dominion presentation with respect to some of the ETE, evacuation time estimate requirements that are now reflected in Appendix E to 10 CFR Part 50. And those came about from the EP rulemaking in 2011, which went into effect in 2012, including the evacuation time estimate, additional evacuation time estimate requirements.

The basic change in the EP rule enhancements for the ETE was the requirement for licensees to periodically update the evacuation time estimate. Prior to the enhancements in 2011, there was no requirement for them to update the ETEs and so that was addressed in the enhancements. However, with respect to an applicant, there was really no change in that they were always required to submit in a COL application an evacuation times estimate and also to review that with the offsite state and local entities, which they have in support of this application.

Now, the evacuation time estimate. The

evacuation time estimate is a massive document. This particular one is 470 pages. We reviewed that in detail. In fact, we had reviewed the prior ETE in detail, which supported the early site permit application, as well as the initial application for a COL, which reflected the 2000 census data.

Now, I think Dominion has given a very good presentation and summary of the evacuation time estimate where I really don't have to get into the details. I would be happy to answer any questions about it. I was trying not to be overwhelming in my single slide here, representing the ETE requirements, but in short, there is merely one requirement in 10 CFR 50.47(d)(10), which says you have to develop an ETE and then in Appendix E, you have to develop an ETE provide it state and local authorities and then we review it. We actually approve it and then as Dominion described, their subsequent updating requirements that is ongoing after they get their license.

That is really all I have. If there are any questions about the ETE or the application and the SER in general, I would be glad to address them as best I can.

MEMBER MARCH-LEUBA: Yes, let me repeat

the question I had before. Is there a criteria for the estimated time or I mean if they come out with 72 hours to evacuate the area, will you predict it or how do they want it?

MR. MUSICO: I'm not sure I quite understand your question but I think I do.

For evacuation time estimates, there is, first of all, in our regulations, and I said this in the during the Turkey Point ACRS meeting recently, there is no required time within the licensees or the state and locals must be able to evacuate the people in the affected area. There is no set time.

The evacuation time estimate and it is just an estimate -- that is what it is -- is estimate given various parameters, given the snapshot in time of the offsite situation as far as the populations, the transients, the special facilities, and such. It is an estimate looking at the road network of time that it would take under certain conditions, including snowstorms and such to get the people out. It is a planning tool. Again, it is an estimated planning tool, which gives an idea of the estimated time under certain scenarios that the planners, not so much the

licensee but the offsite agencies, could utilize that information to get an idea of how long it would take to get people out under certain situations. It is a planning tool to support their decisions.

I'm not sure if I answered your question.

MEMBER MARCH-LEUBA: So, the only requirement is that it exist, that you can develop one, right?

MR. MUSICO: Well, it's a little more than that. In short, yes, but the requirements for the ETE there are guidance documents which give a lot of detail with respect to the content and the development of these elaborate and very detailed documents, these planning documents. There is Appendix 4 to NUREG-0654. There is NUREG -- and it is in the SER that I have written, I believe it is NUREG-6863 but the most recent one is NUREG/CR-7002, which is detailed guidance on development of evacuation time estimates and that is the most recent guidance document, our guidance document that tells applicants, as well as licensees, how to develop evacuation time estimates. And that has been utilized in this particular ETE supporting the

North Anna application.

MEMBER KIRCHNER: So, Bruce, how did the Fukushima event effect the ETE and all the work that went into that before and after? Can you summarize what changed as a result?

MR. MUSICO: No, those aren't related. The ETE is separate, which reflects the actual site. Fukushima, with respect to emergency planning, reflects the onsite staffing and onsite communication systems capabilities. They are separate issues.

MEMBER KIRCHNER: Does it require, let me call it concurrent event? We heard from the applicant. We saw the table of estimated evacuation time under the various weather conditions. Do you look at the impact of a seismic event on the local infrastructure --

MR. MUSICO: No.

MEMBER KIRCHNER: -- in the ETE?

MR. MUSICO: No. No, the consideration of the seismic issues, which is not within the scope of the EP review, might be a consideration, and I would let others speak to that, but I could see that if there was a seismic issue that arose as a result of an actual event. Then, that would be

considered by the offsite state and local authorities with respect to the feasibility of certain evacuation recommendations.

But as far as preplanning, the seismic issues are independent of evacuation time estimates.

Any other questions?

MR. SHEA: I assume we are on the five-second pause rule. Meteorology.

MR. QUINLAN: Good morning. My name is Kevin Quinlan. I am the lead reviewer for the Section 2.3, which is meteorology. I will just jump right in.

Most of the site characteristics and site descriptions for meteorology were incorporated by reference from the North Anna early site permit. I will try to just discuss the meteorological site characteristics that were not incorporated by reference. So, the differences between the ESP and the COL.

For Section 2.3.1, which is the regional climatology, the differences were related to design-basis drawing but both temperatures there were a handful of temperature values that were not included in the early site permit that were

included in the COL. The staff used 31 years of National Weather Service data, hourly data from the nearby Richmond airport and the staff confirmed that the site characteristic temperature data at the site were bounded by the site parameter values in ESBWR DCD.

The staff also reviewed the North Anna early site permit variance 2.3-1, which is related to the tornado site characteristic values. These values were different from the early site permit to a previous DCD that was being referenced.

They did follow all of the guidance in Reg Guide 1.76 Revision 1 and the staff approved the values that they have included in the COL. And they added in extreme winter precipitation site characterization values related to an interim staff guidance that the staff had issued a couple of years ago.

Section 2.3.2, which is local meteorology, the FSAR addressed the cooling tower induced effects on temperature and moisture and salt deposition on plant facilities. The staff reviewed the SAC-D model, which is a cooling tower model input and output files and the results and the staff agrees with the applicant's assessment

that the cooling towers will not adversely affect or impact the local temperatures, humidity, and salt deposition at the site.

Section 2.3.3, which is the onsite meteorological measurements program, the staff confirmed that the ESBWR plant structures are located an adequate distance from the onsite meteorological tower and won't impact the measurements at the site. Next slide, please.

Section 2.3.4, which is the short-term or accidental diffusion estimates, the applicant described or included the EAB and LPZ accident x/Q values that were incorporated from the early site permit SSAR. There was an updated description of the control room x/Q values. It says the second bullet there, the staff reviewed it and confirmed the control room x/Q values through the use of the three years of onsite meteorological hourly data and the ARCON96 model. And the staff also confirmed that the control room x/Q values were bounded by the ESBWR DCD values.

For Section 2.3.5, which is a long-term or routine release diffusion estimates, there was a departure here from the early site permit ESP variance 2.0-1, which recalculated the maximum

long-term x/Q and D/Q values deposition for the radwaste building ventilation stack and replaced the corresponding values presented in the ESP.

The update analysis incorporated both ground level and mixed mode releases from the site and the staff did an independent confirmatory analysis and confirmed that the ESBWR long-term x/Q and D/Q values conservatively bound the COL site-specific values.

In conclusion for 2.3, meteorology, all of the regulatory requirements have been satisfied and we have no remaining open items. I will be happy to take any questions.

MEMBER STETKAR: Kevin, yes, I don't know, since you said meteorology and wind blows, I have been trying to look through the presentation and I don't see where else to ask this. So, let me ask you. You heard me before. And if you are going to cover it someplace else, the hurricane missile issue --

MR. SHEA: We're going to.

MEMBER STETKAR: You are going to cover it, okay.

MR. SHEA: Right after these guys are done.

MEMBER STETKAR: Okay, never mind.

MR. SHEA: All right, this is Jim Shea again. This moves us on to the flooding.

MR. GIACINTO: Good morning. I'm Joe Giacinto, technical lead for the review of Section 2.4 of the North Anna Unit 3 hydrologic engineering topic.

Today we are going to just discuss the key areas of the staff's safety evaluation, including flooding from local intense precipitation, probable maximum flooding and Lake Anna maximum groundwater levels and radionuclide transport in groundwater.

Of course we are going to begin with local intense precipitation. The applicant evaluated flooding in the drainage channels that direct flow around the power block, selecting conservative modeling assumptions and parameters to maximize the flow depths. And as a result, the maximum flood water surface elevation from the local intense precipitation was determined as 288.4 feet in the ditch system, which is 1.6 feet below the designed plant grade and 0.6 feet below the DCD site parameter of the maximum flood.

The staff determined that no discharge

would occur from the proposed Unit 3 site to the Units 1 and 2 site.

The applicant also evaluated the maximum sheet flow flood depths between power block buildings. Roof drains were assumed to be clogged, that the roof's unclogged and directing discharge to the applicable areas. The resulting maximum sheet flow depths were estimated as 0.2 to 0.8 feet and exceeded doorway elevations at three locations and the flood protection measures for these three locations are as described by the applicant earlier and also in FSAR Section 2.4.10.

The staff confirmed that the applicant's local intense precipitation analysis followed the applicable guidance, used the current engineering practice with conservative assumptions that maximize water surface elevations adjacent to safety-related structure system and components and the applicant's analysis and proposed flood protection measures, as described in the FSAR, are acceptable. Next slide, please.

As to the probable maximum flood, the staff's technical review of the probable maximum floods from Lake Anna was limited to reviewing the supplemental information pertaining to ESP variance

2.4-4 and 2.4-5.

The staff reviewed the applicant's probable maximum flood estimates with the lake's normal pool elevation raised by three inches and confirmed that their model predicted a still water elevation of 263.2 feet, which is approximate 0.03 feet or less than half an inch higher than the ESP value and well below the DCD site parameter for the maximum flood level. Next slide, please.

Switching to groundwater, the staff evaluated the supplemental groundwater information provided by the applicant and determined that the applicant's analysis of groundwater conditions was based on site-specific information and was conservative. The staff accepted all ESP variances related to groundwater.

The staff performed confirmatory analysis. Our modeling of the groundwater levels reviewed the applicant's model inputs and outputs for post-construction conditions and reviewed the applicant's model to evaluate the parameter sensitivity.

The staff concluded that the maximum groundwater level in the power block would be controlled by the rate of intercepted groundwater

flow into the site surface water drainage ditches.

In response to the staff's request, the applicant provided a detailed description of drainage ditch design construction methods and materials to ensure that the ditches function to maintain acceptable groundwater level. Next slide, please.

Moving on to Section 2.4.13 accidental release. The applicant described design features to preclude the accidental release of radionuclides to satisfy ESP Permit Condition 3.E(3) for the liquid waste management system tanks. These features include compartments lined with steel to a height capable of containing the release of all liquid radwaste in the compartment and a building sump pump that provides for any capture of releases to be contained in other tanks.

The condensate storage tank is surrounded by a basin designed to prevent uncontrolled runoff in the event of a tank failure and sized to contain a total tank capacity.

Additionally, the sump for this basin has provisions for routing liquids to the liquid waste management system. Nonetheless, the applicant analyzed an accident release scenario

from the condensate storage tank. The staff confirmed that the shortest and most plausible groundwater pathway from the condensate storage tank was through the upper most saturated layer or saprolite to the Unit 3 intake channel. The staff concluded that the applicant's analysis was appropriately conservative and independently confirmed that the maximum radionuclide concentrations were below acceptable limits.

The staff concluded that radionuclide concentrations would be fully diluted in Lake Anna before reaching the exclusionary boundary. Next slide, please.

The applicant stated that the site layout and boundary proposed for North Anna Unit 3 remains within the ESP proposed facility boundary. Therefore, there are no variances for change in the location of the site.

The staff reviewed the applicant's site-specific analyses related to local intense precipitation and probable maximum flood, groundwater levels, and radionuclide transport, as discussed previously, and concluded that flooding remains below the ESBWR DCD site parameter for maximum flood.

Specific conditions near safety-related buildings would need protection from local intense precipitation-induced sheet flow. And for the probable maximum flood in the Lake Anna drainage area, raising the normal lake pool elevation by three inches would not result in any safety-related issues.

And finally, the maximum groundwater level would remain below the DCD site parameter and the maximum radionuclide concentrations from an accident release to groundwater are below acceptable limits. Next slide, please.

In summary, the staff found that the applicant demonstrated that the site is suitable and satisfied applicable regulatory requirements, addressed the COL-specific information items identified in the DCD, the applicable COL action items and the ESP permit condition.

The applicant performed necessary hydrological analyses and adequately determined the design-basis flood with an acceptable level of conservatism. And finally, the applicant specified appropriate flood protection for safety-related structures affected by local intense precipitation sheet flow flooding.

And that concludes my presentation.

CHAIRMAN RICCARDELLA: Thank you. Any of the subcommittee members have any questions? Okay, we will move on.

MR. SHEA: Okay, with no questions, we will continue with the panel with the other reviewers. So, we will do a quick switch out here. This is Jim Shea.

Okay, are we ready? All right, this is Jim Shea again. We are going to start with the second half of this panel with Bob Fitzpatrick on the surge protection.

MR. FITZPATRICK: I'm Bob Fitzpatrick in the electrical branch, NRR, not NRO.

The first departure I would like to talk to you about today is surge protection. In Section 8.1.5.2.4 of the COL, they took an exemption for a departure from the requirement -- well the guidance, Regulatory Guide 1.204, in that they don't meet all of the particulars in IEEE Standard C62.23 on surge protection for the switchyard.

And now since Regulatory Guide 1.204 is part of the ESBWR DCD, the applicant, by taking exception to certain aspects of this standard felt

they had to declare a departure.

So, for this, the staff issued RAI 8.02-61 to get full details and reviewed each exception and concurred with the applicant that either the subsection did not apply to the measures taken or provided equivalent protection. And the staff's detailed evaluation is provided in the SER.

Just to give you an idea of the departures they were taking, these were at the fourth or fifth indenture level within the standard and one of them was that if you are going to build a steel mill you should refer to this paper written by someone. Of course, that doesn't apply because this isn't a steel mill.

Another one was that if you have a controlled area or a controlled building out in the switchyard and there was a controlled area within that, you should have a static -- a non-static or static-free mats or a carpet or whatever. And their approach to that has been from way back, apparently, their standard design is to have a concrete floor to ground the instruments and controls to the panel or racks in a ground to racks to ground. So, that seems very equivalent type of protection for static electricity.

So, the conclusions from this is that departures from the Reg Guide 1.204 guidance were not significant, were either not applicable or the preference was to use their own established practices.

The issues is being discussed today because it was part of the ESBWR DCD and, therefore, had to be called a departure, not because of any significant technical issue.

MR. SHEA: Thank you.

MEMBER STETKAR: Bob, before you leave, I have three questions. I will get to them in order here.

On Figure 8.2-201 in the FSAR that shows the configuration of the power supplies from 203 and 500 and the licensee -- applicant -- sorry -- had up earlier, they have drawn a dotted line on that and everything on one side of the dotted line is what I will call in-plant and everything on the other side of the dotted line is will call offsite.

And in particular, that dotted line on the power supplies to the unit auxiliary transformers and the reserve auxiliary transformers slices through on the high side of the motor-operated disconnect on the switchyard side of the

circuit breakers for the unit auxiliary transformers.

There is no circuit breakers for the reserve auxiliary transformers. Right? The reserve auxiliary transformers have no circuit breakers on their high side.

MR. FITZPATRICK: I don't recall.

MEMBER STETKAR: If you look at Figure 8.1-1R in the FSAR, you will see that each unit auxiliary transformer has a circuit breaker on the high side but the reserve auxiliary transformers just have removal mechanical links and a motor-operated disconnect. And then it goes out and connects to the breaker in the half scheme out in the 230 kV switchyard.

Now, in the past during license renewals, we have had several discussions with applicants, licensees in that case, about the scope of equipment, in particular electrical equipment that is in-scope for license renewal and where is that boundary between onsite and offsite. And the staff, in the past, at least for license renewal, seem to have come to an agreement that it is the first circuit breaker that provides separation between onsite and offsite. So, for the unit

auxiliary transformers, I understand that that boundary could be the circuit breakers on the high side of the unit auxiliary transformers --

MR. FITZPATRICK: Yes.

MEMBER STETKAR: -- because they are circuit breakers and they are there. I don't see any circuit breakers for the reserve auxiliary transformers. The first circuit breakers are actually out in the 230 kV switchyard. So, my question is, is the staff okay with where that dotted line is drawn in terms of the demarcation between onsite and offsite power, in particular for the 203 kV supply to the reserve auxiliary transformers. Is that consistent with what we do?

MR. FITZPATRICK: I don't think the dotted line makes a difference in terms of the renewal. It is up to the first circuit breaker.

MEMBER STETKAR: Well but they are clearly saying that they are not responsible for the circuit breakers out in the switchyard. That's my point. They, the applicant here Unit 3.

MR. FITZPATRICK: I haven't gotten that message from my looking at it, that that is what they are saying.

MEMBER STETKAR: Okay. I will just

leave it as a question because my basic question is does the staff interpret -- I don't have circuit breaker numbers. There are two circuit breakers out in the 230 kV switchyard that separate the single line that comes into the reserve auxiliary transformers, they are 230 kV circuit breakers. Is North Anna Unit 3 responsible for the maintenance, testing, everything of those circuit breakers? My interpretation of where that dotted line is, they would claim no they are not because that is the offsite grid.

MR. FITZPATRICK: But it is also the first circuit breaker on the basis --

MEMBER STETKAR: That is the reason for my question.

MR. FITZPATRICK: I think we should look into that and get back to you on that.

MEMBER STETKAR: Okay, thanks.

The second question I had is the one that I raised with the applicant next to -- the staff, in your safety evaluation report, you make the observation that the addition of that intermediate switchyard that we talked about earlier with the circuit breaker there and the three single-phase transformers, introduces no new

failure modes for the electric power supply compared to the certified design -- that's a quote -- and that there is a minimal change from the standard information provided in the ESBWR.

What is your basis for those conclusions?

MR. FITZPATRICK: Well, there are no new failure modes.

MEMBER STETKAR: I'm sorry.

MR. FITZPATRICK: There may be some new failures but they are not new failure modes.

MEMBER STETKAR: The certified design doesn't have a transformer. So, if we are going to split hairs, I don't know about a transformer failure, whether you want to call that a failure or a failure mode, it is a new thing that can fail.

MR. FITZPATRICK: Right. Are we actually moving on now to the next item, which is the intermediate switchyard?

MEMBER STETKAR: Yes, that is -- oh, I'm sorry. You have a separate slide on it. All right, I will wait until you discuss that.

MR. FITZPATRICK: All right, so going off script here, I think I should go directly to your questions from earlier in the morning.

Our reviewer on this has actually been retired now for a number of years. So, I picked this up afterwards but having done a detailed review that supposedly he did and I am sure he did, knowing him.

But basically, I think there are two acceptance criteria we have to address when we come up with a departure in the power systems. One is does the new configuration meet GDC 17? And the answer to that one should be yes. And the second question is does the departure create a materially significant increase in risk to the health and safety of the public. And the answer to that one should be no.

So, on the first question, does it meet GDC 17, yes, it does. GDC 17 doesn't require a signal failure proof and this adds more signal failures if you were building a fault tree but it still leaves -- there is nothing in this line in the intermediate switchyard that affects the alternate preferred power.

MEMBER STETKAR: And for the record, I agree with that completely. I am not challenging GDC 17.

MR. FITZPATRICK: Right. And then the

other piece is because of the extra signal failure, does that cause a materially significant increase in risk. And we do not see that.

MEMBER STETKAR: And that goes to my question about what is the basis for that conclusion. Because the plant -- there is a design certification risk assessment that has not, does not contain, to the best of my knowledge from what I can find, this configuration. So, the applicant hasn't evaluated the actual risk implications of this configuration. And it is different because a certified design just has -- it presumes this single switchyard out there. So, it takes away the switchyard as a switchyard-related loss of power. It is just a number that is in there.

This configuration is different because there is a 230 kV switchyard, a 500 kV switchyard that talk to one another. One is the source of the normal preferred power. One is the source of the alternate preferred power. And in addition, they have added this intermediate switchyard equipment that can take away the normal preferred power with those failures that we talked about. And it is a fairly interesting configuration if I can call it that because it introduces new failures -- I won't

use failure modes but new failures and new combinations of conditions that could exist that could affect the PRA. For example, as I mentioned earlier, I don't know what their operating practices are but, in principle, they can fully operate the plant with the entire 230 kV switchyard out of service, the energizing doing maintenance out there.

If they lose, if one of the intermediate transformers fails, that would be at least in the sense of a PRA a non-recoverable loss of offsite power from that side because you can't replace that transformer within a day or so. It takes longer than that.

So, there are a bunch of new failure modes that come in here in terms of recoverable, not recoverable conditions and, as best as I can tell, they have not been evaluated in the PRA to determine whether there is a risk. There might be a risk decrease. There might be a risk increase. But it is certainly different from what is in the certified design PRA.

MR. FITZPATRICK: Right.

MEMBER STETKAR: So, in terms of making conclusions about how does it affect the risk from

the plant, is it small, is it big, it is not clear.

MR. FITZPATRICK: At this point, it has just been our engineering judgment that it really didn't make a big impact.

MEMBER STETKAR: Okay.

MS. BORSH: Dr. Riccardella, this is Gina Borsh from Dominion. We did get an answer about how we dealt with this configuration change in the PRA for the site-specific situation. So, if you would like, we can offer that now, if that would help the discussion.

CHAIRMAN RICCARDELLA: Yes.

MS. BORSH: Okay, so David Hinds from GEH was able to contact our PRA people and he will go through it with you.

MR. HINDS: Hi, David Hinds from GEH.

The DCD level PRA was done using NUREG data, industry data. We searched the industry data for the probability, probabilistic values for loss of preferred power and used the bounding data from all industry available data for loss of preferred power in the DCD. So, therefore, for site-specific, going to the same industry data set, the North Anna data would have already been captured there, at least what is available for North Anna,

which is primarily from North Anna 1 and 2. So, from a probabilistic standpoint, there was no change to this -- this configuration doesn't impact the evaluation since it was based upon industry data is the simple summary.

I understanding it is a different configuration, as you have stated here.

MEMBER STETKAR: Yes, and you are going to rue bringing up those numbers because I dug up the numbers. I don't have Rev. 6 of the PRA. I have Rev. 5 of the PRA. I can't talk about it because it is not a public document but it was provided for our earlier review of the DCD.

So, if I look at the numbers -- and I don't want to talk about the numbers too specifically either because they are in the PRA report. I know where you got the numbers for switchyard-centered grid-related, weather-related losses of offsite power. I have traced those back and you have cited them.

If I use data for transformer failure rates and circuit breaker failure rate from -- I will have to pull it up here. Bear with me -- from NUREG CR 6929 the 2010 update to that, which is the most recent one I have, and I build myself a little

model, I find that loss of 500 kV preferred power without the possibility of recovery happens about three times as frequently as you used in the PRA for a loss of preferred power. So, it is not clear how the numbers that you used in the PRA bound this particular configuration, at least for the 500 kV side.

But as I said, from a PRA perspective, this configuration is much different than what you modeled in the PRA. So, it is not clear to me. There are some pluses and some minuses but it is certainly different and it is not clear to me that the PRA evaluation, as you characterized it, bounds the risk from this configuration. All I can determine is the risk from this configuration is certainly different from what was in the PRA. It might be lower and it might be higher.

MR. HINDS: Yes, I understand your statements. And the approach that was taken was the DCD level of PRA, which is also the COLA level of analysis did not go to a component-by-component level analysis within the -- for the switchyard but rather used the approach of industry data set and using bounding values. And an additional point that was taken into account in determining the PRA

and determining whether this is impactful is the risk relevance of the loss of preferred power is very low from the standpoint of impact and core damage frequencies.

MEMBER STETKAR: And I looked up those numbers also. They are not in the DCD. So, I don't want to quote them. They are in the PRA report. I know what those numbers are. And the term not impactful I will just say, for the record, can be interpreted a variety of ways. I know the percentages from Revision 5 of the PRA for each of those different contributors. And let me just say they are more than one percent. I don't want to get any bigger than that because we don't want to talk about numbers. In fairness to you, I really don't want to talk about the numbers.

MR. HINDS: I understand.

MEMBER STETKAR: I'm trying to make the point that since this is a change from the DCD for the COL, it is just curious to me why conclusions are made and statements are made that the DCD, carte blanche, provides a bounding estimate of the risk without having actually evaluated this configuration in the PRA. It is not rocket science to evaluate this in the PRA. I mean you know we

could have probably put it in the PRA model and cranked it in the time that we have spent discussing it this morning.

MR. HINDS: I understand. And the process treatment here was that this level of DCD and COLA is taking the industry data and in the final PRA, at construction time, would go into more detailed component-by-component evaluation. I understand your technical statements of the difference in configuration.

MEMBER STETKAR: Yes, got it. Thank you.

MR. HINDS: Okay.

MEMBER STETKAR: That last statement actually helps.

MR. HINDS: Okay, thank you.

MEMBER STETKAR: So, anyway, I'm done. Hold on. I had one -- I'm not sure if I am done because I don't remember what the last thing is. I'm probably done.

Yes, I'm done.

MR. SHEA: This is Jim Shea. Moving on to Chapter 11, 12 Departures. Steve.

MR. WILLIAMS: My name is Steve Williams. I work in rad protection group in NRO.

I have reviewed Chapters 11 and 12. And I am here to talk about Exemption 4 requested by the applicant.

This exemption involves the radwaste discharge pipe. The overall change involves Tier 1 and Tier 2 changes. The Tier 1 change is in the design description section 2.10.1. The change revises the sentence that says the LWMS either returns processed water to the condensate system or discharges to the environment via the circulating water system. It changes that system to the LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline that is in the exemption.

The main Tier 2 change involves Section 11.2.3.2 concerning the liquid radwaste effluent discharge piping flow path. This section will describe the liquid effluent discharges from the LWMS to the environment. It will use only the liquid radwaste effluent discharge pipeline and not discharge the processed liquid effluent into the cooling tower blowdown line and then on to the environment. Next slide.

The staff has reviewed Departure 12.3-1

submittal in accordance with the design certification rules and regulations and agrees with the applicant's determination concerning the departure to describe the liquid radwaste effluent discharge and that this Tier 2 departure does not change the functional line as described in the ESBWR DCD.

The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the radwaste building directly to the environment only as necessary. Next slide.

In conclusion, the staff conclusion for the COL changes are that the staff finds that the requirements of 10 CFR 52.7 and 50.12 are met, including the existence of special circumstances and that issuance of the requested exemption is warranted. This is based on the information provided in Tier 1, Tier 2, and Section 11 and 12 -- actually Chapter 11 and 12, which describes the release point dilution factor of 1,000 minimum is maintained during a liquid release with dilution flow provided by either Units 1 or 2 circulating water system.

MR. SHEA: All right, this is Jim Shea

again. Moving on to the Chapter 19 departure on hurricane missiles.

MR. NOLAN: My name is Ryan Nolan. I am in the Plant Systems Branch. I will be discussing Departure 19A-1, as I am the missile reviewer for extreme winds and I know Member Stetkar is anxious to discuss treatment of RTNSS structures and we can discuss at that the end.

The applicant already provided a brief background of the development of Reg Guide 1.221. It was finalized in 2011 time frame. In the 2007 to 2011 time frame, the way missiles were calculated, the methodology shifted from what was originally done and so kind of ESBWR North Anna is stuck in that. So, it can get kind of confusing as we work through this.

But the new Reg Guide, Reg Guide 1.221 showed that hurricane missiles could be more severe than the design-basis tornado missiles. And a we didn't have time to go back and reevaluate ESBWR, in the design certificate rule there is language that excludes this from finality, which is what allowed me to ask questions on this topic. I asked a couple RAIs requesting the applicant to address site-specific hurricane missiles.

And as was discussed earlier today, all the seismic Category 1 structures were bound by the DCD tornado missiles. However, there were some non-seismic Category 1 structures housing RTNSS equipment and some site-specific hurricane missiles were not bound by the design certification hurricane missile.

Therefore, Exemption 5 and Departure 19A-1 modify the DCD to specify that the RTNSS structures are going to be designed to whatever is most limiting, whether it is the DCD or the site-specific values calculated from the Reg Guide. Go to the next slide.

This is a similar table that was presented earlier. What it is trying to show is that there is DCD philosophies for hurricane missiles. Then, there is the site-specific velocities using the Reg Guide 1.221 and in some cases, the Reg Guide is a higher value. In some cases, it is the DCD. And so, ultimately, we found that Exemption 5 and Departure 19A to be acceptable because they did consider the hurricane missiles and that these structures will be designed to what is most limiting.

Five second rule. Any questions before

we move on to the more generic discussion on treatment of RTNSS?

Did you want to repeat your question?

MEMBER STETKAR: I will. And let me just ask you why are non-seismic Category 1, and I will use RTNSS structures right now because they are different than the shed out in the yard, why are those structures, in particular, subject to only an evaluation of hurricane missiles but not tornado missiles? In particular, what element of our regulatory guidance permits that to happen? Because as I said, in the interim, I went back and I confirmed in Reg Guide 1.221 and the supporting NUREG/CR-7005 that was the basis for that Reg Guide, the hurricane wind contours, for example, do not extend into the Midwestern states. And I used Kansas as an example.

So my question is, not to you, if I were to build this precise plant in the State of Kansas, do I need to evaluate missile impacts on the RTNSS structures? And that is a yes or no answer. I am trying to get a yes or no answer.

MR. NOLAN: The answer is yes.

MEMBER STETKAR: You do? Okay.

MR. NOLAN: Yes, and I can step

through. There is kind of a long history that takes us back through RTNSS policy papers. But just to preface this, there are some new ACRS members, you brought up this during the Fermi ACRS. I'm not sure if you remember. I certainly remember.

MEMBER STETKAR: I remember. I don't remember people but I remember discussing this before.

MR. NOLAN: So, this was discussed.

MEMBER STETKAR: But I don't think we have had as an explicit example.

MR. NOLAN: Yes, so what was -- just to provide the background, this was also included in the ACRS's letter to the Commission. So, there were 300 questions on this topic. There were multiple hearing questions and post-hearing questions. So, the Commission was interested in this as well. So, there is history with Fermi.

But to answer your question, the RTNSS policy was originally discussed in SECY-94-084. And there was confusion on whether GDC 2 applies or does not apply to RTNSS and specifically to RTNSS-B, since that is providing long-term cooling post NQRs. And later there was a clarification memo

from the EDO, Joe Callan, to Chairman Jackson, I believe at the time. This was 1997. And they clarified that no, it doesn't have to meet GDC 2 but there are certain events, and they used the Turkey Point Hurricane Andrew scenario that says there are natural phenomena events that affect the broad community, which would limit offsite resources getting to the site.

And so the philosophy was to design to those that would affect bringing in offsite equipment from a large scale natural phenomena event. And at the time, the staff felt that the tornado being somewhat localized, it was likely you could get in offsite resources.

Now, that is what was done in the past.

MEMBER STETKAR: I live in Arkansas. I have seen tornadoes. They are not point sources.

MR. NOLAN: I understand. And so moving forward, now that we have an updated Reg Guide for tornadoes, we have a new Reg Guide for hurricanes, we developed an SRP for RTNSS. It is SRP 19.3. And when doing that, going through the development of that, we decided to actually kind of change and shift from the Callan memo. We said we have much more informed guidance now and we believe

that RTNSS-B structures need to look at both tornadoes and hurricanes and use the appropriate guidance because the Callan memo wasn't specific and it just said designed to a Cat 5 hurricane. It doesn't matter where your site is. And the reason being is RTNSS is reviewed as part of the DCD. It is not reviewed as part of the COL.

And so this is all under the finality envelope of the design certification rule, which is why it is referred to -- it is much more generic. It is not looked really in a site-specific design. The reason here why we are looking at is because there is a specific exclusion from finality for hurricane missiles because of the new Reg Guide.

I'm not sure if that all makes sense.

MEMBER STETKAR: I couldn't write fast enough. I will look at the transcript. But at least you have pointed me to two places.

MR. NOLAN: So, to answer your original question, what happens if there is a new COL building somewhere where they are not affected by a hurricane but by a tornado --

MEMBER STETKAR: Yes, let's take that example because in principle here, they already had a hurricane missile, the automobile hurricane

missile for their RTNSS structure. It just happened to be lower than the site-specific speed. So, they reevaluated that based on the site-specific hurricane wind speed.

MR. NOLAN: Really what they did is using the latest methodology.

MEMBER STETKAR: Right because they derived the previous speed from the --

MR. NOLAN: They actually took a Cat 5 hurricane and they used the SRP, the older SRP Rev. 2 that just says take 35 percent.

MEMBER STETKAR: Right. So, suppose I have done that for -- I want to build an ESBWR, this precise plant, in the middle of Kansas. So, I have done that and I have that now we will call it a hurricane automobile missile speed from the old SRP. I have got that because I apparently had to do that.

Now, how do I know or how do you know that I need to evaluate tornado missiles which might, in Kansas, be more energetic than that hurricane missile?

MR. NOLAN: So, I think when it comes to referencing the ESBWR, since it is part of the rule and there is finality when it comes to this

policy -- and again, it is policy. RTNSS is not a requirement. The guidance is just guidance. There is no requirements for this. However --

MEMBER STETKAR: Remember, the issue isn't final.

MR. NOLAN: No but I --

MEMBER STETKAR: It is in the law. It's not final. That's how you could ask this question.

MR. NOLAN: Well, no, because there is finality with respect to the tornado. The fact that they don't have to assess tornado missiles --

MEMBER STETKAR: The fact that they didn't have to look at tornadoes.

MR. NOLAN: It is because it is in the rule, yes.

MEMBER STETKAR: It's on the record.

MR. NOLAN: Now, to put it into perspective here, for North Anna when I looked at the difference between their tornado -- site-specific tornado missile and the hurricane missile, it is off by two miles an hour. It is not a big difference.

But to bring it back to --

MEMBER STETKAR: If I was going to do

an analysis -- forget the law. Forget agreements. Forget letters, all of that kind of stuff.

MR. NOLAN: Yes.

MEMBER STETKAR: If I was going to do today analysis looking at Reg Guide 1.76 Rev. 1 and looking at Reg Guide 1.221 for tornadoes and hurricanes, respectively --

MR. NOLAN: They would apply those Reg Guides to their site.

MEMBER STETKAR: -- and at Kansas, I wouldn't have any risk from hurricanes. The risk from hurricanes would be zero.

MR. NOLAN: Right.

MEMBER STETKAR: It would only be tornadoes. And the tornado missiles, since it is Region I, it would be Region I tornadoes.

MR. NOLAN: That's correct, 230 mile an hour tornado.

MEMBER STETKAR: If I was going to do it today for a new --

MR. NOLAN: That is correct. And because of this sort of -- we have identified this as somewhat of a strange disconnect. And that is why when we developed the SRP we said we have the latest items. Let's just reference those.

CHAIRMAN RICCARDELLA: I think I should move on because this is more generic and not relevant to North Anna, right?

MEMBER STETKAR: That's correct.

CHAIRMAN RICCARDELLA: So, what's next on the list?

MR. SHEA: Okay, the next one is the fiberglass-reinforced piping. Jim Shea will handle that one. Hi, I'm Jim Shea, fiberglass-reinforced piping.

Dominion talked about this pretty extensively. There is a couple of things I will touch on that were brought up during that presentation. But just to highlight, it is a non-safety related system that is being used with this type of material.

The applicant selected the material for corrosion control and this system is part of the -- there were a number of RAIs mentioned back in Chapter 9 that started with the very first question. It goes back to the specific temperature limits on this piping. So, that was like the first RAI back in '01. I was trying to pull it up on my phone but I couldn't get all the exact results. But someone brought it up that minus 40 degrees or

something up to 150 degrees for this piping.

The other thing that was brought up was all the piping underground as far as our SER states, all the piping underground is the fiberglass pipe. Anything above ground is going to be carbon steel.

And those were the two thing I heard, I think. Anything else?

CHAIRMAN RICCARDELLA: I'm not familiar with the fiberglass pipe. I am familiar with HDPE, the high density polyethylene. Is there a relationship between the two? What is the reason for choosing fiberglass rather than high density?

MR. SHEA: Yes, someone in the staff can answer that.

MR. WHEELER: My name is Larry Wheeler. I am in NRR right now and I was one of the NRO reviewers. Starting back in 2009, I was probably the author of most of the RAIs that we are talking about.

This was Dominion's choice to pick fiberglass. It is not up to the staff to say fiberglass is not a good material. Certainly, there are other materials out there.

So, what we did as we looked at their

proposal of fiberglass, we wrote a number of RAIs based on industry events, based on experiences in the industry. And we found that the fiberglass was a suitable material.

CHAIRMAN RICCARDELLA: Okay, I didn't have a specific concern. I just was trying to educate myself.

MR. WHEELER: Just so you know, I think there is a question from this morning that Dominion was fielding that was related to experience with fiberglass. I was at Perry during construction. Perry actually has fiberglass pipe non-safety in their service water system and also in their circ water system. So, that system has been in service since 1985.

Dominion also has experience with safety-related fiberglass. Dominion has Surry and that is in the safety-related service water to the charging pumps. It has been very successful there. That was installed in the early 1970s.

Also fiberglass is allowed by the staff and spray ponds, return to the spray ponds. And there is a code case out in 155-2 that allows that material to be used in a safety-related application.

Any other questions?

CHAIRMAN RICCARDELLA: No. Thank you.

MR. SHEA: That ends the Panel 1. Well, there is one last but that pretty much ends our staff Panel 1 and we have a break at 10:00, which --

CHAIRMAN RICCARDELLA: But we did cover some stuff from this afternoon.

MR. SHEA: Right.

CHAIRMAN RICCARDELLA: So, I'm not sure exactly where we are relative to schedule but the schedule shows us ending at 4:00. We can certainly go later than 4:00 if we need to.

MR. SHEA: Okay, with that, I will turn it back over to the committee for deciding the break.

CHAIRMAN RICCARDELLA: Let's take a break for lunch until 1:00.

(Whereupon, the above-entitled matter went off the record at 12:07 p.m. and resumed at 1:04 p.m.)

CHAIRMAN RICCARDELLA: I think we have a quorum. Let's -- the meeting is now in session. And Dominion is going to talk to us I guess about vibratory ground motions, is that -- is that --

MS. BORSH: That is correct.

CHAIRMAN RICCARDELLA: Okay.

MS. BORSH: So we're just pulling up the slides. That's it, great.

CHAIRMAN RICCARDELLA: Was that it?

MS. BORSH: That's it. Okay. So while we're pulling up the slides, my name is Gina Borsh, Licensing Lead, again, and I am here with Jim Marrone and Alidad Hashemi from Bechtel, and Jim is going to -- thank you -- is going to begin the discussion, and we're going to talk about vibratory ground motions, Section 2.5.2, and then we'll move into Chapter 3.

CHAIRMAN RICCARDELLA: Okay.

MR. MARRONE: All right. Good morning.

PARTICIPANT: Afternoon.

MR. MARRONE: Yes. Good afternoon. My name is Jim Marrone, and I'm a Seismologist at Bechtel Corporation, and I and my colleague, Alidad Hashemi, will be discussing vibratory ground motions as discussed in FSAR 2.5.2. Next slide, please.

The areas to be addressed include an overview of the elements for performing site-

specific seismic hazard, a summary of events, and guidance changes affecting Section FSAR 2.5.2 since the last ACRS meeting in 2009. We'll also look at a summary of COLA changes from Rev. 2, FSAR Rev. 2 in 2009, to the current Rev. 9 to address these events and guidance changes.

And we'll also detail discussions regarding updated seismic sources, a new PSHA and its results, new site-specific response spectra using new Central and Eastern U.S. Seismic Source Characterization, new GMRS and FIRS, and a discussion of CSDRS exceedance that resulted in associated conclusions. Next slide, please.

This slide is a cartoon illustration of an overview of methodology for site-specific seismic hazard from the earthquake source, with vibratory ground motions transmitted through the earth to the vibratory ground motions at the site and specification of seismic design ground motions. Next slide, please.

This slide indicates a summary listing of the events and guidance changes that occurred since the ACRS meeting in 2009. The 2011 Mineral earthquake was a notable seismic event, and we will

summarize the investigations performed to consider this event and its contribution to seismic design. Ultimately, we will show that this earthquake had marginal impact due in large part to the significant new Central and Eastern U.S. Seismic Source Characterization that was published unrelated to the earthquake soon after in 2012 by EPRI and others, also known as NUREG-2115.

Additionally, a new updated CEUS Ground Motion Model, also key to a PSHA, was published by EPRI in 2013. Finally, clarifying guidance on the development of design vibratory ground motions was presented in the publication ISG-17. Next slide, please.

Given the events and guidance changes since 2009 noted in the previous slide, several analyses needed to be redone. We updated seismic sources using the CEUS SSC and updated seismicity, including the 2011 Mineral earthquake; revised a PSHA using that new information; we developed new site-specific response spectra using the revised PSHA; developed new GMRS and FIRS, redefined using new site-specific response spectra and the new ISG-17 guidance; and finally, because of the CSDRS,

exceedance structures and multiple components were reevaluated. Each of these elements will be discussed very briefly and quickly by me or my colleagues in more detail coming up. Next slide, please.

This slide summarizes the events and guidance changes and their time or process order. Consequences considered by the applicant are noted in the righthand column in the progression or revision of the FSAR from Rev. 2 in 2009 to the current Rev. 9. Next slide, please.

As noted two slides earlier, there were several analyses that needed to be redone since 2009, and these analyses follow directly along the presentation of FSAR Section 2.5.2, Vibratory Ground Motion. This slide indicates the subsections of the FSAR section. I will leave those for you to read. Next slide, please.

You have seen this schematic before earlier of the elements of site-specific seismic design. The following is a very brief sequence of cartoons that indicate some of the key elements that changed from 2009 to present. Next slide, please.

The 1980s EPRI-SOG seismic source model was replaced with the 2012 EPRI and others' seismic source characterization. Next slide, please.

The EPRI 2004 ground motion model was replaced by the EPRI 2013 ground motion model. Next slide, please.

A new PSHA using new seismic source and ground motion models required updating the site response analyses -- next slide, please -- which then redefined the GMRS and FIRS. Next slide, please.

This is a bulletized list of the cartoon sequence we just saw of data and processes needing to be considered for the developing of seismic design ground motions. It should be noted, however, that the 2011 Mineral earthquake occurred after the data and model development presented in the 2012 EPRI et al. CEUS SSC report. As Reg Guide 1208 calls for the evaluation of new data in the execution of a PSHA, it was prudent to consider an update of both the earthquake catalogue and seismic source models of the CEUS SSC, indicated in the first three bullets here.

The remaining bullets follow on as in

previously shown in the process sequence. Next slide, please.

The earthquake catalogue published in 2012, EPRI et al. report included earthquakes through 2008, clearly excluding the 2011 Mineral earthquake. Using the same databases and procedures as had been used in the 2012 EPRI et al. report, the earthquake catalogue was updated through mid-December, 2011. The final catalogue presents earthquakes of uniform moment magnitude 2.2 and greater. Next slide, please.

This slide shows the seismicity in the 200-mile site region. The magnitude-scaled gray circles are from the published 2012 EPRI et al. report, catalogue, and the colored circles are the updated events from the 2009 to mid-December 2011 update. Earthquakes shown here are for uniform moment magnitude 2.9 and larger.

There are a couple takeaways from this -- from this plot. The distribution of updated events are consistent with the original published catalogue, and second, the occurrence of the 2011 Mineral earthquake, the small orange-filled circle, is in -- just about in the middle of the plot

there, is not inconsistent with the cluster of seismicity typical of the Central Virginia Seismic Zone visible immediately south of the Mineral earthquake epicenter. Next slide, please.

The next few slides review information on the magnitude 5.8 2011 Mineral earthquake. It is the largest instrumentally recorded event in Eastern North America since the 1988 Saguenay earthquake in Canada. It occurred near or within the Central Virginia Seismic Zone. The epicenter was located about 18 kilometers southwest of North Anna. The main event and aftershocks indicated a reverse motion rupture plane striking northeast, southwest, and dipping to the southeast, consistent with the general geologic structure in the region. Next slide, please.

This slide shows various views of the aftershock hypocenters, which highlight the rupture plane -- that is the dashed red box with its projection vertically to the surface -- suggesting where its up-dip projection would reach the ground surface, and that is the dashed red line to the northwest of the rupture plane.

Specifically, the field reconnaissance

team, with guidance by geological maps and LiDAR data -- that is the coverage area shown by the tan area in the upper right -- looked for field evidence of surface deformation or faulting that could include the following -- some of the following or all of the following, this is what was looked for: ground fissures or compressional ground buckling; minor fault scarps; fault control drainages; cracked or offset pavement along the roads; springs or adhesion conditions; and changes in vegetation growth. Next slide, please.

This slide presents the conclusions from the investigations of surface deformation regarding the 2011 Mineral earthquake. As indicated here, based on Dominion's field reconnaissance of the epicentral region as well as from work performed by other researchers immediately following the earthquake, it was concluded that the magnitude 5.8 Mineral earthquake did not produce any discernible rupture or deformation at the ground surface.

Also, Mineral earthquake does not appear to have occurred on a previously mapped fault. The conclusion is no evidence of surface

rupture, surface fault features, or geomorphic expression of surface rupture or co-seismic surface tectonic deformation exists for the magnitude 5.8 Mineral earthquake. Next slide, please.

Regarding the seismic source --

MS. BORSH: Excuse me.

MR. MARRONE: Yes?

MS. BORSH: I have to switch presentations, so if you could just hold one second.

MR. MARRONE: Yes.

CHAIRMAN RICCARDELLA: 2A to 2B?

MS. BORSH: Yes, so we are going to 2B now.

(Pause.)

MS. BORSH: Okay.

MR. MARRONE: Okay. Regarding the seismic source characterization model for input to a new PSHA, we started with the as-published EPRI et al. 2012 CEUS SSC report. There are two types of -- of smooth-gridded background sources that are in this model I will refer to as the Mmax zone and seismotectonic zone sources.

There's also discrete repeated large-

magnitude earthquake sources, referred to as RLME sources, and we considered three of those in our PSHA: the Charleston, New Madrid, and Wabash Valley. And we used sources within at least 1,000 kilometers.

Reg Guide 1208 requires consideration of new data and updating models, as I indicated earlier, and the new data of course included the 2011 Mineral earthquake occurrence that suggested updating the earthquake catalogue. It resulted in a very slight -- considering that earthquake, this resulted in a very slight increase in the maximum magnitude distribution for the host zone.

Updated earthquake catalogue was used to update activity rates and b values, that is, magnitude frequency recurrence information, for the local and distance source zones. Two questions, or the same question, two elements: does Mineral earthquake or recent research on Eastern Tennessee Seismic Zone suggest new seismic sources?

With regard to Eastern Tennessee, as discussed in the FSAR, Eastern Tennessee Seismic Zone is located about 500 kilometers from the site, and as presented in the FSAR, there was no

requirement for a new distinct seismic source. Turning to the Mineral earthquake, however, a SSHAC Level 2 investigation was performed to address the question, does the occurrence of the Mineral earthquake warrant a distinct seismic source?

As discussed earlier, several investigations were performed, including field reconnaissance; geomorphic analysis of LiDAR data; solicitation of expert opinions; review of recent published literature. The conclusions are that Mineral earthquake did not exhibit evidence of surface rupture, no evidence associated with the sub-surface structure for this event that would suggest a repeated large magnitude -- that is, magnitude greater than or equal to 6.5 -- earthquake warranting a new RLME source.

There is no available information on recurrence or slip rate information or either maximum magnitude possibilities for a Mineral earthquake source. Experts that were consulted during the SSHAC Level 2 process recommended against consideration of the Mineral earthquake rupture as a new or distinct CEUS seismic source.

So the answer is no, Mineral earthquake

does not warrant a distinct --

CHAIRMAN RICCARDELLA: So then --

MR. MARRONE: -- seismic source.

CHAIRMAN RICCARDELLA: So then how was it considered, as a -- as an --

MR. MARRONE: That is on --

CHAIRMAN RICCARDELLA: -- Mmax --

MR. MARRONE: -- the next slide.

CHAIRMAN RICCARDELLA: Okay. Thank you.

MR. MARRONE: Sure.

Nevertheless, some seismic source updates were made, and I've got the two bullets on this slide that indicate that there was, as I had noted earlier, there was a slight increase in the magnitude distribution of the post-seismic source. That is ECC-AM. You can see that the original as published ranged from 6.0 to 8.1, and re-analysis of the data with the Mineral earthquake led to a range of 6.1 to 8.1, changing only that lowest element.

The second element that was impacted by not necessarily the Mineral earthquake itself but the whole updated earthquake catalogue, the updated

catalogue was used to update the activity rates and the b values for the seismic sources.

CHAIRMAN RICCARDELLA: In --

MR. MARRONE: So --

CHAIRMAN RICCARDELLA: -- short, what is a b value?

MR. MARRONE: The b value is the -- if you have a plot of the annual frequency of events, the annual rate of events as a function of magnitude, the b value is the slope of -- of that line, so larger magnitude, less occurrence rate, so -- and then the --

CHAIRMAN RICCARDELLA: So it changes the slope?

MR. MARRONE: It changes the slope a little bit, that is right. And in this case, there were some increases in the b value, there were some decreases in the b value, because the background seismicity, the activity rates and b values are gridded, characterized by a grid of values, so some of them increase, some of them decrease.

So the Mineral earthquake is adequately considered in the CEUS model with these very moderate changes, or small changes. Next slide,

please.

The new PSHA was performed using the updated CEUS SSC and ground motion models. The reference conditions are hard rock with a shear wave velocity of 9200 foot per second; the output of that PSHA, or 5 percent response spectral acceleration hazard curves at 7 spectral frequencies.

We also looked at the aggregation analysis that was performed to capture the controlling earthquakes by magnitude or distance to implement, as will be shown, the NUREG/CR-6728 approach to a site response analysis, where separate high-frequency and low-frequency hard rock response spectra corresponding to hazard levels of 10 to the minus 4and 10 to the minus 5 are used as input to the sole column.

CHAIRMAN RICCARDELLA: Going back to your earlier cartoon, the --

MR. MARRONE: Sure.

CHAIRMAN RICCARDELLA: -- the hard rock is the tip of that arrow, right, on that -- you had the one you showed several times?

MS. BORSH: Oh, the cartoon?

CHAIRMAN RICCARDELLA: Yes.

MR. MARRONE: Yes, that is right, the hard rock is before the little squiggly before the site, right underneath the site.

CHAIRMAN RICCARDELLA: Right at the arrow, and then you do the -- then you do the --

MR. MARRONE: Right, the little wavy line is the site response analysis.

CHAIRMAN RICCARDELLA: Got it.

MR. MARRONE: Yes --

CHAIRMAN RICCARDELLA: Thank you.

MR. MARRONE: -- that is correct, yes.

High frequency is defined as 5 to the --

CHAIRMAN RICCARDELLA: But the --

MR. MARRONE: Oh, I am sorry.

CHAIRMAN RICCARDELLA: -- GMRS is at the tip of the -- at the end of the wiggly line?

MR. MARRONE: Yes, that would -- that would be correct, the GMRS or the FIRS or however -- whatever horizon --

CHAIRMAN RICCARDELLA: I understand.

MR. MARRONE: -- is required. There will be different levels of horizon for the

different structures. GMRS is a free field --

MR. HASHEMI: We'll go over that --

MR. MARRONE: We'll go over that.

MR. HASHEMI: -- section.

MR. MARRONE: You'll see -- you'll see where it is located in the different places, but yes.

The results are hazard curves, as I mentioned, high frequency, 5-10 hertz, low frequency, 1-2.5 hertz, and you'll see in a moment that the high frequency and low frequency hazard at both hazard levels of 10 to the minus 4and 10 to the minus 5 was dominated by the local seismic sources, and that only at the low frequency hazard, at 10 to the minus 4, you finally see a low hazard contribution from New Madrid and Charleston. Next slide, please.

And you could look at these. These are examples of three seismic hazard curves: PGA, 10 hertz, and 1 hertz, as indicated. The multiple curves there are mean and then various fractiles. In the lower right, you see uniform hazard spectra at the seven different spectral frequencies at the three hazard levels, 10 to the minus 4, 10 to the

minus 5, and 10 to the minus 6. The 10 to the minus 4and 10 to the minus 5 hazard level, ground motions are what are used for input to site response analysis. Next slide, please.

This shows the -- the controlling earthquakes as a result of the deaggregation analysis. Notice in the lower lefthand side, you see what the axes are. The axes are -- are distance, increasing distance r, and increasing magnitude, and you see that in all characterizations wherein the top they are low frequency, bottom are high frequency, and the left column is 10 to the minus 4and the right column is 10 to the minus 5, in all four of those bins, if you will, you can see the dominance of the smaller magnitude, closer distance contributions, relative contributions to hazard.

CHAIRMAN RICCARDELLA: Yes, the height of the bars is the percentage contribution?

MR. MARRONE: Yes, that is right, that is right. If you added up all of those, it would add up to 1. That is right.

And only in the -- the low frequency, 10 to the minus 4, do you finally see some of the

distant spikes there from the contribution from Charleston and New Madrid. Next slide, please.

Finally, those magnitudes and distances for the different high frequency and low frequency for 10 to the minus 4 and 10 to the minus 5 were used to -- as input values to form a spectral shape that would connect the seven spectral frequencies that we had specifically from the PSHA, and here you see the high-frequency and low-frequency response spectra for the three hazard levels of 10 to the minus 4, 10 to the minus 5, and 10 to the minus 6. Those are -- again, specifically, the 10 to the minus 4and 10 to the minus 5 are used for input to the site response analysis to get the GMRS and the FIRS.

So if there are no questions, I will pass the presentation over to Alidad Hashemi to pick up the process from here.

MR. HASHEMI: All right, thank you, Jim. My name is Alidad Hashemi. I am with Bechtel. I'm a Structural Engineer and Earthquake Engineer, and I am here representing Dominion.

In Section 2.5.2.5, we discuss the seismic wave transmission characteristics of the

site from hard rock to the building foundations and to ground surface and other elevations of interest. Our inputs for these analyses are the hard rock motion that Jim just discussed -- the hard rock motion is defined at shear wave velocities of 9200 foot per second and larger -- and for our site, it is located between 155 and 165 foot depth compared to the finished grade at the elevation, 290.

CHAIRMAN RICCARDELLA: That was established through drilling, through sampling?

MR. HASHEMI: It was established through drill technical investigation at the site, right. Our other input is -- is the drill technical investigation results and dynamic sub-grade properties that are discussed and documented in FSAR 2.4.

CHAIRMAN MEMBER STETKAR:KAR: Ali, I -- I --

MR. HASHEMI: Yes sir.

MEMBER STETKAR: -- I hate to interrupt you. Can I go back to Jim? I hate to do this, but to your -- in your deaggregation slide?

MR. MARRONE: Sure, yes.

MEMBER STETKAR: Why are you not seeing

any contribution from Charleston and New Madrid at an exceedance frequency of 10 to the minus 5 at the low -- at the low -- at the low hertz, in other words, the upper righthand corner? I see them coming in --

MR. MARRONE: Oh, at the --

MEMBER STETKAR: -- at a 10 to the minus 4exceedance frequency. I am curious why I do not see it at --

MR. MARRONE: At 10 to the minus 5?

MEMBER STETKAR: -- at 10 to the minus 5, because they are big -- they are big earthquakes, and I would --

MR. MARRONE: Right.

MEMBER STETKAR: Why?

MR. MARRONE: It's a -- it's a counterintuitive type of thing. You would think --

MEMBER STETKAR: That is --

MR. MARRONE: -- the --

MEMBER STETKAR: -- that is right.

MR. MARRONE: Right. At the larger ground motions, you'd think, well, the larger earthquake is going to start contributing more, right, because

10 to the minus 5 --

MEMBER STETKAR: Yes.

MR. MARRONE: -- is a lower hazard level --

MEMBER STETKAR: Yes.

MR. MARRONE: -- and that is further out to the right on the higher ground motions.

MEMBER STETKAR: Yes.

MR. MARRONE: So you go, well, you must expect the -- the larger magnitude events to start contributing more. Turns out it -- what is playing against that is that as you go to the lower hazard levels, that implies the more numbers of times, the longer time period --

MEMBER STETKAR: When you --

MR. MARRONE: -- but the --

MEMBER STETKAR: -- say lower hazard, you mean lower events per year? I -- I need to keep --

PARTICIPANT: Lower --

MR. MARRONE: Lower annual frequency of exceedance.

MEMBER STETKAR: Okay.

MR. MARRONE: So it is --

MEMBER STETKAR: Yes --

MR. MARRONE: -- lower --

MEMBER STETKAR: -- okay --

MR. MARRONE: -- down on the --

MEMBER STETKAR: -- lower events per year.

MR. MARRONE: Right.

MEMBER STETKAR: But I don't want to use frequency --

MR. MARRONE: Well right, yes, I --

MEMBER STETKAR: Frequency hertz versus --

MR. MARRONE: Right.

MEMBER STETKAR: -- as you go to smaller --

(Simultaneous speaking.)

CHAIRMAN RICCARDELLA: -- guys would use probability, we can't.

MEMBER STETKAR: You can't because they are not probabilities. That's a different discussion. But if I go from 10 to the minus 4to 10 to the minus 5, so if I go from the top left to the top right --

CHAIRMAN RICCARDELLA: Right.

MEMBER STETKAR: -- what is the --

MR. MARRONE: What is happening is you are getting -- you are getting more and more frequent -- more events from the smaller magnitude events contributing even more to the hazard. It seems counterintuitive, but if you -- if you go to -- to a -- from a 10,000-year to a 100,000-year time period, you've got a lot more smaller events occurring and finally getting some, if you will, larger magnitude, but not enough to counter the increasing number of small magnitude events. So it is --

MEMBER STETKAR: So what you're saying is that they are essentially there, it is just that on this plot, they are so far out in the tail of the cumulative distribution that you can't see the bumps?

MR. MARRONE: Their -- their percentage contribution is --

MEMBER STETKAR: Right.

MR. MARRONE: -- smaller --

MEMBER STETKAR: Got it.

MR. MARRONE: -- right. And it is something that if you went to the USGS and hazard

maps and played with some of their results, you actually see this counterintuitive type of thing that as you go to lower hazard level, that where you'd expect the greater contribution from the larger magnitude events --

MEMBER STETKAR: Well, at the upper end of the -- of the -- the magnitude range, anyway.

MR. MARRONE: Right.

MEMBER STETKAR: Yes.

MR. MARRONE: Right.

MEMBER STETKAR: Okay.

MR. MARRONE: That is correct.

(Simultaneous speaking.)

MEMBER STETKAR: Thank you. I'm sorry?

CHAIRMAN RICCARDELLA: On this chart, what is meant by the typed values of m and r for each plot? Why is there a single m?

MR. MARRONE: Oh. In the 67 -- NUREG/CR-6728 Approach 2(a), what it says is we know the different parts of the spectrum are being controlled by different magnitude and frequency events on average, right? So Approach 2(a) says take the broad spectrum and at least split it into a high frequency and low frequency portions so that

you can do site response that considers that in this case, the 10 to the minus 4low frequency, the central value, the average over that whole bin is a 7.1 magnitude and a -- and a distance of 340 --

CHAIRMAN RICCARDELLA: Yes.

MR. MARRONE: And -- but you go out to the one on the right, the low frequency 10 to the minus 5, it is now magnitude 6.4, 21 kilometers. There is a complexity there that if the -- in the upper left, where the Charleston and New Madrid is seen, why the big jump from 21 kilometers to 340 kilometers?

And it is -- the methodology forces the -- that mean magnitude out to the further distances greater than 100 kilometers if sources greater than 100 kilometers are contributing more than 5 percent of the total hazard, so it really pushes out and emphasizes the distance-contributing events as long as they are contributing more than 5 percent.

That is why, when you look down at the bottom with the high frequency, they are all 5, 9, 6, 1, at, you know, 15 to 22 kilometers there.

MEMBER MARCH-LEUBA: Yes. I don't know anything about this, but are you being -- are you

helped by the fact that you put your plant in an active, seismically active fault? If you did not have the Virginia Seismic, you would have to design for the New Madrid earthquakes, and because you have so many -- so many more coming down behind you, you don't design for the one that you would have designed otherwise? That doesn't make sense.

MR. MARRONE: Well, what you are designing for is the consideration of all the events. Unlike -- unlike many of the -- the earlier version of -- of design criteria, you looked at the closest, largest event, the controlling earthquake. Now, probabilistically, you consider the contribution from magnitudes 5 on up to as high as 8, 8.1, and how they are distributed spatially certainly has an impact. The further distant, larger magnitude events can contribute, as we see here, not great in this case, but some, and Central Virginia Seismic Zone, being a relatively active area, is probably what is causing a fair part of that -- of those spikes close in.

CHAIRMAN RICCARDELLA: Yeah. Why do you put two frequencies on each plot? You know --

MR. MARRONE: Oh, the high -- oh --

CHAIRMAN RICCARDELLA: The 1 -- 1 and 2.5 hertz?

MR. MARRONE: Sure. Recall that for the PSHA, we only have seven frequencies to deal with, so we've got a range of about like this from --

CHAIRMAN RICCARDELLA: Yeah.

MR. MARRONE: -- right? So the low frequency at this portion sort of -- not all the way to the end, but a little bit in, so that's 1-2.5 for the low frequency.

CHAIRMAN RICCARDELLA: Oh, it's a range? You --

MR. MARRONE: No, it is actually just two values, so it's the values at -- the values of 0.5, 1, 2.5, 5, 10 --

CHAIRMAN RICCARDELLA: Spectral --

MR. MARRONE: -- 25 --

CHAIRMAN RICCARDELLA: -- the spectral accelerations at -- what?

MR. MARRONE: They are the spectral acceleration values at those seven frequencies, so just take the two values, the one at 1 hertz and

2.5 hertz --

CHAIRMAN RICCARDELLA: And add them?

MR. MARRONE: You -- you add their annual frequency of exceedance to get the relative contribution.

CHAIRMAN RICCARDELLA: Okay.

MR. MARRONE: Yes, so it is a --

CHAIRMAN RICCARDELLA: Oh --

MR. MARRONE: -- little --

CHAIRMAN RICCARDELLA: Go ahead, finish your thought.

MR. MARRONE: Well, what you are seeing here is if -- you could, in each of these plots, you could have scaled that to the total hazard, if you will, or annual numbers of events per year, and they would add up to the point on the hazard curve, but to make these all scale nicely, they are all normalized to 1. But it is the same thing. The individual bin values of magnitude bins and distance bins, if you added those all up, they would all add up to the total annual frequency of exceedance on that hazard curve.

MEMBER RAY: You've done a very good job of explaining why, when you go to 10 to the

minus 4, 10 to the minus 5, the New Madrid disappears from this plot.

MR. MARRONE: Okay.

MEMBER RAY: But help me, if you would, to a similar insight. If I'm sizing a snubber on a large component in a plant and I want to avoid exceeding allowable stresses in the pressure boundary that it is connected to, the pump or something like that, how does -- how does the potential for New Madrid to be the source of the greatest force or acceleration or ground motion relate to these plots?

Like I say, I can understand how going from 10 to the minus 4to 10 to the minus 5 has the effect, as you explained it well, but I need to come up with a force at some point in all of this. How does the New Madrid get reflected into the ground motion that he is about to describe that is ultimately translated into the structure and --

MR. MARRONE: Sure.

MEMBER RAY: -- allows me to size this snubber?

MR. MARRONE: Okay. One -- one thing to remember is that the high frequencies with

distance tend to damp out faster. They tend to white out faster.

PARTICIPANT: It's like radio waves, right?

MEMBER KIRCHNER: Physically, what you are showing here is --

PARTICIPANT: Microphone?

MEMBER KIRCHNER: Oh. Physically, Jim, isn't it showing attenuation with distance of higher frequencies?

MR. MARRONE: They -- the --

MEMBER KIRCHNER: That is --

MR. MARRONE: -- high frequencies --

MEMBER KIRCHNER: -- why it doesn't --

MR. MARRONE: -- will --

MEMBER KIRCHNER: -- show up.

MR. MARRONE: -- attenuate faster, that is true.

MEMBER RAY: Well --

MR. MARRONE: So once --

MEMBER RAY: Hold on, let me interrupt you --

MR. MARRONE: Okay.

MEMBER RAY: -- for a second and just

talk to Walt for a second. What I understood before was as you extend the probability of occurrence or exceedance out, you wind up dominating the -- the -- this way of showing the data by the closer in earthquakes, smaller earthquakes that are more frequent, and that causes the suppression of the New Madrid. It hasn't got to do with the attenuation of the frequencies from the earthquake source, but anyway, now go ahead. That's at least what I took away from it.

MR. MARRONE: Well, it has to do in that -- in that at least for the high frequency part, which are the -- the lower ones --

PARTICIPANT: Yes.

PARTICIPANT: Yes.

MR. MARRONE: -- the high frequency --

PARTICIPANT: Yes.

MR. MARRONE: -- did I mix it up?

PARTICIPANT: No.

MR. MARRONE: No, it is on the bottom, right. So the high frequency, say for Madrid or Charleston, the high-frequency motions, because of their distance, will be -- will be diminished.

MEMBER RAY: Oh, I know that.

MR. MARRONE: Okay.

MEMBER RAY: The thing I was getting at was how looking at it at 10 to the minus 5 --

MR. MARRONE: Okay.

MEMBER RAY: -- like I say, I understood your explanation, but I -- I am trying, like Jose was asking, I think, how do I still recognize that New Madrid may cause the sizing of the snubber?

MR. MARRONE: Sure.

MEMBER RAY: How does that get translated into ground motion, and then he'll take it up through the structure, too?

MR. MARRONE: Okay. If you recall, I mentioned where we have this broadband spectrum that is from 0.1 to 100 hertz, and we split it into two parts. The high frequency does not get much contribution from a very distant event, particularly if there's lots of seismicity nearby, but the low frequency does, and in this case, for this site, you go to 10 to the minus 4, and you will finally see some contribution from the distant events, and the way it -- the way it gets into the site response analysis is that -- that the

magnitude and the distance for
10 to the minus 4being a large magnitude at 7.1 will -- will shape the spectrum to -- to match that part of the uniform hazard spectrum, the low frequency, and that magnitude goes into the site response analysis in terms of an increased number of cycles.

MEMBER RAY: Well, stick with that now and take me out to 10 to the minus 5 --

MR. MARRONE: Okay.

MEMBER RAY: -- exceedance. I am going to have a larger earthquake, aren't I?

MR. MARRONE: At --

PARTICIPANT: But they are less frequent.

MEMBER RAY: I know that.

MR. MARRONE: They are less --

MEMBER RAY: But I've still got to size the snubber.

MR. MARRONE: Well, what it is telling you is that the hazard is really dominated by this -- well, by the smaller magnitude events, and they are not that small.

MEMBER RAY: Okay.

MR. MARRONE: They are actually up in the -- in the --

MEMBER RAY: I won't take more time. I do understand that --

MR. MARRONE: Yes.

MEMBER RAY: -- the probabilistic --

MR. MARRONE: Yes.

MEMBER RAY: -- dominance. I am trying to size this snubber, and I am trying to see how this very rare and therefore very large earthquake gets into the loading that I have to have in order to size the snubber I am talking about.

MR. MARRONE: Right.

MEMBER RAY: That is what I am trying to understand.

MR. MARRONE: Sure. And it does, not great, not a large amount, but it does, and realize that it is -- it is about 1,000 kilometers away --

PARTICIPANT: I thought it was 300.

MR. MARRONE: -- so it gets in there, it gets in there finally at the 10 to the minus 4low frequency part, but that is -- that is about it.

MEMBER RAY: I'm going to take a class,

I guess, because --

CHAIRMAN RICCARDELLA: It's attenuated. It is so far away --

MEMBER RAY: I am used --

CHAIRMAN RICCARDELLA: -- that by the time it gets to --

MEMBER RAY: -- to thinking about this in terms of if I have to design against an earthquake that is not going to be exceeded, and 10 to the minus 5 --
10 to the minus 5 probability of being exceeded, I am going to have a larger earthquake than 10 to the minus 4, and that should appear as a larger loading for this device that I am trying to put in the plant.

MR. MARRONE: Oh, it will -- it will show up -- the 10 to the minus 4will be at a higher level -- if you go to the next slide? The 10 to the minus 4will be at a higher loading -- or, I should say, the 10 to the minus 5 is at a higher loading than the --

MEMBER RAY: Yes, what --

MR. MARRONE: -- 10 to the minus 4.

MEMBER RAY: -- I am asking about is --

MR. MARRONE: Right.

MEMBER RAY: -- how do you get to that point? How do you bridge the two things? I understand about high frequency attenuation --

MR. MARRONE: Okay.

MEMBER RAY: -- and so on.

MR. MARRONE: Okay. So if you look at this slide, you will see that the 10 to the minus 4, the -- the blue lines at the bottom, that is -- that is the input motions for site response at 10 to the minus 4, and then you go to a -- a lower hazard level, higher ground motions, and that is what the green ones are. So you finally get -- you will finally get the higher ground motions from that.

MEMBER RAY: Okay, so it works even though I can't do the math without --

MR. MARRONE: It is --

MEMBER RAY: Okay.

MR. MARRONE: Yeah, there's some counterintuitive element to this, but if you --

MEMBER RAY: It all seems intuitive. I just wanted to know if I was going from 10 to the minus 4to

10 to the minus 5, would I wind up putting in stronger --

MR. MARRONE: Yes.

MEMBER RAY: -- supports --

MR. MARRONE: Yes.

MEMBER RAY: -- and the answer has got to be yes --

MR. MARRONE: Yes.

MEMBER RAY: -- unless you are telling me, ah well, but it is so rare that you don't --

MR. MARRONE: No, I am -- okay. I see what you mean. Yes, the 10 to the minus 5 hazard level, all across the board, the green -- the green spectra there are at a higher level than 10 to the minus 4.

CHAIRMAN RICCARDELLA: And -- and New Madrid is in both of them, it is just playing a bigger role in the blue one than it is in the green one?

MR. MARRONE: That is -- that is right, that is right. In the -- in the blue dashed line is where you finally get a contribution, or a noticeable contribution, from New Madrid, and particularly with regard to site response, you will

have a larger magnitude that -- that is the input element in the site response analysis.

(Pause.)

CHAIRMAN RICCARDELLA: This is like a class. You're educating us.

MR. MARRONE: Sure, yes.

(Laughter.)

MR. HASHEMI: So we talked about our inputs for site response analysis. Our output is basically site amplification factors, and so uniform hazard response spectra at 10 to the minus 4and 10 to the minus 5, mean annual frequencies of exceedance. Next slide, please.

This is a cross section of the site that goes through the three Seismic Category I buildings, the reactor building, RB/FB, control building, CB, and FWSC. It also shows different sub-grade material, different zones under the building, and the engineers fill around each one of the buildings. It also identifies the bottom of foundation elevation for the three Seismic Category I buildings, and note that there is a 2:1 vertical-to-horizontal exaggeration in plotting this. That is why things seem a bit exaggerated. Next slide,

please.

The GMRS, or ground motion response spectra, is defined for the site at elevation 224 foot, which corresponds to the deepest excavation at the site. This is the deepest foundation of the site, and it is on competent material. For foundation input response spectra, or FIRS, the elevations are defined at the bottom of foundation of each building. You have elevation 224 for the FB elevation, 241 for CB, and 282 for FWSC.

We are -- we are calculating the FIRS to be consistent with the SSI analysis that follows, and we discuss that later on. This is per requirements of ISG-17. Specifically, there are two types of SSI analysis that are done for RB/FB and CB. One is the partial column, partially embedded SSI analysis.

CHAIRMAN RICCARDELLA: For the record, you should state what SSI is.

MR. HASHEMI: Oh, I am sorry, soil-structure interaction.

So partial -- partially embedded SSI analysis considers only embedment in rock, and then we have fully embedded SSI analysis. That

considers embedment both in rock and in the soil above it, and the results from those are in, you can see. But we have to calculate foundation input response spectra that is consistent with each one of those. Those are calculated in this section.

We also calculate the performance-based surface response spectra, or PBSRS. That is calculated on finished grade elevation 290 on top of each one of our truncated soil columns that we use for partial column analysis. Next slide, please.

CHAIRMAN RICCARDELLA: What --

MR. HASHEMI: Yes, please?

CHAIRMAN RICCARDELLA: On that -- on that slide, I was looking at this -- go back to that slide, please, the figure?

MS. BORSH: Oh --

MR. HASHEMI: Oh, with the figure.

MS. BORSH: The --

CHAIRMAN RICCARDELLA: Yes. What are those vertical lines, blue lines?

MR. HASHEMI: Those are the bore holes that --

CHAIRMAN RICCARDELLA: Ah --

MR. HASHEMI: -- happen to be in this --

CHAIRMAN RICCARDELLA: Okay.

MR. HASHEMI: -- cross section.

CHAIRMAN RICCARDELLA: Okay. I understand. Thank you. And you have -- you have drilled those? I mean --

MR. HASHEMI: Right, correct. So next slide, please.

The site amplification calculations are following requirements of NUREG/CR-6728. We follow Approach 2(a), Reg Guide 1.208, and ISG-17. Basically, what we are doing is that we are taking the high-frequency and low-frequency inputs that Jim talked about at 10 to the minus 4and 10 to the minus 5, mean annual frequencies of exceedances and propagate them through the soil columns that we assign for -- for each bed.

We use three base soil columns for the analysis based on the footprint of each one of the buildings, so we have a RB/FB soil column, we have a CB soil column, and we have an FWSC soil column. And then, as a conservative measure, we envelope all the results coming out of RB/FB and CB soil

columns, so the GMRS is calculated as envelope of those two, the RB/FB and CB FIRS and SSI input are calculated as envelope of those two. For FWSC, because it has a small footprint, we just use the sole column corresponding to that. Next slide, please.

This is an example for RB/FB soil column, the site amplifications at the GMRS horizon. On the lefthand side, you have the 10 to the minus 4amplifications. On the righthand side, you have the 10 to the minus 5. The high frequency and low frequency amplifications are shown, high frequency with dashed line, low frequency with solid line, and as we can see, they are pretty much the same. For 10 to the minus 4, 10 to the minus 5, high frequency, low frequency, we're getting the same amplifications.

The reason is that the material below the GMRS application is basically linear, so we are not getting any difference in amplification. It is not dependent to our input.

We have similar results for all other elevations of interest and all other inputs in the FSAR presented in Section 2.5.2.

CHAIRMAN RICCARDELLA: Do these include damping factors --

MR. HASHEMI: Yes, yes.

CHAIRMAN RICCARDELLA: -- I presume?

MR. HASHEMI: Well no, the dampings are coming also from the site investigation, so we have a damping for the soil column for the soil properties that are included in the site response --

CHAIRMAN RICCARDELLA: Oh --

MR. HASHEMI: -- analysis.

CHAIRMAN RICCARDELLA: -- okay, because it's just kind of an issue.

MR. HASHEMI: These are -- the -- this is -- the site amplifications are calculated using RBT, and they include the damping. They are -- the amplifications are calculated as the ratio of the 5 percent response spectra at the horizon of interest to the bedrock.

CHAIRMAN RICCARDELLA: Okay. Thank you.

MR. HASHEMI: Next slide, please.

This is an example of the actual excavation response spectra, again for the GMRS

horizon using the RB/FB soil column at 10 to the minus 4on the left and 10 to the minus 5 on the right. In both these figures, the green curves are input. The blue curves are the output. The high frequency is shown with the dashed line. Low frequency is shown with the solid line.

Notice that there is a very different scale in -- in the vertical axis there. On the lefthand side, the peak corresponds to about 0.8g. For 10 to the minus 4on the righthand side, the peak corresponds to about 2.5g, for 10 to the minus 5, so there is a big difference between 10 to the minus 5 and 10 to the minus 4.

The uniform hazard response spectra is calculated as the envelope of the low frequency and high frequency results for -- for each case, and again, we have similar results for all other soil columns and horizons of interest presented in it. Next slide, please.

So in this, 2.5.2.5, so far, where it has talked about the site amplification factors, and from hazard response spectra, 10 to the minus 4, 10 to the minus 5, that's what we used for GMRS horizons and FIRS horizons, consistent with the SSI

analysis. These uniform hazard response spectra are used in Section 2.5.2.6, which is my next topic, in calculation of the actual FIRS and GMRS as a design response spectra. If there are no other questions, I can just go along to the next one.

(Pause.)

MR. HASHEMI: Should I go ahead?

PARTICIPANT: Yes.

MR. HASHEMI: So in Section 2.5.2.6, we calculate the performance-based design response spectra, or DRS, and these are basically our GMRS horizontal and vertical and FIRS and PBSRS again horizontal and vertical. Next slide, please.

These design response spectra are calculated following performance-based requirements of Reg Guide 1.208. The horizontal GMRS, FIRS, and PBSRS are calculated from 10 to the minus 4and 10 to the minus 5 uniform hazard response spectra using an appropriate frequency-dependent design factor that is coming out of Reg Guide 1.208. As I mentioned before, we envelope the results coming out of RB/FB and CB soil column to come up with GMRS PB -- RB/FB FIRS and CB FIRS.

For vertical direction, we use an appropriate v/h ratio that is determined using NUREG-6728 procedure, and we apply that to the horizontal FIRS and -- and GMRS, et cetera, to come up with the vertical version. Next slide, please.

The GMRS horizontal and vertical is shown in this figure. The dashed blue line is the horizontal direction. The solid red line is the vertical direction. And again, similar plots for all other FIRS and PBSRS are out there within the FSAR. Next slide, please.

In this slide, the FIRS for RB/FB and CB are shown and are compared to the CSDRS for ESBWR. On the lefthand side, you see the comparison for horizontal FIRS. On the righthand side, you see the comparison with the vertical FIRS. The red lines correspond to RB/FB. They are lower because it has a lower foundation elevation, and then the blue lines are the foundation input response spectra for control building.

The dashed lines are corresponding to the partial embedded analysis, and the solid lines correspond to the fully embedded analysis. In both cases, you see that there is an exceedance in mid-

and high-frequency ranges from the CSDRS, and this exceedance is the basis for having NAPS Departure 3.7-1. Next slide, please.

Similar information are shown for FWSC. On the lefthand side, you have the horizontal. Righthand side, you have the vertical. And again, you have that mid-frequency-range exceedance when you compare it to the CSDRS. Next slide, please.

CHAIRMAN RICCARDELLA: For the record, FWSC is fire water --

MR. HASHEMI: Fire water service complex. So in this section, we've talked about calculation of GMRS and PBSRS FIRS for each building consistent with SSI analysis, and we showed that GMRS and FIRS exceed in some frequencies the CSDRS for ESBWR, and this is the basis for NAPS Departure 3.7-1. Because of this departure, we do site-specific seismic analysis of all Seismic Category I structures as will be discussed later in 3.7-1.

Are there any questions?

(No response.)

MS. BORSH: Okay. Thank you guys.

MR. HASHEMI: Yes.

MR. MARRONE: Sure.

MS. BORSH: So Jim, you are ready for your piece? Okay.

(Pause.)

MR. SHEA: This is Jim Shea again from the NRO staff, and we have the panel number two presenters, Alice Stieve, Vlad Graizer, and Weijun Wang. And we'll start right off with -- is this -- is this you?

MS. STIEVE: Yes.

MR. SHEA: Alice, yes, Alice, take it away.

MS. STIEVE: Okay. So at one point, I might want to grab the mouse, okay?

MR. SHEA: Yes.

MS. STIEVE: I'll let you know.

MR. SHEA: Yes, go ahead.

MS. STIEVE: Okay. So my name is Alice Stieve. I am a Geologist in NRO, and I was the lead reviewer for the geology sections 2.5.1 and 2.5.3. My review covered only new information since the 2005 ESP SER, so this includes the geologic aspects of the Mineral, Virginia earthquake and the additional borings done for the

COL.

Because of the Mineral, Virginia earthquake, the applicant implemented a geologic field reconnaissance program to look for surface deformation associated with that earthquake. Because the applicant did not docket this field reconnaissance report, I asked several RAIs to bring that information onto the docket so I could make my safety finding.

In addition, many other geologists in other -- in other institutions like USGS and various academics were also looking in the landscape for surface deformation, so I reviewed additional pertinent publications there, and my site audit included visiting several of the field sites that were included in the applicant's field reconnaissance.

I also reviewed original source materials regarding the discovery of the Fault A at North Anna in 1968, and this is -- and I will talk with you in a slide or two because this was apparently a public comment in a previous ACRS meeting, so they asked me to say something about that. So next slide, please.

This -- this view is a map and cross sections of the aftershock sequence for the Mineral, Virginia earthquake, and this defines a slab, a southeast descending slab, in the cross section over here, that was subsequently called -- named the Quail Fault by USGS, and this is where that -- that slab is when it is projected to the surface on a map section, and it projects to the surface right about here, and this is the uncertainty around where that projection is.

This helps -- this defined -- helped define for the applicant where they were going to do their field reconnaissance to locate surface deformation or -- of liquefaction, or any other deformation feature. Next slide.

This is the scope of the field reconnaissance report, and this is -- they collected -- the applicant collected LiDAR, and this is LiDAR data. It can be used to get very high-resolution topographic information to determine if there's any young fault scarps or something or deformed river terraces or things like that, so this is the extent of their LiDAR.

This is where the Quail Fault

earthquakes project to the surface. This is -- this is where the surface fault is, or that fault projects to the surface. It does not come to the surface, it is --

CHAIRMAN RICCARDELLA: Excuse me, Alice, LiDAR is?

MS. STIEVE: Light detection and ranging, and it's a laser pulse from airplanes that crisscross in the -- you know, so it's a remote sensing sort of thing, and they collect the -- the different range for the returning signal, and they can determine very precisely, very close, the different -- the topography, and they can strip away buildings, they can strip away tree canopy and things like that, so they can get a very high-resolution look at topography.

CHAIRMAN RICCARDELLA: Thank you.

MS. STIEVE: Because this area, this landscape is, you know, typical Virginia Piedmont landscape. It is covered with all kinds of forests and things like that, so it is hard to do field reconnaissance in that and find something that would be a small feature, which is what you would expect from that size earthquake, if anything.

So that is the extent of the LiDAR. This is the -- where the earthquakes were, and you can -- and these dark lines are where they did their -- their road traverses and checked outcrops or geologic contacts, and -- and then they also had continuity all the way back to the site, which is over here, because they wanted to see if there was any connection perhaps with any of the faults, the older geologic faults that they knew in the area might project back to the site. Next.

And in addition, using -- still using the LiDAR data, they pulled off the elevation --

MEMBER BROWN: Can I ask one, just understanding, I'm not a seismology person: you said the -- the quake never came to the surface, and --

MS. STIEVE: That is --

(Simultaneous speaking.)

MS. STIEVE: -- yes.

MEMBER BROWN: You don't need another slide. Well, do whatever you want, but --

MS. STIEVE: One more, there, right there. Okay.

MEMBER BROWN: So all this mapping is

just a surface topography of the -- of the land, right? I mean, it is -- if nothing came to the surface, you are just mapping what the land surface ----

(Simultaneous speaking.).

MS. STIEVE: The Quail Fault is defined only by aftershock sequence. It is not defined by any surface geology.

MEMBER BROWN: Does it --

MS. STIEVE: However, on the surface, there are many faults, and many of those faults are very ancient, and there's -- there was speculation because that was a northeast-trending seismic aftershock kind of fault, so it matched a lot of the other geologically known faults in the area, and it is close to the surface -- the -- the aftershock sequence is close to the surface, so we were speculating that maybe there was some evidence of surface deformation, and that could have been where the fault could have projected to the surface.

You see, there is no -- there's no aftershocks here, right? That is -- that is just a modeling to project it to the surface. You want to

do that?

MR. GRAIZER: No no no no --

MS. STIEVE: No.

MR. GRAIZER: -- I just -- I am a seismologist. I just wanted to add a little bit to what Alice just said.

These dots are aftershocks. There is --

MEMBER BROWN: The locations of aftershocks?

MR. GRAIZER: Yes.

MEMBER BROWN: Okay.

MR. GRAIZER: And there is a notion in seismology that the aftershock sequence of the first few days, or maybe a week, counters the full zone of the main shock. This is why kind of the search for surface trace was on the continuation of this, on the projection of this on the surface. Sorry, I didn't want to distract --

MEMBER BROWN: That is fine, no, thank you.

MR. GRAIZER: I just wanted -- yeah, basically, this notion of aftershocks countering full zone, but aftershocks of the first may be a

week, not more. After that, they have a tendency to spread out and show in bigger zone, but --

MEMBER BROWN: You think the -- for the first -- the first few days or a week, whatever it is, they kind of -- these things bound the general underlying fault that was below -- below ground, is that what you are --

MR. GRAIZER: Correct.

MEMBER BROWN: Okay. All right.

CHAIRMAN RICCARDELLA: How do you define these points on the cross section where the aftershock occurred?

MR. GRAIZER: Okay. These -- these points are coming from seismic investigations. What -- what is going on, basically, there are stations around, and in this case, they installed additional -- the group of the university and USGS, they installed a lot of instruments --

CHAIRMAN RICCARDELLA: Right after -- the same day as the earthquake they're going out there and --

(Simultaneous speaking.)

MR. GRAIZER: And these instruments give you very precise location. Now, coming back

to whatever joke or -- you just made, before the earthquake, we also had a lot of instruments, but not so close to the fault. This is why we still can pretty precisely determine the location, but as -- it is not as precise as when you have very large network of instruments.

CHAIRMAN RICCARDELLA: Yes, yes, no, the reason I made the joke was you said you have to get it in the first week, and so you went and put in all these instruments, they had to go down there pretty quick if you are going to get the data for the aftershocks in the first week, right?

MR. GRAIZER: That is very true. That is very true, and this was, as far as I know from the meetings I attended, it was a big effort from United States Geological Survey, from Virginia Tech University. I probably forgot somebody, but it's a big group of people, and they published a lot of papers, and actually, another set will be presented next week at the Eastern Session of Seismological Society, but basically, it's a joint effort of many organizations to get the precise locations of aftershocks.

CHAIRMAN RICCARDELLA: Okay, thank you.

MR. GRAIZER: Sorry. I --

MS. STIEVE: No, it's okay. So, you know --

MEMBER BROWN: No, I got it, it's a quick- mobilization of seismological instrumentations, you get out, place them in place, and then see what you get.

MR. GRAIZER: Exactly, and also, just to add to this, since it is my whole life, some organizations, they keep a lot of spare instruments specifically for this task also, recording aftershocks and tracing well the main shock using this, and they have a group of people who are supposed to be ready to go immediately.

MEMBER BROWN: So they were happy campers, then?

(Simultaneous speaking.)

MEMBER BROWN: They were probably having a good time?

(Laughter.)

MEMBER BROWN: I would have been.

(Laughter.)

MR. GRAIZER: Sometimes it is true, sometimes not.

MR. SHEA: Vlad said his whole life, but he's only 22, so don't --

(Laughter.)

MS. STIEVE: Okay. So the geologists went out to look for surface deformation in that area where the epicentral location is, so in addition, they looked at river profiles. This slide is showing in the various colors the different streams that crossed the epicentral area wherein they were -- they pulled off longitudinal river profiles.

River profiles are usually nicely graded, and they smoothly descend down to the mouth of a river or a creek, but if there are -- if there is any kind of deformation that's expressed at the surface, either as a sharp -- you know, like a fault scarp, or even as kind of like a warp zone, an arch, it may show up in the longitudinal streams, and they also examined the river terraces on South Anna --

MEMBER BROWN: The longitudinal stream, you mean, water- stream profile running along the --

MS. STIEVE: Yes, going from the high

elevation down to the lower elevation in that area --

MEMBER BROWN: All right.

MS. STIEVE: -- and they used the LiDAR information to get the very high resolution kind of so they can see small offsets or small knickpoints or things like that.

So you can see that the profiles cross the epicentral area, so that was a good place to be evaluating those streams. There were no obvious signs of deformation. There were some knick zones in some rough places on the profiles, but they are attributed to changes in lithology in locations where other watersheds were entering in the stream, so the stream power goes up, and that may cause some changes in that longitudinal -- that smooth longitudinal line. The next slide?

So in addition to what the applicant did, USGS, notably Burton et al., went out and did some geologic mapping. So in this area, there are several generations of geologic map, and they are conducted for different objectives, and they are done at different scale, and they -- it's a patchwork of coverage, and this particular map was

done specifically after the Mineral, Virginia earthquake happened. They went out there afterwards, and they mapped it at a scale of 1:24,000, which is a very fine, high resolution kind of mapping for geology, and they -- they found two additional faults that were not previously known.

And they looked in the area. So in this area, this is where all the earthquakes are at depth, and over in this area, where the projection of the Quail Fault would have been, they discovered two additional faults. They are not new. They are old faults, so they are not known to be active. They did trenching. They did test pits, and there was no quaternary disturbance in the soil, so those are just old faults. They are just additional. Next slide.

CHAIRMAN RICCARDELLA: Old faults, but newly discovered?

MS. STIEVE: Newly discovered, old -- yes, old faults, but newly discovered, and these are the faults that we kind of like considered because they showed up in the literature right after the Mineral, Virginia earthquake as being

maybe actors in the Mineral, Virginia earthquake, and as Burton et al. went out and looked at where these things are, they relocated some, like Chopawamsic was relocated a little bit. It is situated to the west of the epicentral area, so it is structurally below the aftershock sequence, so it is not associated with the Mineral, Virginia quake.

Going down here to the long branch, this one is to the east, and it is structurally higher than the aftershock sequence, so it cannot be part -- it cannot be an actor, and the two here, the Harris Creek and the Roundabout Farm faults, those were the ones that were newly identified by Burton et al., and they did trenching, but no quaternary -- that's a misspelled word there -- there is no quaternary deformation- for those faults.

Fault A, I asked them -- I went back to the original material as best I could get it from the 1968 through 1973 to examine how they investigated Fault A, and I asked an RAI. So there is no alignment of aftershock data with that fault, and the field reconnaissance and LiDAR data that

the applicant did from the site all the way out to the epicentral area, there was like that continuity coverage that they did, they did not find any reactivation of the surface deformation.

When I went and did my field audit and we went to visit several of these wave points, there was nothing -- there was nothing to be seen. And then of course the previous ESP SER done in 2005 said that the fault was -- would you give me another slide? -- was certainly older than a million years old.

So this is -- I'm sorry, it is a little fuzzy. It just didn't import into the PowerPoint slide. This is the site. This is -- this magenta line is Fault A, through here. This is Unit 1, Unit 2, abandoned Unit 3 and 4, and this -- as you can see that, that is going to be where the new Unit 3 is.

So in 1968, they found it in the excavations, right here, and then subsequently, Dames and Moore did a trench here. They did a trench here, and then they did a trench here, and they determined that the fault was very old.

So they did potassium-argon dates, and

they got ages like 239 million years old from chrolite seams that are within the fault zone itself, and they got 214 million years old for the fault gouge that was also in the fault zone, but of course, stuff that is in the fault zone is not a single plane, it's a zone. It's a bunch of shears and some ductile deformation, some brittle deformation.

It was originated as a thrust fault, and it was reactivated later as a normal fault where there were brittle features, but they had a -- a soil scientist came in and did a detailed investigation directly over the fault zone, and that -- that soil evaluation -- so the fault goes right up to the B horizon. There was no -- he found no disturbance in soil-related structures, and the soil is a very old soil. It is called a red yellow podzolic soil, and that only forms on old landscapes.

And it is -- it takes a long time to develop. That soil was 6-10 feet thick, and it is at least a million years old, so that -- that fault was determined not to be a seismic source. So next slide.

So I conclude that the applicant's assessment for potential surface expression was appropriate, and it reveals no measurable surface deformation when we looked at a suite of geological maps and detailed topography from the LiDAR and specific field reconnaissance to determine those things, and that the surface deformation at North Anna is negligible. Fault A was previously found to be a geologically old structure, and the post-Mineral, Virginia field reconnaissance and examination of high resolution topographic maps also confirms that.

MEMBER RAY: In the old days, we used to use the term "capable or not." Here you're just saying it's an old structure.

MS. STIEVE: I don't like to use the word "capable" because, I mean, that is a very deterministic thing, and that -- that definition has got some flaws in it, so when you're looking at -- we -- the younger it is, the more -- the more detail, the more I focus on it, so if it is older than quaternary, you know, because it is 2.6 million years old, and it hasn't ruptured since then, that is a long time ago in terms of seismic

hazard.

MEMBER RAY: No, I understand, but I guess my question would be is the terminology one that is personal, reflecting your -- what you just said, or is it something that we're now generally --

MS. STIEVE: It is --

MEMBER RAY: -- in the Agency --

MS. STIEVE: -- still in Reg Guide 1.208.

MEMBER RAY: What is?

MS. STIEVE: The "capable" --

MEMBER RAY: Yes.

MS. STIEVE: -- definition is still in Reg Guide 1.208 --

MEMBER RAY: Okay.

MS. STIEVE: -- but in practice, what we do is we consider structures that are at the quaternary -- younger than quaternary are going to attract more attention, because if it happens at a very young age -- or recently, we figure that there is a reason for it, there is a structure for it.

MEMBER RAY: Well, in the public debates that sometimes do take place, the idea of

old, I pay more attention to more recent, and so on, it does not sometimes always work, so when the reg guide comes in for updating, we'll probably have a debate --

MS. STIEVE: Right --

MEMBER RAY: -- about --

MS. STIEVE: -- we will. This -- the standard review plan was revised, and we took that definition out of the standard review plan, and that happened to come up for renew recently. The reg guide is not being renewed right this minute, so we took it out of there, and we put in the focus on the quaternary and younger.

CHAIRMAN RICCARDELLA: So does a million years old translate to something like 10 to the minus 6 exceedance frequency, or --

MS. STIEVE: Kind of. It is -- well, if it --

CHAIRMAN RICCARDELLA: Forgive me --

MS. STIEVE: -- didn't move within the last million years, you know, 10 to the minus 6.

CHAIRMAN RICCARDELLA: Yes. Maybe they excuse the year, though.

MEMBER BROWN: So is a million years,

is that the calibration point relative to the 2.5 million?

MS. STIEVE: This is what the soil scientists determined 40 years ago about that B horizon, and that -- and sometimes, you can't get a more precise date. That is -- that soil horizon is a ceiling of that fault, whereas the chlorite age and the fault gouge age at 238 and 214, that is within the action of the fault when it was ductile or brittle and -- and it had -- it's the maximum age, but it's not the minimum age, which is what we are interested in. So there is this big gap in time, and that is -- it is just what we had available to date.

MEMBER BROWN: If this had been 100,000 years ago, would you have been concerned?

MS. STIEVE: Yes.

MEMBER BROWN: Okay. I am just trying to bracket where you are -- 2.5 million years, I can -- that is pretty long ago, I can relate to that, but where is the -- where is the gray area, and then where is where you say, uh-oh, hold up your hands and say stop?

MS. STIEVE: It's a graded approach.

The younger it is and the closer it is, the more we pay attention to it. It is just a graded approach, because otherwise, it is very deterministic, if we put it has to be, because we can't always -- like in this case we can't determine exactly how old that fault is, and even if we did it today --

MEMBER BROWN: But you know that it is more than such-and-such, though?

MS. STIEVE: Right. It is certain, it is certain, because I went through and I read that soil scientist's report, and he did x-ray diffraction and he looked at --

MEMBER BROWN: You're going far too detailed for an electrical engineer, okay?

(Laughter.)

MS. STIEVE: Well, I mean, he could find that fault in the sample, like going up to the B horizon, and the B horizon was a line that sealed the fault. And it wasn't deformed, so that means it has to be older than at least 1 million years. I can't give you a better --

MEMBER BROWN: That's fine, I'm just -- you're mushing all over the place. I'm just looking -- I'm just trying to get a calibration as

to where you would have started wringing your hands, and I've gone one. Even if it may change.

MS. STIEVE: Okay.

MEMBER BROWN: Thank you.

MR. GRAIZER: Okay. My name is Vladimir Graizer. I am a Seismologist at NRO. Okay, thank you.

Okay. Actually, Dominion, from my point of view, did great job presenting their information on Section 2.5.2. I will try to avoid repetition as much as I can, but certain things should be repeated, unfortunately.

And again, just to remind you what was the difference, or why are we going back to this site, even if it had ESP in 2006? And there are a number of events. There are a number of things which kind of required this re-review of seismic part.

First of all, of course, is earthquake, Mineral, Virginia earthquake of 2011. Second important step in seismology in review of application is publication of so-called Central and Eastern United States Seismic Source Characterization, also called NUREG-2115. It

happened in 2012, long after ESP.

Another big step, again, was publication of the new ground motion models, which happened in 2013, and another issue which was very important is availability of the new site-specific geophysical information, which came to light around 2011, I believe, when they switched technology first time from ESBWR to --

PARTICIPANT: U.S. ABWR.

MR. GRAIZER: U.S. ABWR, sorry, for distinction. What happened, they drilled more holes, they did more investigation, and they found out that this site subsurface structure is not as simple as it was considered during ESP process.

Now, let's go step-by-step. Mineral, Virginia earthquake: you have already heard a lot about this. I will try to bring a little bit from the perspective of an applied seismologist, if I may say.

As it was mentioned before, it is located in the Central Virginia Seismic Zone. This zone was known. It is not a discovery that earthquake happens in this zone, and it is a known zone of small-to-moderate seismicity.

What happened during this earthquake, just to remind you, it -- oh, we had -- Dominion had seismic instrumentation at the Unit 1 of existing plant, and this unit -- this instrumentation recorded at the two elevations. Of course, for us, as seismologists, the most important is the closest to the lowest level at basemat, and I will talk about Central Eastern United States later. Now, next slide, please.

CHAIRMAN RICCARDELLA: Presumably it exceeded SSC for Unit 2 as well, but it just -- you didn't have instruments there, there were only instruments on Unit 1, right?

MR. GRAIZER: It is a hard question, and if -- if you wait a little bit, I may come to it.

CHAIRMAN RICCARDELLA: Okay.

MR. GRAIZER: Thank you. Next slide, please.

Yes, yes, this one. This slide basically shows you the location of the North Anna Unit 3, and two circles not far away are epicentral -- epicenters of the main shock determined by different groups. As you can see, we are not as

precise as engineers.

But according to seismological standards, it is pretty close, and basically, it is about 80 kilometers, or 11 miles, away from the North Anna site. Now, that is what -- next slide, please.

Yes. Okay. The left three panels demonstrate acceleration recorded at basemat location at the elevation of 216 feet. Now, just to remind you, the GMRS for Unit 3 is -- is defined at the elevation of 224 feet. This means that it is pretty close, but it is still slightly different locations, and it is on basemat.

Now, again, left panel, three components of -- recorded at basemat, accelerations. Next three panels are velocity integrated through -- or from acceleration, and the last, on the right side, three panels are displacement. What can be said about this, maximal acceleration was 26 percent g. Maximum velocity was about 14 centimeters per second, and maximum displacement was about 2.3 centimeters.

Now, another important -- just to finish the phrase, please -- important, very

important factor is that the duration of strong motion was pretty short, two, three seconds, which kind of explained why we didn't -- North Anna did not have any damage at Unit 1 and 2. Sorry, I am ready.

CHAIRMAN RICCARDELLA: Channel 3 is north/south or --

MR. GRAIZER: Okay, Channel 3 is actually north/south, yes.

CHAIRMAN RICCARDELLA: Yes, that's what I thought.

MR. GRAIZER: Yes. And as usual, we have two horizontal channels and one vertical.

CHAIRMAN RICCARDELLA: Yes, yes.

MR. GRAIZER: And usually, vertical records lower ground motion, but more high-frequency.

CHAIRMAN RICCARDELLA: Which was the vertical, Channel 2?

MR. GRAIZER: There is some kind of disagreement about this. We analyzed this record, and we believe that Channel 1 is vertical. Some people believe it is Channel 2. I mean, I don't want to go into this, but when you look at the

record, it is -- it is -- they are different horizontal and vertical channels, but it doesn't matter. Maximum acceleration was clearly at horizontal component, north/south, and it was 26 percent g.

CHAIRMAN RICCARDELLA: So if I were to put a single degree of freedom oscillator on this -- on one of these, I could develop a response spectrum, couldn't I?

MR. GRAIZER: Of course -- of course we did it.

CHAIRMAN RICCARDELLA: Okay.

MR. GRAIZER: Yes. Okay. And again, very important part of this is that the record was -- the duration of strong motion was pretty short, which is typical for magnitude 5.8.

CHAIRMAN RICCARDELLA: How long?

MR. GRAIZER: Two, three seconds.

CHAIRMAN RICCARDELLA: Two to three seconds.

MR. GRAIZER: But the total record was like 18 seconds, something like that.

CHAIRMAN RICCARDELLA: Just for background, I was in San Jose -- I lived in San

Jose during the 1989 World Series earthquake, which was more like 30 seconds.

MR. GRAIZER: Yes.

CHAIRMAN RICCARDELLA: That was an experience.

MR. GRAIZER: And I used to live in California before I moved here. I know what you mean. Yes, basically, large earthquakes, they produce longer duration of strong motion, and of course, they are much more damaging.

CHAIRMAN RICCARDELLA: Yes.

MR. GRAIZER: Okay. Applicant -- next slide, please.

Yes, applicant reevaluated PSHA using a new Central Eastern United States Seismic Source Characterization, and of course, just to remind you, ESP was done using old models, EPRI 86 89. They are clearly superseded by the new model.

Applicant, as they presented to you before, updated seismicity and recurrence rates to account for events for seismicity after the publication of 2012 NUREG-2115, and it has resulted in an increase of maximum. They demonstrated this in their presentation. Applicant used the most

recent ground motion models approved by NRC, and on the other side, of course, we did confirmatory analysis to make sure that our results agreed with -- in general, with the results of -- next slide, please -- of the applicant.

This is again just to -- to give you the kind of visual impression of location of the site relative to seismicity around, and again, Dominion has presented this very clearly. Basically, it is about 400 kilometers away from Charleston Zone. It is about 800 kilometers from Wabash Zone and 970 kilometers from the closest point of New Madrid. New Madrid is not shown here because it is beyond.

But all these zones of course were included in seismic hazard analysis. Next slide, please.

Again, I don't want to spend much time. It was heavily discussed before. What is going on, these two plots demonstrate what -- what contributes the most to the seismic hazard. As you can see, for low frequencies -- and I am only showing here 10 to the minus 4-- the contribution, the main contribution of course is from closest

faults, closest seismic sources, and there is a contribution of together Charleston and New Madrid. Okay. Yes. That is all. Next slide, please.

As I mentioned, we did confirmatory analysis, and on our part, we did calculations of seismic hazard, and at this plot -- figure, we are showing comparison of seismic hazard, rock hazard, calculated by Dominion and by NRC staff. As you can see, Dominion is shown in thick lines, and NRC's confirmatory analysis in dashed lines. They are pretty close. And considering the -- all we do in seismology, it is pretty good similarity. Next slide, please.

About testing: applicant conducted additional geophysical testing, and this geophysical -- additional geophysical testing resulted in -- in more complex characterization of subsurface, and specifically, it is not flat layering under the site, it is kind of undulating erosional contents. Now, we had a lot of RAIs, a lot of discussions on this, but just to make it clear what is happening, this is same type of lithological formations. And the difference between different layers is basically gradient, not

dramatic jump of shear wave velocity, and it is kind of different weathering, and it is gradient change of shear wave velocity.

But we reviewed this, and we reviewed seismic analysis that Dominion performed, and of course, we looked carefully at seismic data, suspension logging data measured in different borings. Next slide, please.

Next slide corresponds to another type of -- part of our confirmatory analysis. As I mentioned before, we confirmed -- we got similar, very similar results for rock hazard, and again, Dominion explained this. If you want, I can come back to this, but rock hazard is very similar between us and what Dominion got.

Next step is to calculate site response or final GMRS, and final GMRS on the left side, you can see shear wave velocity profiles for different locations, and based on these shear wave velocity profiles, we calculated amplification factor from hard rock to the surface, to certain locations, certain elevation, in this case, GMRS, which is 224 feet.

On the right side, you can see a

comparison of site amplification function calculated by us, blue line -- sorry, opposite, red line, and blue line is Dominion. There are some differences because we used different methods, but in general, it is very similar, and it is -- results are consistent because Dominion does more randomization than we do. This is why their site amplification function is more smooth. We have more pronounced frequency amplification at some points.

Now, below this is a comparison of the last step, calculation of GMRS. Our GMRS came lower, generally, than Dominion, and there is a reason for this. We used different -- we used different method, Approach 3, and we used slightly different average in profiles, but since -- and also, another difference comes from how you do interpolation at high frequencies because as you probably remember, you only have hard rock 25 hertz and 100 hertz, and basically, between 25 hertz and 100 hertz, it -- it is partially dominated by the way interpolation is done.

CHAIRMAN RICCARDELLA: Do you want to be on the next slide?

MR. GRAIZER: Yes, yes. And next slide, please.

Next slide is basically the main results. As you can see, red line is ESBWR -- it's not showing here -- CSDRS. Blue line is original ESP GMRS, and black line is the final GMRS for COLA. We are showing this just to demonstrate the difference, and again, just to remind you, the different is different elevation and different subsurface characterization. Yes?

CHAIRMAN RICCARDELLA: But you show no exceedance, and the applicant has showed some exceedance --

MR. GRAIZER: It is not correct. If you look carefully between a red line, which is CSDRS, and black line, which is most most recent GMRS, there is a difference. It is about -- within 10 percent, and it -- at high frequencies --

CHAIRMAN RICCARDELLA: But that is --

MR. GRAIZER: This is for GMRS.

CHAIRMAN RICCARDELLA: Okay.

MR. GRAIZER: It's not for other locations. For other elevations and other locations, it is different.

CHAIRMAN RICCARDELLA: I understand. But you show exceedance above 50 hertz or so. I think the applicant was showing exceedances around 9-10 hertz, I believe.

MR. GRAIZER: It is for different location. It is for foundation input response spectra, and there are different -- and, okay, the applicant mentioned this. There is location at 224 elevation which is same for foundation input response spectra for reactor building.

CHAIRMAN RICCARDELLA: Yes.

MR. GRAIZER: Next is I believe 240 something elevation, and this is for control building.

CHAIRMAN RICCARDELLA: Yes.

MR. GRAIZER: And another elevation of course is PBSRS, which is 290 foot, and it is much higher, higher elevation and higher amplification.

CHAIRMAN RICCARDELLA: Okay. All right.

MR. GRAIZER: And, again, just to remind you, I am now talking about GMRS, which is kind of, if I may say, the end of the story for 2.5.2. I am not saying it's the end of the story,

but it's the end of the story for this section. Yes? Can I go to conclusions, or you want to --

CHAIRMAN RICCARDELLA: Well, I think you know what my question is going to be, right, because you already prepared a backup slide?

(Laughter.)

MR. GRAIZER: Okay, that is true.

CHAIRMAN RICCARDELLA: If I did the response spectra for the Mineral earthquake and plotted it on this plot --

MR. GRAIZER: Yes, you are talking about slide 76. So it's the last slide. Yes. On this slide, yes, you kind of preceded this with your question before, you can see with three different colors the components of response spectra calculated using the records that you saw before, and it is compared to CSDRS, red line, and with GMRS.

And as you can see, it exceeds GMRS, but again, please be careful because in a way, we are comparing apples and oranges because this is an actual record which happened to be at this site. What we do with GMRS, it's a probabilistic approach. Now, the important part, according to

GDC, general design criteria, we have to be concerned about maximal event, and we are concerned.

As you can see, CSDRS, or basically averaging this design for CSDRS at the site, is much higher. This is why there is no concern on our part from the safety point of view.

CHAIRMAN RICCARDELLA: Absolutely, there is no concern at all for North Anna 3, but it just -- I guess it doesn't give me a lot of confidence in all this new CS methodology and the new, you know, ground motion model and -- and we apply it, and we don't predict the -- we don't bound the earthquake that actually occurred.

MR. GRAIZER: Okay. Again, since you ask this --

CHAIRMAN RICCARDELLA: It's a generic question. Again, for the record, it has absolutely nothing to do with the North Anna 3 COLA.

MR. GRAIZER: A generic answer is even -- even I said it's apples and oranges, it is even more than apples and oranges. It is even more different because this record was obtained on basemat. Now, we did -- actually, we published a

paper with NRC staff, we actually elevated the record on the basemat at the bottom, basically, of construction, and at the elevation, and what we found out, that low frequencies are also affected by structural motion.

What is happening, when you have an earthquake, the whole structures start moving, and there is a kind of resonance at low frequencies. This is why in -- if it would be a clean record on the ground, like it should be, it may be lower at low frequencies also.

CHAIRMAN RICCARDELLA: Okay. Somebody could do that analysis, couldn't they?

MR. GRAIZER: We did very rough analysis, and rough analysis doesn't include this really absolutely, but clearly, what we concluded is that it is influenced by structural motion at low frequencies, where you see exceedance.

Now, how much? I cannot tell you, unfortunately. Okay, we didn't do this.

MEMBER MARCH-LEUBA: Instrumentation, you mentioned that blue line in there, the one that was in North Anna? Does it have a gradation of high energies -- high frequencies? I mean, I am

more worried -- I mean, Pete is worrying, the fact that the blue line is above the black line. I am more worried that it doesn't even follow the shape, that you completely miss the -- I mean, the prediction is that you're going to have, what, five times more energy at 20 hertz, and you didn't?

MR. GRAIZER: Okay.

MEMBER MARCH-LEUBA: That's a really bad prediction.

MR. GRAIZER: Okay. Let me --

MEMBER MARCH-LEUBA: And the first thing I am asking, is the instrumentation good at 20 hertz, or does it lose sensitivity?

MR. GRAIZER: Instrumentation may be good. The problem is that when you have, again, record on the basemat, it is not a free field. It is well known that it is filtering out high frequencies. What this means, that actually, if it would be recorded on a free field, it is absolutely clear that the high frequency path will be elevation. How much? I cannot say.

But there is a lot of measurements done in Los Angeles, and what I did in my previous slide, we compared real free field with ground

motion in the basemat at the different elevations, and it is always like that. High frequency is degraded or diminished. Now sometimes, even 50 percent. This is why -- but it depends upon structure. It depends upon many things.

This is why kind of, again, as I said, we have to be careful because this was not a free field record, and all these comparisons should be done with free field records.

CHAIRMAN RICCARDELLA: Were there any instruments around the Mineral earthquake that were not at the plant, like between the plant and the --

MR. GRAIZER: Yes, 50 kilometers away.

CHAIRMAN RICCARDELLA: Pardon me?

MR. GRAIZER: 50 kilometers away.

CHAIRMAN RICCARDELLA: 50 kilometers, that is pretty far.

MR. GRAIZER: Okay. It is a very difficult problem for seismology because basically, in our science, we only have money to install instrumentation in the areas where earthquake happens, and California has special provisions for this, special funding. This is different. All other part -- all other country part is not having

this law. California has a law that every new building pays certain fee to put strong motion instrumentation, and this is why there are gazillions of instruments in California, and there is not many instruments in Central Eastern United States.

CHAIRMAN RICCARDELLA: Okay.

MEMBER MARCH-LEUBA: Yes, I think you convinced me that there is no way you can move the whole plant 20 hertz.

MR. GRAIZER: Yes, exactly, exactly. If you look at --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: That's what you will have to do, though.

MR. GRAIZER: There is a filter --

(Simultaneous speaking.)

MEMBER MARCH-LEUBA: Quit while you are ahead.

MR. GRAIZER: Okay.

MEMBER MARCH-LEUBA: You were right. I was wrong.

CHAIRMAN RICCARDELLA: But it's the low frequencies that do most of the structural damage

though, so --

MEMBER MARCH-LEUBA: There is no way you can move it.

CHAIRMAN RICCARDELLA: Yes.

MR. GRAIZER: Yes, but this is a very good point.

CHAIRMAN RICCARDELLA: Yes.

MR. GRAIZER: I didn't mention this.

Just to finish, okay. The applicant -- basically, we concluded that the applicant did a good job, and we didn't find any -- at the end of the day, we had many many conversations, many many interactions with them, but at the end of the day, we concluded that they did good job, and they adequately addressed new and significant information related to the Mineral, Virginia earthquake, Central Eastern United States model, and additional subsurface conditions.

The site-specific GMRS adequately represent the seismic hazard at the North Anna site and meet relevant regulatory criteria of 10 CFR Part 52 and 10 CFR Part 100, and the site-specific ground motion meets and doesn't exceed ESBWR DCD in main area. I am done.

MR. WANG: Okay. Thank you. My name is -- my name is Weijun Wang. I am a Geotechnical Engineer. Dr. Graizer just gave a very interesting presentation, and I will very quickly go over the Section 2.5.4 and the Section 2.5.5 staff review.

And I actually came with a presentation in front of this subcommittee in 2009, and at that time, there was no outstanding issues regarding the geotechnical engineering. However, during the past seven years, we had some new information. So basically, three items: one, the applicant conduct more seismic investigation. They drilled 38 additional holes to get more the detail, the geological, geotechnical information, at the North Anna 3 site.

And during the site investigation, they conduct standard radiation test and collect more samples, and they use those samples to conduct more laboratory tests. They also measured some of the subsurface material, the properties such as the seismic velocity, in two borings. We call it the geophysical logging, and based on those new information, they validate, confirm, and fine tune the property and parameters of the subsurface

material which are used for foundation design and other analysis, such as we just talk, SSI, soil-structure interaction analysis.

And the second item is we just -- and all the seismologists for life, all they said, we got a new GMRS. So that comes to the question: will the new GMRS upset the stability analysis of the foundation structures? The answer is from the foundation stability point of view, the answer is no. Why? Because the new GMRS actually is lower than original GMRS.

Some people may ask why, so if we have time, I think that Dr. Graizer can give you a detailed explanation. Probably need two more hours.

(Laughter.)

MR. WANG: So I just stop here. So we got the new GMRS, so we got the lower GMRS, the ground motion, so the applicant could use the lower one to do a -- redo the analysis, but they choose not because if you use a higher seismic force to do your analysis, and if it's okay, then you will not get an update. The seismic loading is lower, which means your analysis, your contribution is more

conservative, so in that regard, we totally agree with that.

And the third item is about ITAACs. The ITAACs are new items in addition to the last subcommittee meeting presentation. Why we have the two new ITAACs? Because the new nuclear power plant, we will build at the site. However, underneath the foundation, the Category I structure, we will -- not we, the -- whoever build the nuclear power plant will place the concrete backfill underneath the Category I structure.

So we know the stability of the Cat I structure is very important, so we want to make sure the concrete backfill, when you place in the field, will have the property you designed for, the strength, the shear wave velocity, and so forth. So how to do that then? We said, okay, the applicant proposed ITAAC, so during the construction, they will follow the ITAAC to make sure the backfill will meet the design requirements, and similar to the -- the so-called engineer, the backfill, which is granular material backfill, those backfill will not place underneath the foundation, but surround the Cat 1 structure,

because the primers for those backfill will be used in the analysis, so we think it is also very important.

Because of that, we came up with two ITAACs. So now it comes down to our conclusion. Next slide, please.

The conclusion is very simple. The applicant properly characterized the subsurface material properties, the profiles underlying the North Anna 3 site and with consideration of all the new information. The analysis methods and the procedures are adequate and conservative. It meets the requirement of the DCD.

By the way, the slope stability analysis also showed there would be not any adverse effect of slope should it fail. Actually, based on analysis, it will be none.

And I just mentioned, we have two very good ITAACs to ensure the property of the backfills meets the design requirements, and all the shear wave items and related license conditions are resolved, and based on our review, we come to the conclusion the application of the Subsection 2.5.4 and 2.5.5 meets the regulatory requirements. That

is the end of my presentation. Thank you.

CHAIRMAN RICCARDELLA: Thank you. So we're now at lunch.

(Laughter.)

MR. SHEA: Just remember, it is lunch somewhere.

CHAIRMAN RICCARDELLA: So I suggest this is a good point to take about a ten-minute break, okay? So let's -- and I think we're changing panels, correct?

MR. SHEA: Yes, we're ready to go to panel three on the seismic structures.

CHAIRMAN RICCARDELLA: Okay. So let's say five after three, we'll get started with panel three.

(Whereupon, the meeting went off the record at 2:53 p.m. and resumed at 3:06 p.m.)

MS. BORSH: Dr. Riccardella, are you ready?

CHAIRMAN RICCARDELLA: I am ready.

MS. BORSH: All right. So we are back again. So we have Luben Todorovski from GEH is going to be - oh, I am sorry. Alidad is going first. We are going to talk about - Alidad from

Bechtel is going to do the 371 section and then Luben is going to go on and start with 372. Okay.

So Alidad, ready?

MR. HASHEMI: Sure.

MS. BORSH: Okay.

MR. HASHEMI: Thank you. Again, Alidad Hashemi from Bechtel representing Dominion. So in Section 371 - next slide, please - we talk about seismic design parameters for North Anna 3.

They include the safe shutdown earthquake, or SSC for the purpose of seismic design analysis and qualification of plant SSCs. We also talk about establishing the OBE, or operating basis earthquake for the purpose of plant shut down determination.

Also we calculate the SSI inputs including SSI input response spectra - corresponding spectra time histories and SSI input strength compatible soil profiles for SSI analysis of RB/FB, CV and USC.

We also adjust changes to NUREG or 800 SRP Section 371 Rev. 4. Next slide, please.

The SSC design motion is defined by two sets of ground motion response spectra. The first

one is ESBWR CS DRS and the second one are the site-specific fares for each building.

Because all safety-related SSCs are for North Anna 3 are designed and qualified to both CSDRS and site-specific fares, you would exceed SSC if both CSDRS and site-specific fares are exceeding.

The OBE is defined consistently with SSC as one-third of SSC. The OBE accidents is - the checking for OBE accidents is performed at the - in the free field at the ground surface.

So spectra associated with OBE is considered exceeded if both the one-third of the ESBW are CSDRS and the one-third of site-specific SSE manifestation upgrade are exceeded.

CHAIRMAN RICCARDELLA: Is this one-third new? I always recall from my old days it used to be one-half. The SSE was always twice OBE.

MR. HASHEMI: So one-third, based on SRP requirements, if you use one-third then you don't have to do a specific OBE analysis. It's a more conservative measure because you have a lower threshold for shutdown.

CHAIRMAN RICCARDELLA: Okay.

MR. HASHEMI: These OBE and SSE definitions are exemptions from Tier 1 and they are covered in 37-1.

Next slide, please. One of the inputs the SSI analysis or SSI strain compatible soil profile (coughing) material developed following Reg Guide 1.28 methodology. We use the results of site response analysis from Section 2525 that we discussed earlier.

We come up with lower bound best estimate and upper bound strain compatible soil profiles for each building. We consider minimum evaluation requirements of ASCE 498 as well as if for subgrade material that are below the ground water we adjust the period velocity of the material to account for the existence of water.

Also, for this material that surrounds the buildings for engineered field we do a very similar analysis with the same methodology to come up with lower bound SSE and upper bound properties for the engineer field.

Next slide, please. Another input to SSI analysis are the SSI inputs response spectra. So these are developed from the first that they

discussed in Section 2526 except that now you have additional requirements of so-called NEI check for ISG 17 and also the minimum required response spectrum for 10 CFR 50 Appendix X.

Consistent to SSI analysis we calculate SSI input response spectra for RB/FB NCD for both partially embedded analysis and fully embedded analysis.

For FW/SC we calculate SSI input response spectra not only at the foundation elevation of 282 but also at the bottom of the concrete field that exists below the foundation at elevation 220.

Note that this concrete field below FW/SC foundation is a site-specific feature and it's included in the departure 37-1.

And then development of spectrum compatible acceleration time is to follow option one approach to SRP 37-1.

Next slide. So on the next few slides I have a presentation of SSE and OBE spectra as well as the - an example for strain compatibility SSI soil profiles and then finally the SSI input response spectra for RB/FB CD and FWSC. But in the

interest of time I am not going to linger over them. Just let me know please if you have any questions. I'd be happy to answer. Otherwise, my colleague, Dr. Todorovski, will continue the presentation.

MR. TODOROVSKI: My name is Luben Todorovski. I am from GE Hitachi and I will present seismic analysis and evolutions we need to address the departure or the exceedances of the site-specific ground motion with respect to the standard design ground motion found with the CSDRS.

We perform a safe structure interaction and structure interaction analysis to calculate the demands on the reactor on seismic category one buildings by using site-specific ground motion and so properties that Alidad explained before.

Before the metals presented in the DCD using the same ESBWR dynamic models. The results from this analysis - from design basis analysis for envelope and then enhanced using the results from sensitivity analysis to determine demands - boundary demands that bound effects of sub grade properties and structure difference variations, sewer separation and side effects.

Site-specific analysis and aberration were done after that for structures and components using these bounding site-specific seismic demands.

Next slide, please. I would like to explain those are the - we consider the lower bound, upper bound and base estimate site properties to address the variation of site report. Then the next slide.

We also included near field elements in our dynamic models to represent the field materials around and below the control building and reactor building. We considered two different configurations - partially embedded and fully embedded, partially embedded in rock and concrete and we enveloped the results from these two analysis in order to obtain responses that will bound the effects of soil separations, variations of horizontal extent of the field materials and also elevation of water table elevation.

Next slide, please. In 5 of the 6 complex model we included also near field elements below the base of the structure - basement of the structure in order to account for the presence of the concrete material and for this model we

performed two sets of analysis, one with input motion at the bottom of the foundation and one with input motion at the bottom of the concrete field and we enveloped the results in order to account for the effects of raised beams transmitted through the concrete field.

Next one. Our design-based case analysis were performed using upper bound structural stiffness properties that represent uncracked concrete stiffness. These properties provide bounding seismic responses for North Anna Hard Rock High Frequency site.

In order to further evaluate the effects of the structural stiffness variations, we performed a sensitivity analysis on more of the reduced weakness, representing cracked concrete - fully cracked concrete conditions.

Sensitivity analysis confirmed that for North Anna site conditions the upper bound stiffness provides bounding responses. There were some local response amplifications that we considered in our design but you can see the demands obtained from the design basis analysis.

The next slide please.

CHAIRMAN RICCARDELLA: Just help me with what that figure is that's kind of - looks like spaghetti.

MR. TODOROVSKI: Okay. This is the design basis model used for the - in the DCD. So used exactly the same model that followed the DCD - ESBWR DCD.

CHAIRMAN RICCARDELLA: That's a stick model.

MR. TODOROVSKI: Right, and there are a series of structures which are modeled too. I did a motion direct portion of this plot represents the additional oscillators we introduced in this model - single degree of freedom oscillators.

Those were introduced in order to capture all the frequency - important frequency of out-of-plane oscillations - oscillations of the wall and the slats under fully cracked conditions.

Next one, please. Besides the SSI analysis of stand-alone models, we also performed analysis of combined models. In order to address typical side effects on the reactor building fuel building on the control building and also on the Firewater Service Complex on the control building

and control building of Firewater facilities complex.

CHAIRMAN RICCARDELLA: You've added another S to SSI. Would you help me with what that -

MR. TODOROVSKI: The first is structure soil structure interaction.

CHAIRMAN RICCARDELLA: Okay.

MR. TODOROVSKI: So SSI is only one structure and then you have triple side. That means more than one structure.

So the results from this analysis show that triple side effects are relatively small but there was some - but not negligible and we enhanced the demands to bound this triple side amplifications.

Next one, please. Besides this sensitivity study we also performed an additional study to consider the effects of the separation between the concrete field to below the complex foundation in the surrounding soil.

Those defects were addressed by running SSI and soil analysis with models that represent conditions of maximum separation between the

conflict of the surrounding soil.

The results showed some amplifications of the loads and also frequencies incidence from the complex response spectra as well amplifications from the load demands on the Firewater facilities complex. Firewater facilities complex demands were enhanced to bound these effects as well.

Next slide, please. This slide shows the 18 analysis cases formed for the reactor building fuel building. This one shows the 18 SSI analysis cases and five triple assign analysis cases that formed the site-specific design basis for the control building and this slide shows the analysis cases performed for the Firewater Service Complex.

The next one, please. Now, site-specific load demands for reactor fuel building can contribute structural developed as an envelope of the results from the analysis with different structural stiffness properties to notice that the triple side effects were negligible and didn't affect the design of the comparability structure.

The site-specific demands for the Firewater facilities complex structure were

developed as an envelope of the results from the SSI and triple SSI analysis representing fully bonded and maximum separated soil conditions.

These enveloping loads were further enhanced by using cracking amplification factors in order to address the effects of complex cracking.

Next slide, please. On the next slide we show examples of exceedances with respect to the DCD loads and you can see that for the reactor building they are fairly moderate.

The next slide, please. The same example - the next slide, please. Another example and then this shows the out-of-plane loads - local loads on the fixable slats and here we see bigger exceedances up to more than 50 percent in some cases.

The next slide, please. And this is the load from the flexible walls and also showing considerable local exceedances.

Next. For the control building it's shown before because there are more exceedances in the site-specific ground motion with respect to the CSDRS. We saw bigger exceedances on the horizontal loads, up to 40 percent.

Next slide, please. For the Firewater facilities complex the reflecting exceedances we received very small exceedances with respect to the standard design besides the torsion. And these are the out-of-plane loads from the slats and roofs of the Firewater Service Complex and control building.

The last table shows the 41 percent exceedance of the load on the shear key, complex shear key.

Next slide, please. Besides the loads we also looked at the response spectra following the DCD requirements and we saw that exceedances and frequencies of hertz which is consistent with exceedances in ground motion.

Next one, please. This is - these are representative, just one case to illustrate the exceedances. But we provided comparisons for key locations defined in the DCD.

The next slides, please. The same applies for the Firewater Service Complex. Next slide, please.

Next slide, please. Now, how this response spectra was developed, they would develop as envelope of the design business in the office.

Then for the reactor building - fuel building and control building they will enhance to bound all significant larger than 10 percent exceedances up to 50 hertz due to the concrete cracking effects.

Control building in structure and spectra were also enhanced further to bound the exceedances due to the typical side effects. Prior with the service contract and structure response spectra were developed as envelope of the results from SSI and SSSI analysis. So the bound effects of SSSI.

Also, they were enhanced to bound all significant exceedances due to the soil separation and also they were further enhanced to bound all significant exceedances due to the concrete cracking.

So all these instructions response spectra that we are using for evaluation of components and the equipment we have bound all this effects - site-specific effects.

The next slide, please. This is an example of the design in structure response spectra. The left is the standard design and the

right one is the site-specific and you can see for the site-specific for frequency close to 10 hertz there significantly higher and lower for frequency below 10 hertz.

Next one, please. Also the FSAR we have ITAACs are included that specify the SSI and SSSI analysis that have to be done in conjunction with the DCD ITAAC analysis to verify as-built non-Category 1 structures - the interaction of non-Category 1 structures with seismic Category 1 structures.

And as we discussed in the first session, this would specify the three PSI load on the as-built building for the liquid hydrogen storage tanks.

And the next one, please. ITAACs were also - are also presented that you used for seismic evaluation of underground piping and tunnels and conduits.

This ITAAC specified that a seismic analysis should be done for a design basis - I mean, standard design based motion and also first which will be developed based on the methodology presented in Section 2.5.2.

The site-specific first will be amplified as necessary to include the effect of SSI site from the adjustment of heavy foundations.

The next one. Now, this is the last light in Section 3.8 besides the seismic Category 1 structures. We did all separations of components and equipment. Oh, no, this is for the seismic category structures.

We did the final element analysis to calculate the stress demands. Those analyses were performed following the methodology in the DCD and using site specific seismic loads.

Those loads were combined with the demands from no seismic loads which are bound by corresponding site-specific demands.

The next one. The next slide shows that models used for this stress analysis which are the same as the one in the DCD. The next one, please.

Stress checks were performed to check if the demands are acceptable correspondence to ASME and ACI codes.

The one departure from the DCD methodology was that they used parabolic instead of

linear concrete stress strain relationship for this evaluation for some regions where we have higher load demands but this is in accordance with the ASME code. So that's - we didn't depart from the code.

In addition to the elements which are specified in the DCD, we also looked at the elements that are in the regions which have experienced high site-specific load demands.

Those additional stress checks demonstrated that we do not result in changes of the DCD concrete properties like thickness or the cone sizes or so.

Next one. The performed seismic stability evaluation to demonstrate the stability of the Category 1 foundations for the North Anna site based on the seismic force obtained from the site-specific response analysis.

I've used 0.6 coefficient friction which is the smallest among those for the - for the site. Effective rate reflecting the site-specific ground level - ground working level.

We neglected conservatively the resistance from the soft soil, the reactor building

fuel building shear key, as well as the skin friction. And the site-specific evaluation demonstrated that the capacity of the concrete fuel and the rock subgrade as well the shear keys and below grade walls is sufficient to resist any demands that - ensuring the slide and stability of the foundations.

We also demonstrated that the bearing capacity of the sub grade is sufficient to resist site-specific dynamic bearing pressure demands.

Next slide, please. Also, there were some small changes that were done to address some local exceedances. Those changes are small and are based on changes in the arrangement of the sheer ties for the summary enforcement for reactor building - fuel building exterior walls.

We performed refined calculations as a departure from the DCD methodology where we applied average acceleration load for the down-frame floor and ensured that it remains within allowable limits.

The next slide, please. A similar conclusion was from the evaluation of the control building and Firewater Service Complex structures,

that one steel girder needs to be changed, to be beefed up, to withstand the site-specific seismic loads. And also some additional rebar and shear ties were added to the Firewater Service Complex shear keys and the basement in order to resist the higher - the loads from the shear keys.

Next one, please. Besides that, we also looked at the seismic adequacy of the equipment and components so we looked at the PCCS condenser, the site and the new and the spent fuel storage racks and basically they are within the limits.

They are adequate for the North Anna with small changes in the supports like anchorables and embedments and some welds on the base plates and with this I will conclude my presentation unless you have any questions on that.

CHAIRMAN RICCARDELLA: So in summary, there were load increases that resulted in some small design changes needed but for the most part not a lot of changes?

MR. TODOROVSKI: Very small. Okay. Very local, very small and in the locations which we will expect looking to the exceedance in the

ground motion that I am looking at exceedance for the load demands as well.

CHAIRMAN RICCARDELLA: Thank you. So we have the staff coming now or -

MS. BORSH: We could, or it might be more efficient - so we have about five or six slides to do - the seismic components. So would you like us to just go ahead and do that?

CHAIRMAN RICCARDELLA: Yeah. Let's keep going.

MS. BORSH: So Mike - thank you, guys. So Mike Arcaro is going to come up and cover that for us. Thanks, Mike.

MR. ARCARO: All right. My name is Mike Arcaro from GEH. I am going to be presenting the seismic components and seismic margin analysis for North Anna 3.

So as part of the seismic closure plan Dominion committed to perform site-specific seismic evaluations for components that were done in the DCD and prepare a site-specific seismic margin analysis and this evaluation will be performed using the North Anna 3 seismic demands.

Next slide. Okay. So one of the

components that was done was the GE 14E fuel. The evaluation was performed considering seismic demands from site-specific analysis using approved DCD methods.

This analysis considered effects of safe shutdown earthquake, loss of coolant accident and safety relief valve accelerations.

Limiting fuel accelerations from the combined seismic and dynamic loads were compared to the bounding limits given in the DCD and the results showed that for the GE14E fuel it was adequate for use for the North Anna 3 site.

The final as-built information will be used for ITAAC to verify the seismic and dynamic loads that are within the limits.

Next slide. In addition to the fuel, the control rods were also analyzed. So an analysis was performed using the North Anna 3 seismic demands following the DCD approved methodologies.

The North Anna 3 maximum horizontal fuel channel oscillation amplitude was less than 10 percent higher than the DCD value. That was the acceptance criteria.

During that evaluation we identified three areas that could be affected by the approximate 10 percent higher value in the oscillation. So those were the control rod wing outer edge bending, the absorber tube to tie rod weld and seismic scram testing.

So we looked at those specifically using conservative assumptions for the deflections due to, again, seismic and dynamic loads and the results show that all three of those evaluations were acceptable.

CHAIRMAN RICCARDELLA: When you say fuel channel oscillations you mean movements -

MR. ARCARO: That's correct.

CHAIRMAN RICCARDELLA: - due to seismic, not power oscillations or anything like that, right?

MR. ARCARO: Right. And so the assessment also demonstrated a margin to the seismic scram testing and the controller design was acceptable.

During this evolution, we also developed a new ITAAC and that added acceptance criteria and the final as-built information.

Next slide. Okay. So we also looked at the fuel storage and handling in Section 9.1 of the FSAR so the fuel storage racks structurally were evaluated using the DCD methodology, again, using the site-specific seismic demands.

For the new fuel storage, and this was - Luben brought this up in this presentation - the new fuel stored in the buffer pools showed the local exceedances so the size of the anchor bolts were increased and the loads of the final embedments will be increased to withstand the higher site-specific loads.

The spent fuel pools - spent fuel racks in the buffer pool - same sort of scenario. The size of the anchor bolts will be increased. The corner welds from the enveloping plate to the base plate are also increased and the embedments - final embedments will have to be increased to withstand the site-specific loads.

So considering those modifications, the fuel racks in that area are adequate for use at North Anna. The final area that we looked at was the spent fuel stored in the fuel pool storage racks in the fuel pool and that was evaluated using

the DCD methodology under the site-specific loads and no design changes were required there. That was adequate and could withstand the North Anna 3 seismic demands.

Next slide. In addition, we committed to performing a seismic margin analysis with site-specific evaluation. So FSAR Sections 19.12, 19.5 and Appendix 19 alpha discussed the North Anna 3 seismic risk evaluation for the departure 3.71.

The site specific seismic margin analysis update was performed to evaluate the impact of the peak ground acceleration under DCD DRA risk insights in support of the plant-specific DRA using the DCD methodology and the guidance provided in ISG 20.

MEMBER STETKAR: Mike, you talk about this as a seismic PRA. It's a PRA-based margins analysis. The site has to do an actual seismic PRA prior to fuel loads, right? Just - I just want to make that clear for the record.

MR. ARCARO: Okay.

MEMBER STETKAR: Thank you.

MR. ARCARO: Like I said, the results of this - the site-specific seismic margin high

confidence low probability of failure sequence analysis showed that North Anna 3 is inherently capable of safe shutdown in response to beyond design basis earthquake and has a plant level HCLPF of at least 1.6 times the peak ground acceleration.

So as-built values will be compared and confirmed prior to fuel load.

MEMBER STETKAR: Mike, why - I noticed that and I think I know - it states, that last thing that you just said there, as-built values in a particular as-built HCLPF capacities will be compared to the ones used for the margins analysis prior to fuel load.

Why do you need to do that if you're going to do a full seismic risk assessment? Because those HCLPF capacities are essentially meaningless once you do the real PRA.

MR. ARCARO: Yeah. You know, so they didn't use the actual equipment. Is that what you're getting at?

MEMBER STETKAR: No, no. When you do a real PRA you do - you take the entire hazard spectrum and you take the entire fragility spectrum and you convolute them and you get likelihoods of

failure which you evaluate in the PRA model.

So the notion of a HCLPF capacity - HCLPF for the record - is only a numerical value that people tend to use for truncation of their fully convoluted analyses.

So, to me, once you - once you perform the PRA a comparison of the as-built HCLPF to some HCLPF that was used in the - whether we want to call it the COL margins analysis or the DCD margins analysis, I don't know what you gain by that because you've - by performing the PRA you essentially obviate the need to do that.

If you - you know, and, you know, well aware of the guidance says that the required fuel load the applicant has to perform an PRA consistent with - I don't know, whatever the words are but it essentially endorsed guidance in place one year prior to fuel load and theirs endorses ASME and ANS standard guidance on how to do a seismic risk assessment and it says you can't do margins analysis.

So I was just curious why that's the - it seems like, to me, essentially what it's saying is it seems like extra work and I don't know what I

get out of it. You know, what happens if there is a difference.

MR. ARCARO: Yeah. I think we do have the subject matter expert on the phone so -

MEMBER STETKAR: It's fine. It's just a - you may want to think about that.

MR. ARCARO: Yeah. I can't answer why we did that.

MEMBER STETKAR: I read it in there and I said well, gee, why are they - why are they doing that.

MR. ARCARO: And that might have been a commitment for the seismic closure plan also.

MEMBER STETKAR: I think it may be a commitment that's held over from the DCD because the DCD was - you know, it's a COL whatever you call it - information item -

MS. BORSH: Oh, yeah.

MEMBER STETKAR: - out of the DCD.

MS. BORSH: Yeah.

MEMBER STETKAR: Because when the design was certified it's not clear what - I don't think the seismic guidance had been approved yet for - in the PRA standard.

MR. ARCARO: Yeah. So the FSAR says that a seismic analysis update using site-specific values will be performed and then in addition you're going to do this comparison prior to fuel load.

MEMBER STETKAR: I mean, you're going to have to develop site-specific full fragility curves for the as-built -

MR. ARCARO: Right.

MEMBER STETKAR: - plant design. You can back HCLPF capacities out from those, obviously. But then doing that comparison with whatever is used is kind of this incarnation of the PRA I don't know - suppose they're different.

How - I mean, if they are the same, okay. Suppose they are different. What do you do? You say well, we did a PRA and rely on it.

MR. ARCARO: Right.

MS. BORSH: We - that's a change to - that we added in Rev. 9 of the FSAR and it may have been in response to the seismic closure plan or an RAI. So we will take that back and look at it and see.

MEMBER STETKAR: The staff may have

more insight. I think I know where it came from but it's a poor man's SPRA, right?

CHAIRMAN RICCARDELLA: No, no, no. You can't do it. See, the problem is by the time of fuel load they have to have a real - what I call a real seismic PRA.

Convoluting of hazard and fragility curves for the as-built plant design and they can't avoid that.

I mean, that's required. And once you do that, comparing, you know, the HCLPF capacities at that time to the HCLPF capacities that are used in the current - I am not going to call it poor man's seismic PRA because it's more than that but it's not a real seismic PRA. It's called a PRA margins analysis. I just don't know -

MR. ARCARO: Yeah, we will have to get back -

MEMBER STETKAR: I am trying to get you out of being on the hook for doing things that I am not sure - well, no, I am not sure.

If they come out the same that's kind of good but somebody's got to do that comparison and they've got to tell somebody that they did it

and somebody has to review what they did and, you know, if they come out different I have no idea what it means because you don't use that information anymore. Anyway, I am sorry.

MS. BORSH: So that's a comment that we will go back and look at and see if maybe we want to revise our FSAR. We will see. Thank you.

MR. ARCARO: The last bullet on my slide talks about non-seismic structures that house - written as category Charlie systems. They are designed to two-thirds of the SSE as defined in the FSAR Section 371.

Any further questions?

MEMBER KIRCHNER: May I ask a question, Mr. Chairman? It's - I am not sure if Mike is the right person. It's more of a generic question.

So there - in the course of what was presented, a lot of detailed analysis, there were a number of exceedances. Were you surprised by these? I mean, typically why I am saying this as a generic is that we often have presentations for standard designs. I didn't say that correctly.

Comparisons of designs - the COLA designs for - against the DCD and usually the DCD

brackets almost - everything that's thrown at it. But here because of the unique site characteristics you have a number of exceedance. Is that out of normal? Is that - did that surprise you, the fact that there were a number of ITAACs where you will go in and make changes to the physical structures to deal with the analyses?

MR. TODOROVSKI: I will take that. I am Luben Todorovski. Basically, to my presentation in the FSAR we provide a lot of comparisons of the results of the DCD and basically all the core comparisons confront the exceedances in the ground motion that consist -- and the loads are consistent.

Now, as I said, as a conclusion of my presentation, yes, we did the loads exceed - they can exceed considerably, almost 50 percent in some cases.

But those exceedance are usually local and then they are - because they are high frequency domain they are not - and these are quite -

MEMBER KIRCHNER: They are high frequency.

MR. TODOROVSKI: Right, and there are

also quite a bit of margin in the standard design they were enveloped with a few differences and those are small changes in the design - the actual physical design represented by more reinforcement in certain cases for reinforced complex structure or slightly bigger I-beams or more welds or bolts or something. But nothing substantial that -

MEMBER KIRCHNER: Nothing that surprised you or -

MR. TODOROVSKI: No. Actually we were very careful to see the results really match and to explain why we have more, for example, amplification control building loads than for the reactor building and this is because the ground motion for the control building exceeds more than for the reactor building.

CHAIRMAN RICCARDELLA: I mean, going back to Section 2.5 I mean the foundation input response factor exceeded the certified design spectra from about six or seven hertz up to about 20 hertz.

MEMBER STETKAR: Right. But Walt, you know, you have to look at the historical - we heard it from the staff but again to reinforce what's

happened between the design certification for the ESBWR and the results that we are seeing now is that, first of all, the whole central and eastern United States seismic hazard has been reevaluated.

They are basing that on that. The original certified design was based on the previous - the earlier hazard. Second, the ground motion response models - the upper ground motion response models so getting the hazard to the site. And third, there hasn't been a earthquake which had a small effect, you know, on the site.

So there is been a bunch of changes compared to the spectra that were developed for the certified design and in some sense it might be surprising that there is closest - so I think all of those things, you know -

MEMBER KIRCHNER: Okay.

MEMBER STETKAR: I think Fermi was fortunate because it's such a low seismicity zone and so far away from the RLME sources that it really wasn't affected by all of the - it still remains enveloped by what was done earlier.

MEMBER KIRCHNER: Okay. Thank you.

MS. BORSH: So with that, we are done

with our presentation and we will move over and let the staff present on seismic. Is that okay?

CHAIRMAN RICCARDELLA: So you're completely done, Gina?

MS. BORSH: Well, excuse me, Jim. The only other thing that we have is we do have some answers to the questions that were raised or comments this morning on electrical and ETE. So if you'd like us to talk about those before we go we can certainly do that.

CHAIRMAN RICCARDELLA: Okay. Well, we are doing a pretty good job of catching up here.

MS. BORSH: Yeah. Okay. So would you like us to go after you -

CHAIRMAN RICCARDELLA: Yeah. Let's finish up the seismic and then come back and answer those questions.

MS. BORSH: Sorry.

MR. SHEA: This is Jim Shea from the project staff and we are on to panel three, which is the seismic structures. We have Manas Chakravorty - is that right, Manas?

MR. CHAKRAVORTY: Yeah.

MR. SHEA: And James Gilmore, who will

go through these seismic structures. And we will start with Manas.

MR. CHAKRAVORTY: Okay. Is it on?

MEMBER STETKAR: Turn it - push down at the bottom towards your thumb there and the green light - yeah, there you go.

MR. CHAKRAVORTY: Okay. My name is Manas Chakravorty. I am a structural engineer in the NRO and myself and there was three more persons, Jinsuo Nie, Sunwoo Park, George Wang. They are from NRC.

They also participated in this review as well as we had a contractor from Brookhaven National Laboratory. His name is Joseph Braverman and NRC staff is right here.

So anything - you know, anything they could answer they might answer. But at any rate, we had total for four people, including myself. And I was the team lead and I reviewed 3738 primarily and I would - Dominion did a very good job presenting the details of the seismic evaluations that was done.

So I would go basically how staff rebuild this - the process mainly and also the

results - what was the results of staff's.

The background - I think we have heard already that there is the exceedance of CSDRS of - at the North Anna site and the exceedance probably started around 8 hertz and went beyond that and there are a lot of components on these in that region and structure also has the matter of frequencies in those region.

So it is important to look at that very carefully. It was a little bit challenging but probably the most challenging one that I have done in the NRC.

Applicant took a departure from the DCD and because the departure was also in the tier one information they also - it was an exemption from the rules and then the seismic inputs they already say the seismic input consists of now two input like CSDRS, which is already, you know, done as a part of DCD and then the site-specific first, okay, which are the manifestation of an SSE event if it's not done on site at various locations so wherever the structure is they are a little bit different depending on the evaluation.

We call that first and then that first

is partly defined to make the seismic actual input because of additional requirements of Appendix X which defines that you need to have a minimal level.

So we had really two input. Now, for this evaluation we looked at the first because CSDS is already done. The applicant, as a result, to demonstrate that the ESBWR will be acceptable at the North Anna site, they did analysis - seismic analysis to calculate the seismic demand as well as a designed evaluation of the scanned plan structures because as we have seen before that there are a lot of exceedances of the loads.

The reviewed scope of what we did, we looked at the designed evaluations of the reactor building and fuel building, control building, Firewater storage complex and then also reactive containment, concrete containment vessel including inside - including the PCCS, the passive component - passive cooling system and the condensers containment internal structures. Then we looked at new and spent fuel storage racks.

If you look applicable tier one and tier two information as well as part seven of COLA

- the departure and exemption evaluation. We have also performed confirmatory analysis of the seismic input motions. In other words, when they provide, say, force, representative force, now really for a deterministic analysis we need to develop a time history.

So we also made some independent evaluation of the time history as well as strain-compatible soil profile and the SSI analysis for Firewater Service Complex. We just needed one case with the soil separation just to see how the results compare.

And then in addition we also have done the verification and validation of the computer programs that they have used or we have used in the North Anna primarily SASSI 210, and all the details are present in the SER how we did it and step by step, all those information.

So we also reviewed spent fuel pool, you know, storage vats and so can you go to the next slide?

These are primarily the regulations and guidance that we used in the - as far as - then I'll go basically the results of our review, okay,

what we found.

Now, staff originally reviewed FSAR - they have seven and eight and based on that review we had about 29 RAIs and these RAIs, you know, the major issues that we identified in these RAIs include consideration in the seismic demand, the effect of potential variation of structural stiffness, potential of separation of soil and the embedded walls, effect of adjacent structures which are known as triple IS - SSSI, the location of the control motion for the Firewater Service Complex SSI analysis. Also we identified that it was an approximate method for evaluation of the standard design for site-specific demand and also at the time, you know, we did not have in the FSAR the fuel storage evaluation, the PCCS condenser site specifics - you know, for site-specific seismic demand and as well as an updated SMA was not there.

So anyway, these are - these are the RAIs that we initiated and then also in response to these RAIs we had a number of public meetings and then the applicant modified its approach to performing certain aspects of the seismic analysis and they have developed a seismic closer plan.

The seismic closer plan included the tasks necessary to address the RAIs with an accompanying schedule and then a key feature of this closer plan was to provide information to the NRC as soon as it becomes available and that so it was very helpful because as soon as they are doing it you can do it so it saves a lot of time and issues that are identified in a timely manner.

So we went that way and as Dominion mentioned, they have done several SSI analysis, you know, like 18 SSI analysis for the reactor 12 building - control building. They had a slide on that. And then so can you go to the next - the next page?

We have done the review in two phases. The first phase was primary to develop the seismic demand aspects, okay. Anything to do with developing the seismic demand which means the loads on the structure, amplified response.

But they are the seismic events. So we focused primarily on that in phase one and once phase one was done we focused on the capacity evaluation. In other words, where this load had exceeded and what was the magnitude and how it will

be - how the design was verified and the applicant already mentioned they used a similar method as DCD, basically the same method, and plan on running a finite element to develop the detailed stress tests. So they actually performed a detailed stress test for this specific seismic demand at the North Anna site.

Now, what we found that the standard design is adequate except few instances where a design change is necessary. The changes include modifying the element of some steel reinforcements, some shear ties, the size of steel girders, well size and some anchor bolt sizes and embedments.

Important thing is no changes to the thickness of the concrete walls or slabs. That's very important because that gives us confidence that the design is okay. You know, I mean, we don't have a major change and in fact -

MEMBER KIRCHNER: May I ask a question? So my earlier question - I expect that the DCD - the base design is a very robust and, yes, there are different site-specific aspects of this - the seismic demand.

So when you say no changes to thickness

of concrete walls and slabs that were needed, what basis do you - you had exceedance of loads. You look at the margin that's in the building wall and apply the load against? Then even if there is an exceedance you say, well, you have sufficient margin?

MR. CHAKRAVORTY: Well, yes. Basically, we have to go to the code - allowable code stressors. So when you do that there was no need for the change in the thickness, only minor changes in the shear ties and some spacing of the shear ties spacing, that kind of change. Okay. Or some anchor bolt increasing a little bit of the diameter of the anchor bolt.

So that kind of change. In fact, I am very confident that had there been no changes - you know, they didn't do anything, that this structure will perform excellent - my professional experience. But since we are now in a design mode we should take care of what it is, not an evaluation. We are designing it. That's why, you know, any little changes that it can do it can do and these are very minor changes.

CHAIRMAN RICCARDELLA: Yeah. Well,

having done a lot of code stress analyses in my life, you don't necessarily always go to .98 percent of the limit. Sometimes it comes out to be 50 percent of the limit or 75 percent of the limit. And so you increase the load - you're still below the limit and very often it's the case.

MR. CHAKRAVORTY: Right, and -

CHAIRMAN RICCARDELLA: My point was it's against code, though, that you make the determination.

MR. CHAKRAVORTY: Yeah, against the code. So next slide.

Documenting our SAR that they do confirm that the site-specific seismic design method for SSIs is acceptable at the North Anna site will be identified changes. I think it will perform adequately.

The site-specific ILS, you know, we had ISIs instructional response spectra that is used for design analysis of the equipments and components. You know, it has been developed all the places separately and where necessary they have taken all the effect of stiffness variation and triple IS and all those things. They are there.

So and those codes were developed because we did audit in two phase - to audits. Okay.

Audit one for the demand evaluation, audit two for the capacity evaluation and we have seen they have - when the applicant has developed all those IRS inappropriate locations, given the source. These IRS has exceeded also the CS DRS. So nevertheless they would now use volt, okay, in their qualification.

So I do not have any concern. I think - I think the - we have - our applicant has done an adequate analysis to justify that and we have reviewed it and we find it acceptable.

MEMBER RAY: When you say you use both, do you mean envelope both or do you mean use them both - each one separate?

MR. CHAKRAVORTY: No, separate. Separate. They have done the CS DRS already, okay, of the will - of the different qualification. They will use the spectra denied from the CS DRS as well as the first.

CHAIRMAN RICCARDELLA: I assume there were some areas where the ISRS didn't exceed the designs. Is that right?

MR. CHAKRAVORTY: Yes. There may be some.

CHAIRMAN RICCARDELLA: In those cases that would require a reevaluation.

MR. CHAKRAVORTY: Of course. Absolutely. No question. You know, never duplicate your work. That's basically -

MR. GIACINTO: If there are no further questions I'll - okay. I am Jim Gilmer from Reactor Systems Branch. We will be discussing the Chapter 4 review.

You got the slide? Oh, you want to -

MR. CHAKRAVORTY: The rack already presented.

MR. SHEA: We will skip the racks?

MR. CHAKRAVORTY: Yes, skip - because it's already the same thing, that dominion provided.

MR. SHEA: Understand. Skipping.

MR. GIACINTO: Okay. I am Jim Gilmer from the Reactor Systems Branch of NRO and have a couple members from the branch to help me out with questions if I can't answer over to the side here.

Actually the first seven revisions of

the COLA on Chapter 4 was IDR incorporated by reference. I believe Revision 7 introduced the departure 371, which then resulted in site-specific exceedances for both the fuel and control rod due to a few frequencies exceedance.

The regulations that we used and, of course, the ESBWR rule - Part 52 Appendix E - and the key regulation was generally designed criteria two design basis for protection against natural phenomena which requires demonstration for structure systems and components that the safety function can be performed with a combined natural phenomena and the hydrogeneric loading.

The rest are just the guidance there that is applicable. Next slide. I've already given a little bit of the background but basically the concern that we had is that because of the exceedances we were aware of we needed information to conclude that the site-specific fuel would remain bounded by the design certified capacities.

And the certified design includes a couple of mechanical topical reports - I believe two for the fuel and one for the control rod that documented analyses and testing.

The fuel testing was actually done for the GE 14 fuel, which is 12 foot length and it's used in the operating fleet and the ESBWR fuel is two feet shorter, approximately.

So it would actually be stiffer. So we concluded that the tests would be using GE 14 fuel would bound the 14E.

The hydrogeneric loads portion which would include LOCA SRV chugging, condensation oscillation, et cetera, is an approved topical report that is incorporated in the rule for the ESBWR and there is another topical report in the NEDE 20175 that provides the methodology. Essentially the latest revision is a method for calculating the vertical uplift for the - for the fuel.

The earlier version has documented the entire methodology. The design cert has a tier one ITAAC number 15 for the - for the fuel to ensure that the as-built analysis is completed prior to the fuel loading the demonstration acceptability.

Dominion prefers an additional ITAAC as part of the COLA for the control routes, a similar analysis and demonstration of the acceptability.

Okay. Next slide. Okay. The staff confirmed that the methodology used to determine the site-specific fuel accelerations was consistent with the method approved in the DCD and essentially what Dominion has done is done the ITAAC in advance except using downing hydrodynamic loads since the detailed engineering is not complete yet and that will, of course, be repeated once the detailed engineering is complete.

Okay. I've talked already about the tier one ITAAC and the COLA part ten - ITAAC for the control blade.

Next slide. Okay. In conclusion, the staff determined that the site-specific mechanical stresses are bounded by the certified DCD test values and the control rod stresses as well as the scram and searching times remained bounded by the DCD test ways.

And prior to - prior to fuel shipment the ITAAC will be completed to demonstrate that the fuel that's loaded will be acceptable.

And finally, our safety evaluation concludes that the fuel in the control rods are in compliance with the regulations. Any questions?

MEMBER KIRCHNER: Jim, so I would assume that all the design and analysis work is done for the - for the fuel elements and the control rods so what will you confirm when they get ready to ship fuel? You'll do a quality control check on the fuel to see that it needs design specs or - or not repeat analyses at that late date, would you?

MR. GIACINTO: Well, the part that will be completed prior to fuel load is the hydrodynamic loads. In fact, actually they are currently using basically frictionless bounding as SRV and local loads.

So the actually as-built will be - actually lower the hydrodynamic loads. So we needed to determine now that what actually gets built will be - will be acceptable in order to grant the COL.

MEMBER MARCH-LEUBA: Have they tested hydronically the short GE 14 fuel for pressure drop and CPR or are they using conservative long fuel correlations?

MR. GIACINTO: I am actually not sure what they did on the - on the CPR. I believe

though the methodology is the same. They are using basically the GSTAR method for - that's used in the operating -

MEMBER MARCH-LEUBA: So they are using the 12-foot tests. I am assuming that it bounds the - what is it, 8-foot?

MR. GIACINTO: I believe that's the case but I'd have to confirm.

MEMBER MARCH-LEUBA: And second, we are - the staff is given a license for North Anna to operate with GE 14E.

MR. GIACINTO: Right.

MEMBER MARCH-LEUBA: So 15 years from now when they rate the load GE will have to refit - retool their machinery to - because everybody is in year five then, right?

MR. GIACINTO: Right. Maybe GH can answer that better. But I assume that -

MEMBER MARCH-LEUBA: Basically come in and to find GE 14 is somewhere, right?

MR. GIACINTO: Yes.

MEMBER MARCH-LEUBA: And then for cycle two you put GRF 12?

MS. BORSH: We have to revise our

license to reflect - this is Gina Borsh from Dominion. Yeah, so our license is for the GE 14E fuel and that's what we plan to use and if we have to get a license amendment at some point then we will.

MEMBER STETKAR: That one stays on all the time. Just don't whack it.

MR. SHEA: Other questions?

CHAIRMAN RICCARDELLA: Yes. This question is probably more for Manas. Noteworthy to me by its absence is no reconsideration of the reactor pressure boundary seismic loads and I am kind of surprised that the seismic response would affect the fuel, I mean, without affecting the reactor vessel.

MR. CHAKRAVORTY: Well, the reactor vessel was modeled in the dynamic analysis but it was a - what do you call, lump mass model simplified. And it was - fuel was included there too.

CHAIRMAN RICCARDELLA: Hmm?

MR. CHAKRAVORTY: Fuel as well as the reactor vessel.

CHAIRMAN RICCARDELLA: Yeah.

MR. CHAKRAVORTY: They are included in the lump mass model.

CHAIRMAN RICCARDELLA: But there was no increase in the loading - in the loads on the vessel or -

MR. CHAKRAVORTY: There was no - well, we had -

CHAIRMAN RICCARDELLA: - some piping connected to the vessel?

MR. CHAKRAVORTY: We had looked at from the structure point of view the support loads - okay, the reactor vessel support loads and we have looked at them and they are fine, okay. They are within the DCD limits. Okay.

Now, as far as the reactor coolant system and we have not looked at that.

CHAIRMAN RICCARDELLA: But I assume that if the loads had gone up in the reactor coolant system that we'd have seen a presentation of the results, right?

MR. CHAKRAVORTY: That - you know, that's a - we didn't review the actual components, you know, like cold - you know, I don't know here, you know, what kind of things, you know, the

reactor vessel needs to go to these streamlined -

MS. BORSH: Right.

MR. CHAKRAVORTY: We have not looked at it.

MR. SHEA: The staff did review this in Chapter 6 and basically it comes down to meeting the ASME code requirements so at the as-built condition.

So that's what they are - when they evaluated in Chapter 6 we actually sent this back to them - to validate that they didn't have any additional need to review or add or, you know, based on your exact question and they came back and said no, what's in Chapter 6 is acceptable because it's really based on whatever the results are on the actual design they will meet the ASME code requirements for the pressure boundary.

CHAIRMAN RICCARDELLA: Yeah. Well, that's what I mean. But that's the case for all the components we reviewed and but they made specific presentations on some equipment and some components.

I am assuming that loads on - in the reactor cooling system are still bounded by the

DCD.

MR. CHAKRAVORTY: I don't know - I know the supports are bounded.

MS. BORSH: This is Gina Borsh again from Dominion. So what we did with North Anna 3 was we evaluated the structure systems and components that were evaluated in the DCD. And then we had some - Mike wants to go ahead - and then - and then for those areas in the structures, as Luben was explaining, where we saw some loads that were higher than what was in the DCD or than what we - or in certain areas than we evaluated those further.

So we are following the DCD and as Jim said, you know, we will have to meet the ASME code and we will have to do additional analysis as the detailed design proceeds.

MR. ARCARO: I think that was - this is Mike Arcaro form GE - I think that was the answer that we would give too is that, you know, the seismic closure plan just looked at those components that were looked at in the DCD. You know, every component - every seismic Cat. One component is going to have to beat the, you know,

the seismic criteria for North Anna 3. So this is just a sampling and I believe that, you know, the vessel was not one of those components that was impacted by this.

MR. SHEA: Thank you.

MEMBER KIRCHNER: And if you look at what the - why we looked at the fuel a little closer because the actual DCD, the technical reports that are referenced, even though the ultimate answer in the technical reports are bounded by what Jim and the staff did there was exceedances based on what the DCD approved - in other words, in the stresses, for example, on some of the fuel materials. It was - it actually exceeded the DCD. So that's why they wanted to relook, I guess -

CHAIRMAN RICCARDELLA: I guess I am just trying to understand how the load - the loads that get to the fuel have to go through the reactor vessel and how the - how they could go up and not - and not have the loads in the coolant system go up I don't understand.

MEMBER KIRCHNER: I think physics comes into play here. This is, you know, the smaller

components like the fuel are more likely to see an impact from higher frequency than a reactor vessel.

So from a physical standpoint I wouldn't expect to see a major impact on the - at least the vessel - the steam generator is the heavier piping. But a more fragile - pardon my use of the word - component like a 12-foot-long fuel rod is going to interact with that seismic signal much differently than a stiff RPD.

CHAIRMAN RICCARDELLA: Thank you.

MR. LUPOLD: Mr. Riccardella, I am Tim Luphold. I am the branch chief from the mechanical engineering branch and it was my branch that evaluated the exceedance for the mechanical components, and basically what we did is we ensured that the licensing was still going to meet all the requirements for the ASME code for all the mechanical equipment and we also have an ITAAC then that we will go back and verify that this is actually met.

CHAIRMAN RICCARDELLA: Thank you, Tim. So where are we? With that we managed to - we will finish up with -

MR. CHAKRAVORTY: I'll finish up. But

the SMA update, I have really no new information there other than what Dominion already told you. And all I wanted to say there, the original structures, you know, we have category two - which are located in the category two structures. They are fully qualified for SSE.

MR. SHEA: If I could just add, based on discussion that with Dominion was that the reason there was an update in Rev. 9 and that a confirmatory item because the site-specific CD DRS infers actually applies - that it's 1.67 times the new actual site-specific, you know, ground motion and that's why you end up with a departure of 3.71 which is now confirmed through a Rev. 9 which was the change essentially for that chapter.

CHAIRMAN RICCARDELLA: Okay. So I guess - are we - we are done with seismic, I think, and we were going to go then cycle back and hear the answers to some of the questions on electrical engineering - on the electrical.

MS. BORSH: Okay. Do you - do you want us to come up front or can we do it from here? What would you prefer?

CHAIRMAN RICCARDELLA: If it's just a

short answer you can do it from there.

MS. BORSH: I think - I think it'll be short. Okay. So John Disosway has the short answers for electrical as far as the questions about the control room and the switch room

MR. DISOSWAY: Okay. John Disosway from Dominion. So the first question from this morning to get an answer for had to do with how many transmission lines were required to power units one, two and three and as I understand it in shut down condition recovering from a loss of offsite power is where you left it.

In that case, it would be one 500 kV transmission line as suitable for that. The second question had to do with operation of circuit breakers in the 230 kV switch yard. There are no controls in the control room at the bench board that allow you to operate the 230 kV breakers in the 230 kV yard.

Those are local operations that electric transmission does in conjunction with operators.

MEMBER STETKAR: Okay. Thanks. And that helps me in terms of knowing what will be in

the - those instrumentation trenches that go out there. Thank you.

MR. DISOSWAY: Thank you.

MS. BORSH: Okay. And then John Costello is back to talk about the ETE questions that you have about - well, it was really Dr. Corradini about the three inches of ice. It happened when he was here.

CHAIRMAN RICCARDELLA: Okay.

MS. BORSH: Dr. Corradini, are you still -

CHAIRMAN RICCARDELLA: Unfortunately, Mike is not on the line any longer but we will listen to the answer and we will relay it to him.

MR. COSTELLO: Thank you. John Costello with Dominion emergency preparedness. So both during the NRC staff and my presentation there were questions having to do with evacuation time estimates.

Mr. Musico mentioned NUREG CR 7002 was the basis for evacuation time estimates and it established the scenarios that needed to be evaluated.

Traffic impediments due to an ice storm

that paralyzes the road network seismic event that might disrupt traffic patterns or a massive tidal wave that damages the infrastructure were not within the scope of that guideline.

So evacuation time estimates are not considered to be a sliding criteria. There is no evacuation time estimate that's considered acceptable or unacceptable.

The ETE - the evacuation time estimate - is a tool for planners. So protective action guidance is contained in NUREG-0654 FEMA-REP-1 Supplement 3 and it includes consideration of evacuation time estimates.

The licensee develops ETEs, updates ETEs decennially and when population changes causes significant change in ETE results. Provides ETE results to offset authorities, submits the ETE to the NRC for review at least 180 days prior to using it, informing protective action recommendations.

Off-site authorities use ETEs to develop protective action decision processes including use of ETE results on a real time basis when deciding whether to evacuate or to shelter

employees and to develop traffic management strategies such as changing a two-way road into a one-way road with multiple lanes going in one direction.

Per an agreement between Dominion and the Commonwealth of Virginia, Dominion's protective action recommendation formulation process considers hostile action as an impediment but nothing else.

The Commonwealth's protective action decision making process considers other impediments - ice, snow, congestion, infrastructure damage, et cetera. Thus, the Commonwealth of Virginia would consider existing environmental conditions and their effect on evacuation routes before making a protective action decision.

In case of a roadway impediment that makes evacuation a greater risk than those consequences, the Commonwealth has the leeway to order shelter in place in lieu of evacuation. Thank you.

CHAIRMAN RICCARDELLA: Okay. Thank you. So Jim, do we have more staff presentation?

MR. SHEA: Yeah. We can continue with panel four and that's with the DCD topics and we

have our panelists, Bob Fitzpatrick, to talk about the single phase and Dinesh -

MR. TANEJA: Taneja.

MR. SHEA: - Taneja will talk about follow up on that instrumentation I&C DCD issue that we brought up. With that, we will start with - who's first? Oh, I&C.

MEMBER BROWN: I can shorten -

CHAIRMAN RICCARDELLA: Charlie, turn your mic on.

MEMBER BROWN: Thank you.

CHAIRMAN RICCARDELLA: You're welcome.

MEMBER BROWN: I can shorten this a little bit. You don't have to go through this drill if you want me to.

CHAIRMAN RICCARDELLA: Go right ahead.

MEMBER BROWN: I went back and found some of my information from back in 2009 and 2010 and then I tracked - even though I don't have Revision 8 which was supposed to be rejected subsequent to the - you know, all the discussions - you remember Skip Butler and all the stuff he did - plus the emails and other stuff they rewrote. So I was able to track that up through into Revision 9

and 10.

However, there was one part of his presentations, and you will - I am going to give you - you will know what I am talking about - the others won't.

There is a - you know, there is the inputs. There is the bi-stable trip unit. I've forgotten what it's called - BTUs or something like that - and then there is a trip logic unit which feeds an output logic unit which goes to the actuators.

The output logic unit is not a microprocessor-based unit. It's an analog type thing. The trip unit is a microprocessor-based unit. Trip logic unit as well as the by-stable trip unit.

And both of those are discussed in the DCD that says when you have a watchdog kind of timeout that it resets the microprocessor, which is fine, and it - but at the same time it also results in the channel being put in a trip condition.

That all translates. The one part that Butler talked about that is at the trip logic unit output ceases going to the output logic unit. The

output logic unit was supposed to be placed in a trip condition also.

There is no discussion of - I went through all the revisions and could not find any discussion of that anywhere. So we must have missed it or what have you. I have no idea how that's going to happen in any of these designs.

So that's one - that's the one loose end that's still hanging out which you probably can't answer because there is nothing, and I've key worded that all the way through all three sets Rev. 7, Rev. 9 and Rev. 10 and the only time logic units are referenced is in - relative to bypass - the bypass switches operating and the provisions of the bypass switches.

So that's one loose end. The other one was we had extensive discussions on the - you know, that giant redundant network where all the information goes, you know, from the plant systems up to the main control room and then out to other entities and it's the old control of access.

And there is this little box called a firewall - redundant firewall. It's the only mention in the entire DCD of the firewall. It

doesn't give any description of what it is, although when we talked about it verbally it was supposed to be, based on our discussions, a hardware-based firewall.

However, when you go through the DCD there is actually no mention - there is no paragraph, there is nothing in it and in your SER there is absolutely no words relative to firewalls either. It's - and I've looked at your most - whatever, when we were supposed to be looking at it based on where you called out Rev. 9 or something like that.

So I am just saying there is some - well, actually I looked at it. It said Rev. 9 up in the beginning. I'll stick with John over here, based on what I read. And if it's Rev. 10 that's fine. I am not going to argue with you back and forth on that.

MR. TANEJA: Rev. 10 is a certified route, right?

MEMBER BROWN: Well, DTD tier two, Rev. 9 table such and such identifies and that's mentioned all the way through - this is your old FSER.

MEMBER STETKAR: Be careful, because there is a bunch of 9's and 10's floating around.

MEMBER BROWN: That's right.

MEMBER STETKAR: DCD Rev. 10 is the operative revision.

MEMBER BROWN: Correct.

MEMBER STETKAR: But FSAR - COLA FSAR Rev. 9 is the operative version of their -

MR. TANEJA: Got that.

MEMBER STETKAR: But I am looking at their FSER - SER and their SER doesn't have a revision on it. It says DCD tier two Rev. 9 - I am reading the paragraphs right in the FSER.

MR. TANEJA: Right. So all the I&C is -

MEMBER STETKAR: They look the same.

MR. TANEJA: - issues were resolved by Rev. 9. Rev. 10 didn't have any I&C.

MEMBER STETKAR: That's fine. I am not - I am not - you can worry about consistency and you can work on that however you want to, my only point being is that - where was I - the firewall issue is not even discussed in your old FSAR.

MR. TANEJA: See, I think what - if I

remember correctly, I mean, it's been a few years - you know, it was six, seven years.

MEMBER STETKAR: That's - I have a hard time. I am back in paper.

MR. TANEJA: So GE had a separate topical report on cyber security.

MEMBER STETKAR: Yeah, I never got that.

MR. TANEJA: Okay. In that report they chose to put that information in the cyber security topical report -

MEMBER STETKAR: I did go and look at the cyber securities - the -

MR. TANEJA: If I recall it correctly, so it was not part of the - you know, so they kept that - you remember that discussion about malicious versus non-malicious and we needed to keep it to segregated and in such a way and eventually I believe what had happened was that the cyber security issues were handled under Part 73 three -

MEMBER STETKAR: That - yeah, that -

MR. TANEJA: So that's -

MEMBER STETKAR: I remember all that discussion. The problem with Part 73 was it's so general it just says things are programmatic

fundamentally and if you don't have an architecture that allows you do anything then you're screwed. So -

MR. TANEJA: So now if you look at their DCD, throughout the DCD they talk about being cautious of cyber security requirements as they developed the software, as they lay out the hardware.

So if you look at the Appendix B which is the software life cycle development process, so in those steps continuously GEH commits to assuring that the cyber security features are taken into consideration as they are developing the system.

So we have the DACs and the ITAACs would verify that these -

MEMBER BROWN: I went through the ITAACs and couldn't find anything.

MR. TANEJA: Well, those are part of the life cycle development phases. Each life cycle development phase is -

MEMBER BROWN: Not in the DCD.

MR. TANEJA: They are in tier one as part of the -

MEMBER BROWN: I just - I just watch

dogged firewalls and I -

MR. TANEJA: Well, I mean -

MEMBER BROWN: - the watchdogs and it's not in there anywhere.

MR. TANEJA: They may not be specific to watchdogs or this. They are specific to the life cycle phases. So when we look at the life cycle phase where they need to address these commitments, you know, so they are part of those - you know, those - whether they are the requirement phase or whether it's the design phase of the life cycle, whether it's the integration phase of the hardware or software, that's where GEH wants to assure, and I think in their discussion in looking at, you know, where they have discussed the simplicity of the design they talked about that the cyber security needed to be accounted for early in the design. It's not an afterthought.

At the same time they kept the two separate where cyber security did fall into our requirements returned to Part 73 and they kept the design.

So under the IEEE standard, you know, standard 432 and the Reg. Guide that's associated

with that, that's where we talk about secure development and environment.

MEMBER BROWN: Yeah, that's all clear but if you don't -

MR. TANEJA: And that's where they were - you know, they were separating we - you know, we basically were told at that time that, you know, you in the DCD could not address 73 parts on the issues, okay, because those are programmatic issues.

MEMBER BROWN: I understand that, okay.

MR. TANEJA: Right. So -

MEMBER BROWN: The point being that if you don't have an architecture that supports something then you come in six, seven years later and you can't do anything.

MR. TANEJA: Right.

MEMBER BROWN: You have to modify the plant. So you can have all the programmatic words you want to when you come down five or six years later -

MR. TANEJA: And -

MEMBER BROWN: - the point being that the design says - we are still arguing about that.

MR. TANEJA: So no. So there is only one other base point which connects to the outside world.

MEMBER BROWN: And that's the firewall.

MR. TANEJA: That is the firewall, right, and then you have one-way communication at different levels form the safety network to the plant control system network it's a one-way communication and then from there to the plant computer system it's a one-way communication on the plant computer network.

MEMBER BROWN: That's not - okay, that's not very clear when you read it.

MR. TANEJA: And then from there out to the outer world it's a one-way communication to the tech support center, EOF -

MEMBER BROWN: Well, that's part of - that comes out of the firewall.

MR. TANEJA: It comes out of the firewall. That's what I am talking about. But that's a one-way communication -

MEMBER BROWN: Software based or hardware based?

MR. TANEJA: That software hardware

based is really discussed, you know, as part of the cyber security plan as to how that is done. It's not really part of this design requirement.

We did not have that requirement.

MEMBER BROWN: I know you didn't.

MR. TANEJA: Yeah. Right.

MEMBER BROWN: But now we are six years later when we are smarter and we ended up with absolutely zero discussion of the interfaces to the outside world and your old SER and I was just somewhat surprised after we have gone through a number of other design - I mean, ESBWR is probably the - one of the worst looking designs overall, architecture wise. It's complex - it's difficult to understand and there is very few detailed requirements, compared to what we established in later DCDs for the other design centers.

MR. TANEJA: But at the same time, I would say that ESBWRs and I&C architecture was such were you did not have any non-safety to safety communication issues. They were totally segregated. We did not have that in there.

MEMBER BROWN: I am not talking about non - I am talking about up into the network and

how that's addressed and how this final determination on these late licensees like this are actually considered and thought about as part of the SER. That's - so your discussion about -

MR. TANEJA: So what I am - you know, what I want to say is, you know, while we are doing the North Anna COL their application came in. They said incorporated by reference ESBWR design certification.

So we really did not even spend the time looking at the - we assumed that, okay, that certified their finality to it and it's referenced by, you know, incorporated by reference in the North Anna 3 Chapter seven, the RNC design and really there was nothing for us to review -

MEMBER BROWN: So what you're telling me, Dinesh, is that fundamentally there were holes what was originally a certified -

MR. TANEJA: I wouldn't say that there were -

MEMBER BROWN: Well, there are. You know, when there is - when there is no definition of what some of these critical interfaces are that's a - that's a hole. When they are - and they

are defined in some of the later design centers that -

MR. TANEJA: Yeah, but when we look at the process that's laid out in the DCD which basically talks about at various stages to assure that the cyber security features are incorporated in the design from the early stages, and since we have the DACs and ITAACs which would be used, just like what we are doing with AP 1000 right now. We are reviewing these things as they are being built. So there is no hole. I don't see a hole. I don't think there is a -

MEMBER BROWN: If you - I just finished - while we were doing this stuff I just was going through the ITAACs on the entire reactor protection system as well as the safeguard system and fundamentally you do nothing but check functionality. If I turn a switch the plant trips. If I introduce a high power thing, well, it trips. It's functionality based. If I flip a bypass switch I bypass. So it's totally functionality, not -

MR. TANEJA: No, there is a set of ITAACs and DACs that were there on the life cycle

processes also.

MEMBER BROWN: Yeah, I know. But the don't - they don't -

MR. TANEJA: So that's where it's covered. All of these things are covered under that.

MEMBER BROWN: Okay. We can - I guess we can disperse with this and I'll think about what I want to recommend that we write in our letter -

MR. TANEJA: Yeah. We can take it outside of the North Anna discussion because that was certified. So for North Anna's purposes it was IVR. So we -

MEMBER BROWN: I am not arguing with North Anna. I understand that.

MR. TANEJA: So if we want to discuss further on how the ESBWR is going, hopefully they will build the plant sooner so we can get involved in that, you know.

MEMBER BROWN: All right. I don't want to - I don't want to - I just wanted to get it on the record that there is - in my opinion there is a number of loose ends and that I think we need to somehow start grappling with sooner or later.

We did that on the later ones. I know we are dealing with ITAACs and stuff like that on AP 1000 but we also had a far more detailed definition of how time or watchdog time would reduce certain things and that they were hardware and that there was a one-way hardware-based output to the external world such there was no change for the super highway to be opened up to anybody.

If you talk about the safety systems going into the network those are software-based and you don't differentiate. You talk about one-way but you don't say they have to be such and such.

Most - many of them are two-way because you got to get some information from the control rooms back in to the systems or particularly the control systems for various things like your pumps and valves and other type things that you deal with.

So I am just saying there are places where you have to have bi-directional and you depend on your software process. There is other ones where you don't and yet they are not covered.

They are not specifically stated to be one-way hardware and not to be compromised. So

they can't be compromised. And that's my - that's my biggest concern.

I am just worried about that area and it's not part of the programmatic part - I understand all that. If you don't have an architecture and a physical design that accomplishes those - allows that - you know, accomplishes those end results you can't do anything with it once the system is designed and built.

That's all. So I just wanted to get that on the record since this was my opportunity in this circumstance.

MR. TANEJA: All right. If there is further discussion if you like to have we can take it outside.

MEMBER BROWN: We did this six years ago.

MR. TANEJA: Okay.

MEMBER BROWN: Thank you, Mr. Chairman.

CHAIRMAN RICCARDELLA: I guess we have one more presentation on the Byron Open Phase Event. Is that -

MR. SHEA: Yes.

MR. FITZPATRICK: I am Bob Fitzpatrick from the electrical engineering branch in NRR. This is my sixth presentation to the ACRS on passive designs.

So hopefully we can go through it quickly. But the Byron Event that occurred back in January of 2012 wasn't immediately detected. It took the operators about eight minutes to detect that - to determine what was going on.

They had a faulty source and we were able to separate from it as part of that both off site and on site electrical power systems were rendered unable to perform their intended safety function it called upon.

So this presented a potential common cause failure event and therefore the staff needed to address this and see whether it was happening across the entire fleet.

The staff took four separate actions, first, a special inspection at Byron. Then we put out an information notice to all the stakeholders in what we found.

Then we launched a bulletin which was really a questionnaire of how would your plant

recognize this even, how would it react to it and all that. And it turns out one plant in the country said their plant would have actually detected it as it progressed at Byron.

Everyone else said they wouldn't have. So we collected all that data, put together a summary report, analyzed it - analyzed the data and in that summary report we came up with recommended actions for the designs.

And now I am going to talk about those for the passive design. For the passive plants our recommendation was there be detection of single and double loss of phase events with or without a high impedance fault and across all operating modes of the plant.

So that's high low - a high load level or a low load level, basically what that means. Detection should be on the high voltage side of the transformers that feed off site power and get the plant's electrical distribution system.

There should be a dedicated alarm in the control room and provide plant personnel, operations and maintenance with training procedures and how to handle all of this.

Next slide. This was - this design solution was taken on by the ESBWR and in their Rev. 10 they formalized the design approach which we accepted as part of that review and included the following.

They identified existing relays within their distributed control and instrumentation system that can detect loss of phase events with and without high impedance faults. These relays are located on a high voltage side of the transformers and the reserve auxiliary transformers.

The design utilizes these program relays to monitor both current and potential transformer outputs per phase on each of three phases.

The DCD includes inspection tests analysis and acceptance criteria, ITAAC, to demonstrate that the proper set points have been developed and the tests demonstrates full functionality.

And the DC also includes interface requirements for the combined operating license applications to establish training procedures for

the staff - to meet the staff's position.

So here we have North Anna. The North Anna design is incorporated by reference. So they have been design solutions simply by referencing the DCD which includes the design - the detection, the alarm in the control room and the ITAAC.

Then they also committed in Rev. 8 of the COLA. This is where this appeared. The plant operating procedures including normal operating procedures associated with the monitoring system will be developed in accordance with FSER subsection 13 and at least six months prior to fuel load.

Maintenance and testing procedures including calibrations, set point determination and troubleshooting procedures associated with the monitoring system we developed in accordance with the FSAR against another section of Section 13 prior to fuel loading.

And control room operator and maintenance technician training associated with the operation and maintenance of the monitoring system will be developed in accordance with FSAR section, again, 13 for operators and for non-licensed plant

staff and others section - Section 13 - Chapter 13 of the FSAR.

So in summary, it met all requirements and we find it acceptable.

MEMBER STETKAR: Bob, in the DCD - I am - understand DCD and I understand COL but in the DCD all they do is they refer to existing solid state relaying for those transformers. That implies no change from whatever they had.

MR. FITZPATRICK: Right. The claim was that they had - MEMBER STETKAR: The claim was that they had sensitive enough and they would program -

MR. FITZPATRICK: They would -

MEMBER STETKAR: - they would program the stuff so that they could -

MR. FITZPATRICK: And add algorithms.

MEMBER STETKAR: They can be quite sinister, as you know.

MR. FITZPATRICK: Right.

MEMBER BROWN: What did you say? Sinister?

MEMBER STETKAR: Sinister. To detect and open phase condition depending on what it is

you have sometimes be pretty creative in terms of your - what you're monitoring.

MR. FITZPATRICK: Right.

MEMBER STETKAR: And the differences of what you monitor. So did the staff - well, I guess ultimately they need to meet - if there is any I guidance out there - there is industry guidance on, you know, what the industry needs to do and I assume when you finally, you know, look at the as-built stuff -

MR. FITZPATRICK: They have ears to actually develop -

MEMBER STETKAR: Yeah. Yeah. I mean -

MR. FITZPATRICK: I mean, we did not review a design.

MEMBER STETKAR: Yeah. Yeah. Okay.

MEMBER BROWN: I just had one question. Are you finished, John?

MEMBER STETKAR: I am.

MEMBER BROWN: I just had one question. The programmable relays - are those - various versions of programmable relay. Some can be hooked into networks where you have remote access to perform the programming of the software-based

algorithm.

Is this the type of relays they are talking about where they then become susceptible to external hacking?

MR. FITZPATRICK: That question never came up in the review. We don't know. They might know by now but this was a commitment at this time.

MEMBER BROWN: So there - yeah, there was no - so it was just referred to as programmable relays.

MEMBER STETKAR: It's not able to read from the DCD section 8.2.1.2.2 of Revision 10 of the ESBWR design control document. It says we got all that stuff on the record.

Monitoring of the normal and alternate preferred power supply feeds through the UAT and RAT as done by the digital protective relays used for transformer protections, specifically the potential and current transformers on the high voltage side of the UAT and RAT transformers used by the digital protective relays are also used to detect open face conditions with or without an accompanying ground fall. There's other stuff that says there are alarms in the control room and

operators can take -

(Simultaneous speaking.)

MEMBER STETKAR: Well, it didn't say programmable. It said digital.

MEMBER BROWN: Digital.

MEMBER STETKAR: Does not necessarily mean programmable.

MEMBER BROWN: Some place there is something monitoring the outputs of those relays that has to be some sort of comparative evaluation. But and you can have a digital relay which where you literally go and physically, you know, adjust it, not with software.

MEMBER STETKAR: I am not picking on it one way or the other. I just was curious.

MEMBER BROWN: But that's just for the reference because, you know, that's exactly what it says.

MEMBER STETKAR: Yeah, I understand. Thank you for that. But I mean, I just read - I've read a number of - there have been just - all you got to do is go to the Internet and can find out all kinds of places where switch yard type components they are now being controlled in some

cases, you know, for large term grid distribution control. The - you know, internet signals coming in and there are some interesting things that happen and incidents.

So anyway, all right. I just wanted - so it's kind of vague and that's - digital is digital.

MR. FITZPATRICK: The proof in the pudding will be, you know, all with ITAAC.

MEMBER STETKAR: Well, the ITAAC just says if you have something and it gets that doesn't mean it's software controlled or combination of logic type for digital.

Okay. I am done. Thank you.

CHAIRMAN RICCARDELLA: So Jim, do you have some concluding remarks?

MR. SHEA: Yeah. Yes. We did want to - and I think during this - today's meeting we did pretty much go through all these public questions that we had from last meeting.

So just to summarize, we have the issue of the footprint change and I think the question was a little bit off because it sounded like the person thought that the entire site was moved

several miles away but in reality it was just a change of the - within the ESP.

So we addressed that in our Chapter 2 review and showing it was really moved because of a flooding issue on the site one and two.

The other one was the ancient fault. Now, we have had these questions several times since the North Anna review and I think Alice addressed that with the million-year fault and there was the concern about when the unit one and unit two were being constructed.

Back in the '70s there was an issue related to that and it's been well documented and anyway, the person could review those documents based on that review from North Anna when North Anna one, two, three and four were under construction.

The other one was this - the stakeholder actually - I think it was John Stetkar answered that question today about the - about the Fermi being - it's really being bounded by the DCD as well as the central eastern United States SSE curve.

The question was why didn't Fermi use

that curve and I think one of the members actually it and that is that it is bounded by the DCD for Fermi so they didn't - yeah.

Somebody answered it. And that's all we have as far as those - some public comments we just wanted to get back and be responsive to the public.

The only other thing is if you want me to go down - I wrote down a list of, like, questions. Now, I think Dominion answered them and maybe Gina and I can coordinate and figure out what the questions are or are they still questions.

I can start right off at the hydrogen tanks. That was the question number 1, I understand. Did we answer that? Did Dominion answer the hydrogen tank?

MS. BORSH: Yeah. This is Gina Borsh. We gave Mike Corradini the safe distances and he said it was closed.

MR. SHEA: Okay. So that one's closed. Now, the piping temperature range for the fiberglass we addressed that. The ETE follow-up were satisfied with the responses that we had for that?

CHAIRMAN RICCARDELLA: I am going to send that to Mike - to Mike and -

MR. SHEA: Now, there was the site-specific fire hazards analysis. Did anybody come back on that and -

MEMBER STETKAR: Not to my knowledge.

MS. BORSH: No, that was the response where I explained that Reg. Guide 1.206 -

MEMBER STETKAR: Okay. Yes - yes, you did. We do have - we do have a response.

MR. SHEA: Well, should we say it's closed or we are still trying to look at that?

MEMBER STETKAR: It's - no. I mean, I understand what they are doing. They are doing what's allowed by something.

MR. SHEA: Okay.

MEMBER STETKAR: And we have, you know, a record from the subcommittee meeting.

MR. SHEA: There is also the question on the Reg. Guide - I think the Reg. Guide 1.221 I think Ryan answered that or Nolan, right?

MS. BORSH: Ryan Nolan.

MR. SHEA: Ryan Nolan answered that.

MEMBER STETKAR: I am okay on that. I

mean, that was a more generic question and I get it. I understand it.

MR. SHEA: Now, there is the issue of the station auxiliaries, you know, one and two. Maybe I don't have this quite right.

MEMBER STETKAR: That was - say no more. That was answered this afternoon.

MR. SHEA: Okay. Good. The other one was, again, on the same subject was the idea of the site-specific PRA evaluation in regards to the different configuration of the switch yard.

MS. BORSH: Same thing, right?

MEMBER STETKAR: Yeah. I mean, I finally - we have something on the record about how they are going to address it. How - there are opinions but ultimately it will come down to they will finally model it. They have to finally model the actual configuration before fuel loads.

MR. SHEA: I actually did pose the question at length to our staff, our PRA folks that we didn't have here and maybe we will have an answer from them on this particular subject and if we do I'll make sure I get it to Girija.

MEMBER STETKAR: Okay.

MR. SHEA: So just as another data point for you, see what our staff says.

There is also this - the first circuit breaker issue that - was that resolved? That was not, no.

MEMBER STETKAR: Bob said he needs to go back and take a look at that and in my mind if it's - it has nothing to do in the sense of a concern of - a technical concern that could affect safety. It just has to do with consistency in what the staff looks at within the envelope of the interface equipment that's under the maintenance and testing and surveillance requirements of, in this case, North Anna Unit 3 versus Dominion transmission system department. It's more of a regulatory type question.

MR. SHEA: The only other one I had was the SMA, the 1.67 times and the issue about why are we doing that or why are we doing that along with the seismic PRA.

MEMBER STETKAR: No. The - for clarification, I noticed in Chapter - I think it's Chapter 19. I could be mistaken but some -it must be Chapter 19 and on one of the slides today it

said that prior to fuel load there will be a confirmation that the as-built HCLPF capacities are - there will be a comparison made between that as-built capacity and the HCLPF capacities that are currently being used today in the PRA margins analysis. There was not a seismic PRA. It's PRA margins analysis.

And it just says that there will be a comparison made and any vulnerability - additional vulnerabilities or something - I don't remember what the words are but it's something like if there is a difference then the vulnerabilities have to be evaluated and in the - the point that I was making was there is a requirement that before fuel load the COL holder at that time must develop a real - what I'll call a real seismic risk assessment, meaning they have full fragility curves - they have full hazard curves. They convolute them, they run them through a full model for the plant. At that point, once they do that this - these HCLPF capacities for the purposes of a seismic margin analysis become meaningless. They are essentially irrelevant from that point forward. So the question I had to the applicant was well, why are

you - you know, why in the FSAR does it say you're going to do that comparison and, you know, what's the whole purpose of it.

MS. BORSH: We haven't - we did get to look at the - and it is - it's in response to a COL item.

MEMBER STETKAR: There is a - there is a COL item. I found it. You know, I was hoping you were going to say that earlier. But there is a COL item that essentially includes those precise words and in the FSAR are those words you just parroted back saying yeah, we are going to do that.

MS. BORSH: And guess what? It comes from ISG 20 where in section 524 of the ISG it says the post-COL activities - David found this - include verifications of the plant and sequence level at HCLPF of capacity by the COL holder based on the as-designed as the configuration. And it goes on so -

MEMBER STETKAR: I understand where it comes from and I am not - it's on the record.

MS. BORSH: Yeah, I just wanted to get it on the record.

MEMBER STETKAR: It's not a - it's not

at all clear to me why they are doing that or what the implications would be if there - if there is a difference, given the fact they have to do with real PRA.

MR. DUSEK: Well I can take that one back and we can talk to our PRA guys also.

MEMBER STETKAR: It's not a particularly big concern.

MR. DUSEK: Okay. But we will still try to -

MEMBER STETKAR: They're happy doing extra work and the staff is happy reviewing extra work. You know, that's fine.

MR. SHEA: I am always happy to do extra work for you guys.

MS. BORSH: So I appreciate you bringing that up and we will take a look at it and see what the - what the origin is and what we may or may not be able to do about it.

MEMBER STETKAR: This, again, may be something because of the evolution of interim staff guidance and the evolution of the certified design for the ESBWR versus where we are now and what guidance is available to do seismic risk

assessments.

It may be another one of these things that's kind of a holdover of what things were seen or eight or whenever years ago.

MR. SHEA: Okay. Well, we could maybe come up with a history and let you know why it is what is -

MEMBER STETKAR: Oh, no. I know why it is what it is.

MR. SHEA: Well, we could come up with something. I just wanted to do extra work for you guys.

MEMBER STETKAR: No, I know why - I know why it is where it is. Let's move on.

CHAIRMAN RICCARDELLA: So our aim is to address this subject in the November full committee meeting and that will be an abbreviated presentation, typically we allow about two hours. So for both - and that includes both the staff presentation and the licensing or the applicant presentation.

And so let's plan on that and your bullet says additional topics and I don't know what they are - any additional topics.

MR. SHEA: Well, if we don't find some answers to these we could briefly go over them at that meeting if we don't get them before. But my - so we are - so that full committee meeting is two hours total.

So that thought would be then we would come back with all - do you want to come - you want us to come back with all the topics we have covered today but just - or do you mean focus on the seismic maybe? Is that - is that - or -

MR. SHUKLA: Yeah. One thing I would say that your presentations would be only 50 percent of the time. So the other 50 percent for the ACRS questions so we went over the -

MR. SHEA: I told Dominion that but they didn't seem to agree with me. So but we tried. The staff tried hard but I think - seismic certainly is something I believe the full committee would be but we don't need to have all of the detail on the analyses that were done. I think that the kind of high level about what is different, why is it different and what was done to account for the difference is - I think that anything else that's different, again, I am an

electrical guy so the switch yard thing is different. But it's a new thing. Anything else that's different from - nobody's going to remember seven or eight years ago anyway. But highlight differences between things that we have seen before or differences from the DCD. You know, seismic, obviously, is the big thing.

MEMBER MARCH-LEUBA: We recently had another COL review for the full committee and they did it in two hours. I would look through the slides and get some ideas.

MR. SHEA: Well, because I was just going to say everything we really talked about today are the differences. I mean, what we tried to highlight today are all the differences between DCD, the departures, variances, the exemptions. And so -

MR. SHEA: You know, a portion -

MEMBER RAY: Can I make a suggestion? There is got to be an overview. I've done four COL's here in the last two years. So just it's got to be an overview with emphasis on the things that are of particular interest.

But you've got to imagine that part of

the committee doesn't have any idea what you were talking about unless there is some overview.

MEMBER STETKAR: You have to recognize that part of the committee these days we have new members who aren't even familiar with the history of the ESBER including the chairman.

So anyway don't - give it an overview but, you know, stick to my advice would be stick to the issues that are part of the COL, not things that aren't, because it's easy to drift off into stuff that's not part of the COL.

MR. SHUKLA: Your information was very good. So you can't bottle some item from there and educate the committee.

MR. SHEA: Okay. All right. That's all we had.

MEMBER MARCH-LEUBA: But, seriously, shoot for a 20-minute presentation.

CHAIRMAN RICCARDELLA: Normally - we normally at this time go around - okay. So are there any members of the public in the audience that would like to make a comment? Can we get the phone line opened up and see if there is any members of the public on the phone line who would

like to make a comment?

MS. RICHMOND: Virginia Richmond. Can you hear me?

CHAIRMAN RICCARDELLA: Yes. Yes, we can.

MS. RICHMOND: Well, I've been following the whole meeting, thank you, for opening the phone line to me. I also wanted to mention that I have been following this application for the COLA for years.

And I have watched over time how Dominion and the staff relate to each other. I have a lot of concerns over how some of the data was formed and where they arrived at certain things.

I did want to start with the issue of the hydrogen tank and I noticed that in the beginning of the discussion the scenario was used that there was no immediate detonation and that a vapor scenario was assumed, a cloud, and I know it was discussed later on that the distances were given.

Of course, I didn't get to hear what the distances were so I'd like that, first of all.

CHAIRMAN RICCARDELLA: Okay. We will take that question down and the staff will get back to you on it.

MS. RICHMOND: Okay. Well, if you please bear with me because I was not able to kind of ask anything through this whole meeting. I've been on it all day. So I do have a few things I would like to go over.

As it goes with Dominion's experience with the fiberglass for the piping - the underground piping in general, I know that Dominion had their first experience with using the fiberglass cyber stuff on some of the large piping down at Surrey here recently which they were the first to use that type of fiberglass and as they are working on their second license renewal they actually want to be able to use it on safety related piping underground and varied piping which has not been approved of yet.

So I am not sure where this type of fiberglass or materials are going to be used in North Anna surrey. But I definitely heard later it was specifically stated that it was not safety related equipment.

So I think there needs to be a distinction there. I also want to mention I want to know why Dominion is using Charlottesville as a population center, which is 36 miles west, because if you go east and you will see that in Spotsylvania they have as of 2015 they have a population of 130,475 people, which is only 24 miles away.

So I have some grievances here on why they want to use Charlottesville and maybe not some of the other areas.

I am about in western Henrico, I am about 32 miles as the crow flies and I am downwind and we are not considered here in the metropolitan area of Richmond we are talking about, you know, 1.3 million people.

Also, as it goes towards the, you know, issue of hospital and that's - that stuff needs to be looked at a lot better.

I don't think they should be allowed to use just Charlottesville because there is plenty of nursing homes and other facilities that need to be looked at in an evacuation event.

Bear with me. And also, you know, I

haven't heard anything about time estimates at all. You know, what the longest evacuation time is, freezing rain. I am from Virginia. I was born and raised here three generations.

I can tell you there is plenty of times where we are paralyzed and when it comes to the issue of missile, it was just a few years ago actually during - right before our earthquake Surrey was taking down their switch yard was hit by a tornado. Both of those facilities off line - luckily no missile, you know, projections did any other damage.

So this idea of using only hurricanes, event winds, is misguided. I think it needs to be reamped up and really looked at in a full spectrum because I'd like to remind the staff here, you know, I was actually at Wal-Mart buying batteries, getting ready for the hurricane when the earthquake happened.

It was at least five or ten minutes that nobody, nobody could talk on their cell phones or anything. Communication was down everywhere. And, you know, frankly, that was alarming because no one could talk to anyone and how are we taking

into effect not just a singular event.

You know, what if we have another issue again where we have a hurricane and an earthquake at the same time. You know, I hear the singular kind of event think, you know, being analyzed but really it could be more than just one incident.

Bear with me. Obviously, you know, a lot of this North Anna 3 will be a design that has never been built or commercially operated anywhere in the world. This thing only exists on paper, and even on paper it's been mentioned there are a lot of exceedances all over the place.

So I am extremely concerned. Well, I know fire analysis for the yard building, no site-specific fire hazard departure exemption, exemption. Bear with me.

Issues with the switch yard at North Anna 1 and 2 we have had multiple issues already happen over there over time. As I followed the usual NRC event report so I am skeptical about a single switch yard.

I don't think that they should be allowed to postpone a lot of these things prior to this even going to full committee hearing.

I also heard on the line it's whispers and stuff go on which I thought was very annoying is one of the staff members was talking to Dominion saying well, I am doing all you guys' favor lining you up. I wonder who was talking then.

And really, all the revisions and bouncing back and forth, this is how this whole COLA has been. The staff has to go looking for stuff from Dominion because they don't know where half the stuff is and it's still the same problem - oh, it's in 7, oh, it's in eight - oh, where is eight, I don't know - it's in 10.

Bear with me, please. Yeah. And as it goes for the things that have happened in Fukushima, the near term things that are referenced only, we are not - I mean, we are not even through the recommendations of what happened in Fukushima. So it's really amazing that we are even thinking to go building this reactor on a known fault.

Update on evacuation. The time of evacuation, I think you all went over that. You know, and as someone that, like I said, is downwind I spoke with emergency management some years ago

and they seemed to shrug their shoulders and say well, we don't know - I guess we just do a - you know, stay in place, you know, shelter in place. I mean, this has not been given a lot of thought.

And also, you know, I did hear about the flooding and I understand that the Unit 3 was moved because of flooding issues.

Well, that means we still have flooding issues with 1 and 2. And, you know, as it stands right now with 1 an 2 we have 2 million gallons of water that pass through the station per minute.

So I am not sure how that's going to be addressed in dealing with the third unit. But the thing that's even most disturbing - most disturbing is I've heard nothing mentioned about drought and what happens in drought.

Because when we had our seismic event, Unit 1 and 2 were the first units actually in U.S. history to have been taken off line because of seismic events.

But my friends around the lake, and it was also reported, that the lake dropped 20 to 22 inches and Dominion came back and said that it was because of the reactors going offline.

So it does make me wonder, you know, if we had some other big incident and Lord forbid if our earth and dam was to fail or the water to be diverted, you know, where is this makeup water of with two units - of two million gallons a minute going to come from and now we have got a third unit we are willing to put there.

I think we are going to have a water issue. Plus the issue of, you know, thinking that we can just keep diluting radio nuclides into our river system is really quite disturbing.

Bear with me, please. Yeah, Dominion in one document mentions the maximum waters levels were 255 feet or at a low of 242 feet under extreme conditions.

So I am not really sure, you know, if all of that issue has been looked at with, you know, do we have the ability if something was to happen with the water supply there if we could actually survive a major catastrophic earthquake.

And I did hear the different geologists that came and spoke and I know here recently that our Virginia State geologist, David Spears, has said that we could expect an even larger

earthquake.

Of course, they don't know when but there is that prediction that's out there and I don't think it's not - I don't think it's unrealistic.

So and I have followed the history of North Anna 1 and 2 from Bob Bailey, the geologist there at William and Mary, and I have seen the diagrams where that ancient fault runs under one, two and what would have been three and four.

And I still am not really sure how far away unit three would be. Of course, Dominion and the staff at the NRC has told be before oh, well, Ms. Gray, don't worry, Unit 3 will be twice as strong and as durable as Unit 1 and 2.

Well, I don't think the added unit over there in Fukushima are functional because if we lose one or two or one and two, I don't know what good Unit 3 is going to be.

I have read the USGS book actually they have put out and I can tell you there is quite a few geologists out there that really don't know and don't think we know enough on what we can expect because our terrain is so different and it's much

different than California which this - the staff in Dominion on one of the calls sometime back I asked where were they gathering that information from and they are gathering it from California.

Well, our terrain is much different from California and the vibrations because of the rocks that we are on is the reason why the whole eastern seaboard felt our 2011 earthquake.

So I think we are comparing apples to oranges, not apples to apples when we are looking at what we could have expect here in Virginia.

So I am very disturbed on how a lot of this information has been plugged in. Very disturbing. Bear with me, please.

Just to let you know, we have had over a thousand earthquake aftershocks since our 2011 earthquake. We continue to shake even to this day. We have had two earthquakes this past month. We have had I think seven or eight this past year and they are not coming from one area.

We have multiple faults up there and some geologists have basically said one fault can bring alive other faults.

So with Dominion's geologists saying

oh, don't worry, that's just an old fault, ancient fault, never moved, really? Why are we willing to take that chance? And not only that, prior to Dominion taking control or put it under their license name, VEPCO, and what was prior to the NRC, when they were building Unit 1 and 2, VEPCO knew there was an ancient fault and later the agency - the regulatory agency at the time also evidently knew because then Dominion got fined $32,000 for a ton of like, you know, not quite telling the truth.

So here we are so many years later and I am watching this whole fiasco kind of roll out and going are you kidding me. We are willing to invest $20 billion on a reactor that doesn't really - you know, it's on paper, we are going to put it there in Virginia seismic zone. You can pull up the data that shows how many known faults are there already and then you - there is no way that you can convince the public that this is a bright idea. It's fool hardy - just fool hardy.

And the building, by the way, were affected differently. It's not like, you know, the motion was equivalent in all corners or whatever the building. That's not the case at all.

It affected them differently. And the true fact, and I did hear one of the geologists finally pipe up and say this directly, there was no free field scratch plate and that is a determining factor on knowing what the true data would be.

And I have mentioned at other meetings have they put one, where are they going to put Unit 3. And to this day, they don't want to put anything there that really monitors and I am disturbed.

Dominion rates after the earthquake to get the - to get installed the free field - to get installed new seismic centers and also there was a breakdown in communication on knowing how bad the earthquake was.

So I am not convinced that this incident was just couple of seconds long because you can go back and look through the data from various universities and you'll see that with ten to thirty seconds.

So a downplaying, the magnification or the, you know, how long the duration. But we know we had damage all the way up into DC and damage the cathedral, damage the Washington Monument. And my

son and I were in my kitchen, I don't know, maybe a couple of months later, and we heard when rolled - and it rolled right through my house. It was a 2.0 and I felt it all the way over here in western Henrico.

So, you know, we have had so many aftershocks and we continue to shake and yet we are talking about we are ready to go to full committee on this that I've heard about all the exceedances. This is just not right. Let's see, what else did I want to say?

Yeah, because we don't - we really don't know enough here in Virginia and that goes for a lot of the experts that have spoken about this.

You know, I mean, exceedances at 50 percent, 40 percent, this, that and the other exceedances and we don't know - this thing doesn't even exist yet.

And I do agree. I heard someone mention in there, you know, that somehow these loose ends need to be tied up. Somehow Fermi got their COLA yet this whole thing with cyber security hasn't even been firmed up.

So I am really concerned about that. Site-specific - over the years I've watched and heard how Dominion and the staff of the NRC have bounced back and forth about do they use the DCD, do they use site-specific, and that somehow they've managed, it sounds like, to kind of, you know, use the wording appropriately to how they use the DCD but somehow kind of with an overshadow of a site-specific.

I am sorry, I am totally not in agreement with that at all. And I know on the fuel, because I attended one of those meetings as well, they want to use the data on the fuel rods that they have been making which they are different from the ones that are proposed.

Again, there is more guesstimates than assumptions that take place with this. I wish I could get a penny for every time I've heard that. And, you know, any idea that we are going to do - allow Dominion to do all this work and go through all this planning and go through the billions of dollars this is going to cost and then six months prior to fuel loading that they are going to have to do some analysis or even worse, how Gina ended

up saying oh, well, you know, post-fuel loading that they were going to do some sort of review, you know, time for the NRC, especially the subcommittee that oversees your other staff that's been working with Dominion, to really get down to some facts because I've watched so much collusion in this whole process that it really disturbs me.

So if you guys go ahead and you all approve this and you all go to your full staff, I am wanting to know, you know, is the public going to be available to say anything during the full committee meeting that's going to be in November for two hours?

Or are we just as the public get to sit back and listen to this BS?

CHAIRMAN RICCARDELLA: That meeting is open to the public.

MS. RICHMOND: Yes. I want it to be open to the public because if it gets past them, there is a total collusion between our regulators and this industry and I've been documenting it over the years and I can tell you enough is enough.

This is a full party proposal. You're putting Virginia in jeopardy and, by the way, right

around - located around North Anna is some of the our most valuable farmland, agriculture that we have -

MEMBER STETKAR: Ma'am?

MS. RICHMOND: - and to even expose us to anything would be ridiculous.

MEMBER STETKAR: Ma'am?

MS. RICHMOND: And I am sorry, what is the date from November?

MEMBER STETKAR: It's - this is John Stetkar. I am former chairman of the ACRS and just for the public record and for you, because you're obviously quite impassioned about this, all of the ACRS full committee meetings are full open to the public so you can listen in.

In fact, you can watch their webcast. You can see all of the presentations in real time. We encourage people to do that and we also open up the lines, as we have here in the subcommittee meeting, for public comments.

So you have - you'll have an opportunity on the record in front of the full committee to give any comments.

Now, we don't have the time latitude

that we have here at the subcommittee meetings for extended discussions. We try to limit any public comments no longer than five minutes per commenter because occasionally we do have a fairly large number of comments.

But I want to give you reassurance that at the full committee meeting you will have an opportunity to make comments and you'll have an opportunity to watch and listen to what's going on in real time.

MS. RICHMOND: Well, that's good to know. But like I am saying, I am highly suspect being that the subcommittee, at the end of this meeting, is kind of signing off on some of the issues that were brought up earlier - oh, yeah, okay, that looks good - yeah, that's fine.

Because really a lot of things really didn't seem very finalized to me. Why there is such a push in the subcommittee.

MEMBER STETKAR: Also, ma'am - ma'am, if you're familiar with the advisory committee on reactor safeguards, our subcommittees do not make any determinations about anything.

We are simply here as individuals right

at the moment to ask questions. The advisory committee on reactor safeguards communicates only through written letters that are the consensus of the full committee and those written letters are fully available to the public.

So don't construe anything that you've heard today as either a subcommittee consensus or any decision by the advisory committee on reactor safeguards. They are -

MS. RICHMOND: Well, I am just wondering how you all start out a meeting saying this is your final meeting and it will go to full committee. How do you all know that even before questions and answers have even come up?

Is it because you're only allowed two? Is that the case? That's what was stated at the beginning of the meeting - this is our final meeting.

CHAIRMAN RICCARDELLA: Well, there has been meetings on this topic since 2009. To answer your earlier question, the full committee meeting is scheduled for November 3rd through November 5th and it will be posted - I don't know the exact date.

MEMBER STETKAR: It'll be on the third. So the - and also in terms of the time, I don't know what time slot it is for the full committee meeting but are - if you don't have access to the website you can always contact our office and our staff - the ACRS staff will certainly alert you to the time slot and we do keep to those time slots in the full committee meetings.

MS. RICHMOND: Well, that really didn't answer my question though.

MEMBER STETKAR: The subcommittee -

MS. RICHMOND: Are you all only allowed two -

MEMBER STETKAR: We are allowed any number of meetings that we feel is necessary as the subcommittee on this topic to resolve any questions that we have.

Other questions might be raised at the full committee meeting.

MS. RICHMOND: And you all fell confident with the information you all got that it's ready to go to full committee?

MEMBER STETKAR: The subcommittee has recommended that the issue be taken to the full

committee.

MS. RICHMOND: Uh-huh. Well, okay. I see. Oh, and one last thing. I can't seem to find a transcript from the last meeting. How long do things take to get put up?

MEMBER STETKAR: The last subcommittee meeting?

MS. RICHMOND: Yes. Correct.

MEMBER STETKAR: Two weeks ago, or whenever that was. It should be on - it should - Girija said it should be already on our public website.

MS. RICHMOND: Okay. Well, I wasn't able to find it.

MEMBER STETKAR: So just go - just Google ACRS meetings and you should be able to pull it up.

MS. RICHMOND: Okay. Well -

MEMBER STETKAR: September 22nd, it was? How time flies.

MS. RICHMOND: I do believe. Well, I guess we will see if our regulatory agency actually protects people and the environment over industry.

Thank you very much.

CHAIRMAN RICCARDELLA: Okay. Thank you. Are there any more comments - commenters out there from the public? Okay. With that, we will close the public line and we will go around the table for ACRS subcommittee members.

Let's start with Walt. Do you have any comments?

MEMBER KIRCHNER: Just to thank both Dominion and its supporting organizations and the staff. I think we heard a very thorough presentation, particularly on the seismic issues.

My recommendation would be to, obviously, because of time constraints, condense that and mindful of the comments that you just heard address in particular how you dispositioned the exceedances because it does give the, perhaps, impression that there is a large deviation from the DCD.

So I would spend some time on how that is addressed and dispositioned. That would be my recommendation. Thank you.

MEMBER MARCH-LEUBA: I don't have any serious concerns. Only I wanted to emphasize what Charlie said about the I&C issues. If we can

follow up on that it will be - I share his concerns.

CHAIRMAN RICCARDELLA: John?

MEMBER STETKAR: Nothing more. I thought - appreciate the discussion we had. I appreciate the quick feedback we got, at least on my questions, from Dominion. I think you have a challenge to fit things into the time slot that we have available but I am confident you can do that. So thanks.

MEMBER RAY: I thought it was an excellent discussion so I thank everyone who was involved and I don't have any further comment.

CHAIRMAN RICCARDELLA: Okay. Well, thank you and with that, I'd like to thank Dominion. I'd like to thank the staff for an excellent day and the meeting is adjourned.

(Whereupon, the above-entitled matter went off the record at 5:34 p.m.)

North Anna 3

North Anna Unit 3 COLA

ACRS ESBWR Subcommittee Meeting

Introduction

October 20, 2016

Dominion

Introduction

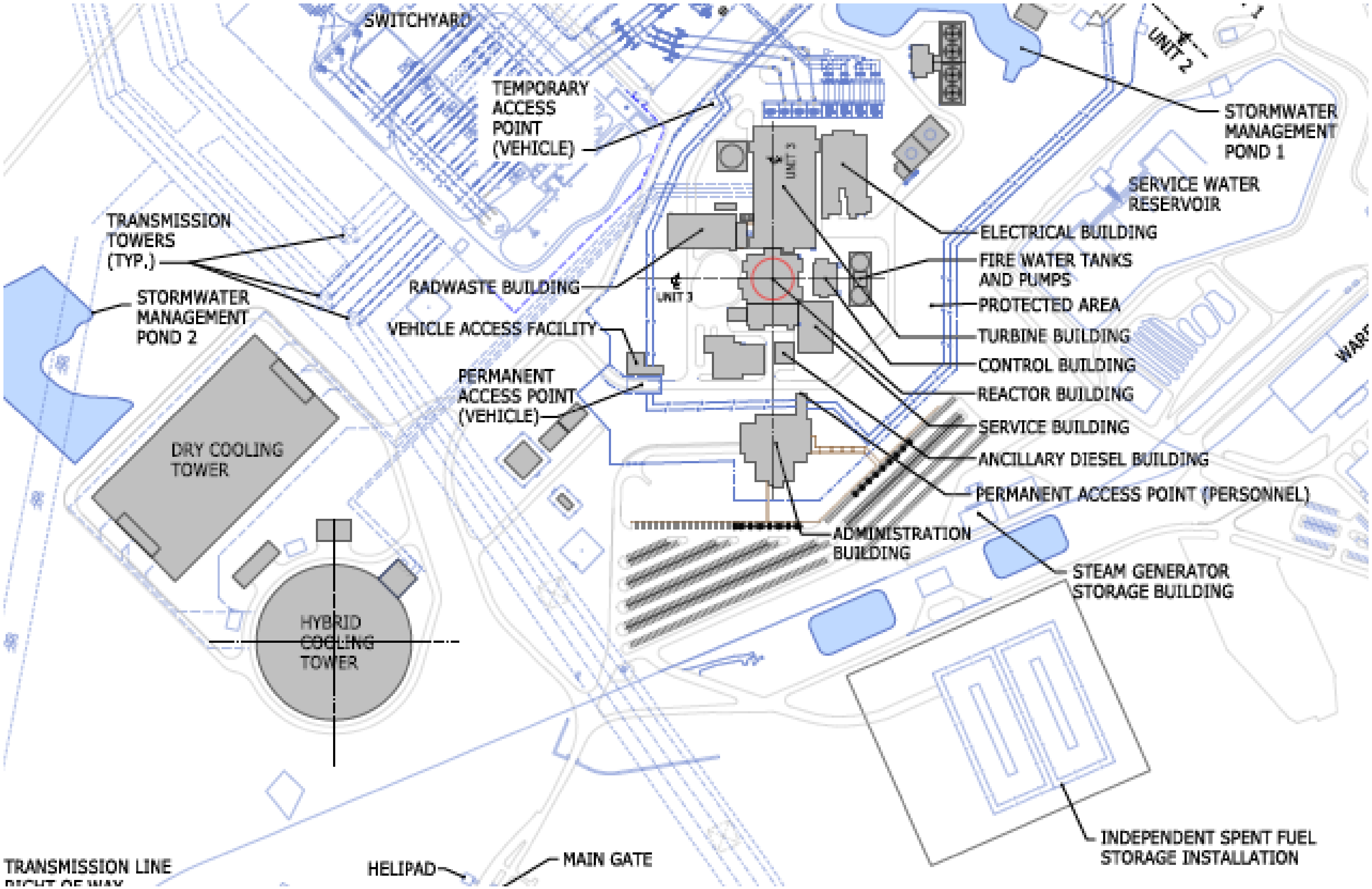
- Presenters
- North Anna Unit 3 (NA3) site
- NA3 licensing milestones
- Presentation topics

Presenters

- Subject matter experts from:
  - Dominion
  - Bechtel
  - GEH
  - Fluor
- Will introduce individuals at the beginning of presentations

North Anna Site Location

NA3 Plan View



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NA3 Power Station

NA3 Milestones

- ESP
  - ESP Application submitted — September 2003
  - EIS issued — December 2006
  - ESP issued — November 2007
  - Supplemental EIS issued — February 2010
- COLA (as ESBWR R-COLA)
  - COLA submitted — November 2007
  - ACRS Subcommittee meetings — June, July, August 2009
  - ACRS Full Committee meeting — October 2009
  - ACRS Letter — October 2009
- Technology Changes
  - Changed to APWR technology — May 2010
  - Reverted to ESBWR technology — April 2013

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Presentation Topics

FSAR Chapter(s)	Topic
2	Flooding, groundwater, accidental releases
2	Population density and hazardous chemical analyses
13	Evacuation time estimate
2, 3, 4, 9, & 19	Seismic
11 & 12	Radwaste discharge piping
3 & 19	RG 1.221 hurricane missiles
8	Offsite power surge protection & switchyard configuration
9	Plant Service Water System and Zinc Injection System

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Flooding, Groundwater, Accidental Releases (Section 2.4)

October 20, 2016

Introduction

- 3 open items from draft NRC SER (with Open Items) addressed
- Revised layout eliminated adverse Local Intense Precipitation (LIP) conditions
- Revised sheet flow analysis for LIP
- Revised groundwater model
- Revised accidental release analysis

Flooding (Section 2.4.2)

Open Item 2.4.2-3: Staff reviewing the response to RAI 02.04.02-3 providing design measures for South Ditch 90-degree abrupt bend addressing:

- 2 dimensional effects
- Superelevation
- Hydraulic jump

Resolution:

- Site layout and road locations have changed
- No 90º bend in South Ditch (now East Ditch)
- No road crossing
- RAI 02.04.02-3 no longer applicable

The issues described in RAI 02.04.02-3 were resolved through modification of the site layout and storm water drainage plan.

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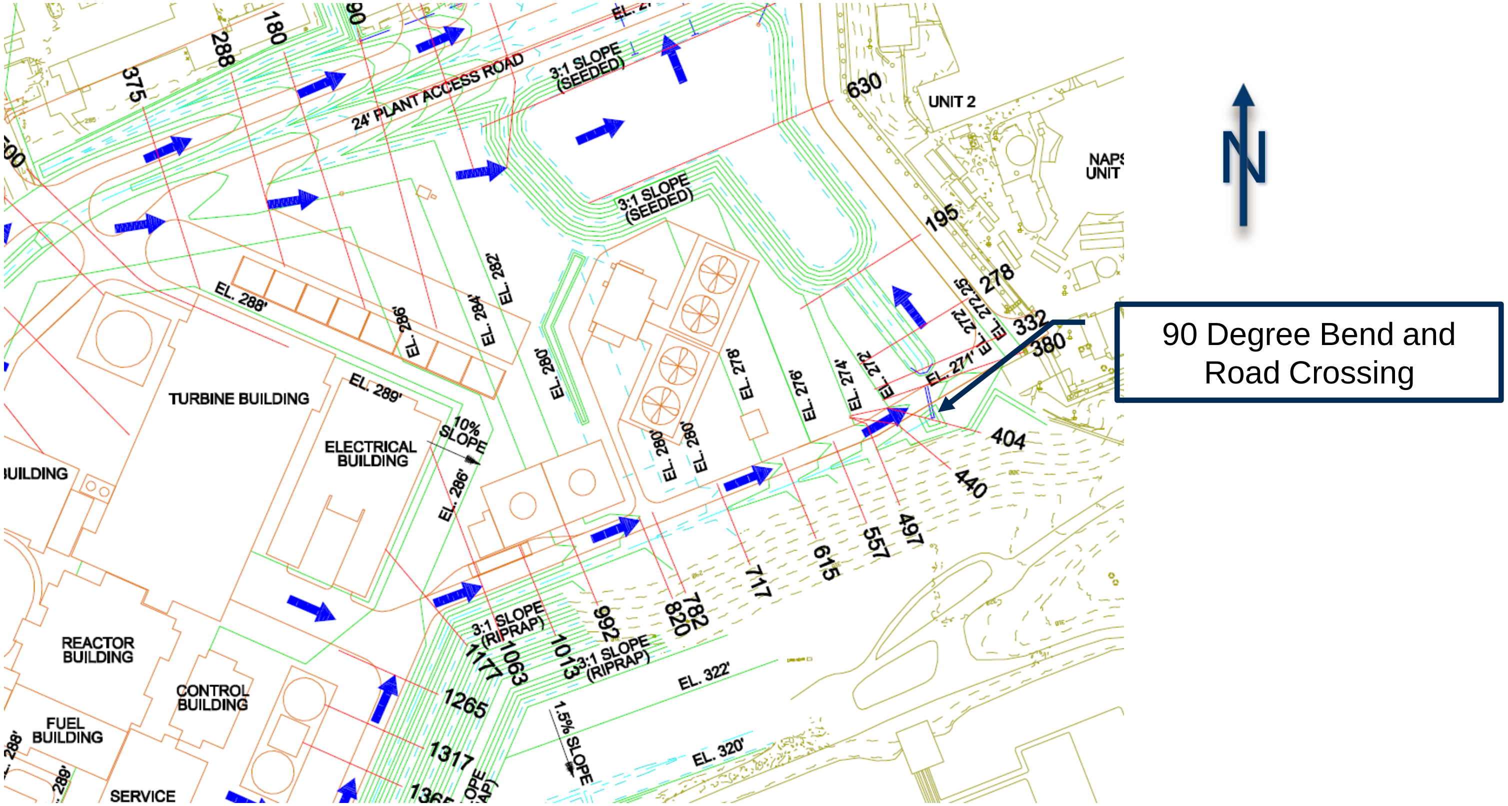
Flooding (Section 2.4.2)



Previous Site Layout
Adapted from FSAR Rev. 2 Figure 2.4-203

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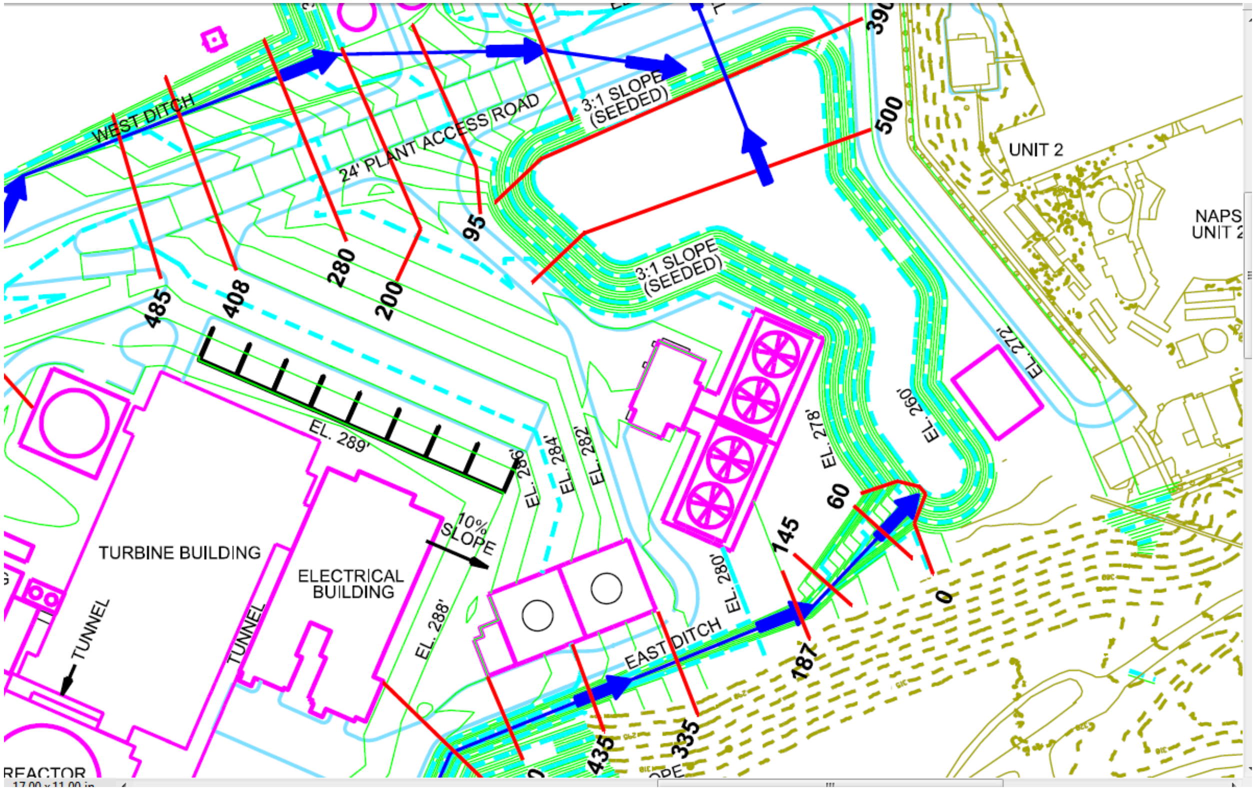
Flooding (Section 2.4.2)



Current Site Layout
Adapted from FSAR Rev. 9 Figure 2.4-203

Flooding (Section 2.4.2)

FSAR Section 2.4.2.3 Effects of Local Intense Precipitation

- Maximum local PMP inundation flood levels are below the DCD Site Parameter Value
- Sheet flow depths were also estimated
- RAI 02.04.02-15 requested more specific information with respect to the sheet flow analysis:
  - The effects of roof drainage on sheet flow depths
  - Comparison of sheet flow depths to elevations of penetrations or openings to safety-related SSCs
- RAI response resulted in a more detailed investigation of sheet flow depths and sheet flow interaction with plant features

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Flooding (Section 2.4.2)

- Flow directions for runoff from roof tops are stipulated in the FSAR
- The investigation indicated that transitory sheet flow depths at 3 locations are above floor elevations at entrances to safety-related buildings:
  - Control Building south stairway emergency exit
  - Control Building north stairway emergency exit
  - Reactor Building north equipment access door
- Commitments are made in the FSAR to place curbs or raise the thresholds of these entrances to prevent water due to local intense precipitation sheet flows from entering these buildings

Site grading and structure configuration as described in the FSAR precludes flooding of safety-related buildings during a local intense precipitation event.

Dominion

Groundwater (Section 2.4.12)

Open Item 2.4.12-2:

Staff reviewing the response to RAI 02.04.12-2 demonstrating the impact of drain cell characteristics on groundwater elevations

Groundwater (Section 2.4.12)

Resolution:

Groundwater model revised to demonstrate impact of drain cell characteristics. Model revision includes:

- Sensitivity of drain cell characteristics
  - Drain conductance
  - Groundwater recharge
  - Hydraulic conductivity
- Recalibration of some parameters
- Revised ESBWR building configuration
- Maximum GW elevation based on most adverse combination of parameter sensitivity values
- Maximum GW elevation is below DCD site characteristic value

GW model revised to address RAI 02.04.12-2.

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Accidental Releases of Liquid Effluents to Ground and Surface Waters (Section 2.4.13)

Open Item 2.4.13-1:

Staff issued RAI 02.04.13-4 requesting the results of a radionuclide transport analysis that uses the maximum observed hydraulic conductivity and the minimum site specific Kd values

Resolution:

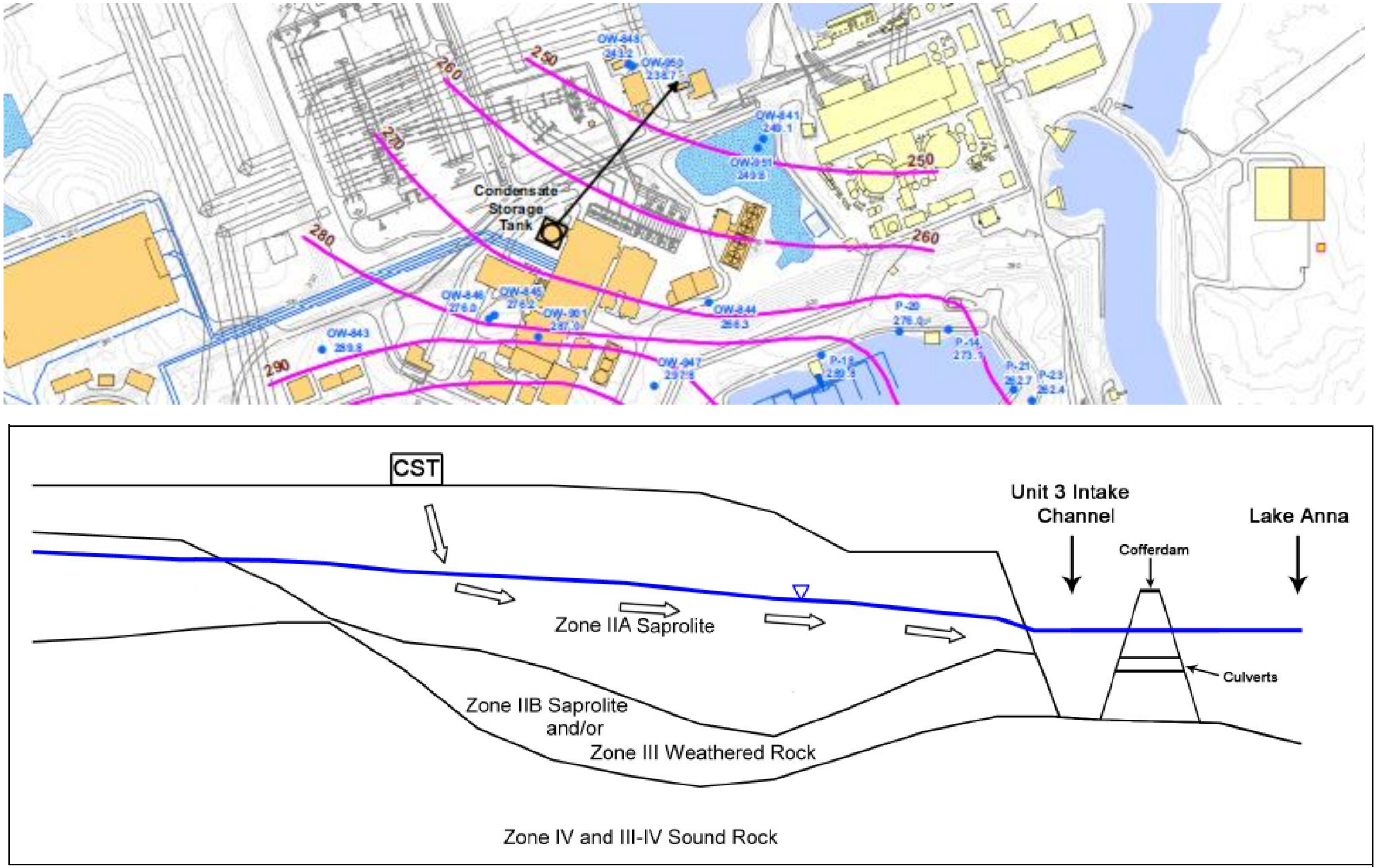
The updated radionuclide transport analysis used the maximum observed hydraulic conductivity and minimum site specific Kd values

The applicable information to address RAI 02.04.13-4 has been provided in the FSAR.

Accidental Releases of Liquid Effluents to Ground and Surface Waters (Section 2.4.13)

- Mitigating design features considered acceptable by BTP 11-6 and DC/COL-ISG-013 are incorporated into the design of Unit 3 to preclude an accidental release of liquid effluents
- Nevertheless, in accordance with SRP 11.2, an analysis of accidental releases of liquid effluents into the environment was performed
- The Condensate Storage Tank (CST) was assumed to be the source of the release, based on a ranking of tanks
- CST ruptures instantaneously, with 80% of contents entering groundwater and then discharging to surface water at the Unit 3 intake channel
- Analysis considered primary and alternative conceptual models involving the operational status of Unit 3

Accidental Releases of Liquid Effluents to Ground and Surface Waters (Section 2.4.13)



Not to scale. See Section 2.5.4 for description of subsurface material properties.

Accidental Release Pathway
Adapted from FSAR Rev. 9 Figures 2.4-217 and 2.4-219

Dominion

Accidental Releases of Liquid Effluents to Ground and Surface Waters (Section 2.4.13)

FSAR Section 2.4.13 Accidental Releases of Liquid Effluents to Ground and Surface Waters

- Results demonstrate that use of the maximum observed hydraulic conductivity and minimum site-specific K_d values result in sum of fraction values less than one (unity) at the culverts that connect the Unit 3 intake channel to Lake Anna, approximately 4000 ft within the Exclusion Area Boundary (EAB), which is designated as the compliance point in the context of 10 CFR 20
- In accordance with DC/COL-ISG-013, dose due to the radionuclide concentrations in the intake channel were determined to meet the 10 CFR 20.1301 dose limit for a member of the public

An accidental release of liquid from the CST to the environment would result in radionuclide concentrations and associated dose in the nearest potable water supply, located in an unrestricted area, that are below the 10 CFR 20 limits.

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North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting
Hazardous Chemicals Analyses
(Section 2.2)

October 20, 2016

Hazardous Chemicals Analyses (Section 2.2)

Evaluation of Hazards:

- Since the last ACRS meeting, no hazardous industrial facilities have been added at the industrial development
- Evaluation of Potential Accidents
  - Accident categories considered included:
    - Explosions
    - Flammable vapor clouds—delayed ignition
  - Analysis demonstrated that the blast effects would not exceed peak overpressure of 1 psi at any safety-related structure with the exception of the storage and transport of liquid hydrogen

Dominion

Hazardous Chemicals Analyses (Section 2.2)

Liquid Hydrogen

- Storage of liquid hydrogen - two 6,000 gallon capacity tanks
  - Immediate detonation following tank failure analysis performed in accordance with RG 1.91 and EPRI methods (NP-5283-SR-A)
  - Delayed ignition vapor cloud analysis used ALOHA model to simulate the travel of the cloud. RG 1.91/EPRI methodology used to determine safe separation distance
  - Distances are less than the distance from the liquid hydrogen storage location to nearest safety-related structure. Therefore, the storage of liquid hydrogen would not adversely affect the safe operations or shutdown of Unit 3 (including the Radwaste Building)
- Transport of liquid hydrogen- 13,000 gallon capacity truck
  - Probabilistic analysis concluded probability of an accident involving delivery truck is less than 10^{-6} per year

There were no design-basis events identified with respect to the storage or transport of chemicals nearby Unit 3.

Dominion

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting
Plant Service Water System (Section 9.2.1)

October 20, 2016

Section 9.2.1
Plant Service Water System

Controls on use of fiberglass reinforced polyester (FRP) for below-grade piping (OI 9.2.1-13)

- FRP designed to seismic requirements of IBC-2003 consistent with SSE ground input motion = 2/3 NA3 SSE defined in Section 3.7.1
- Meets ASME B31.1, "Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lined with Nonmetals," AWWA M45, and other applicable ASTM and AWWA standards
- Other design loads are considered (e.g., water hammer, thrust)
- Special measures for FRP piping include storage and handling (ASTM and AWWA standards); use of slings for lifting; visual examination; proper backfill material; QA controls for RTNSS
- Initial system hydrostatic testing performed in accordance with standards referenced above
- Will be included in the Underground Piping and Tank Integrity Program developed in accordance with NEI 09-14

PSWS design, including use of FRP underground, is acceptable for NA3.

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Population Density (Section 2.1)

October 20, 2016

Population Density (Section 2.1)

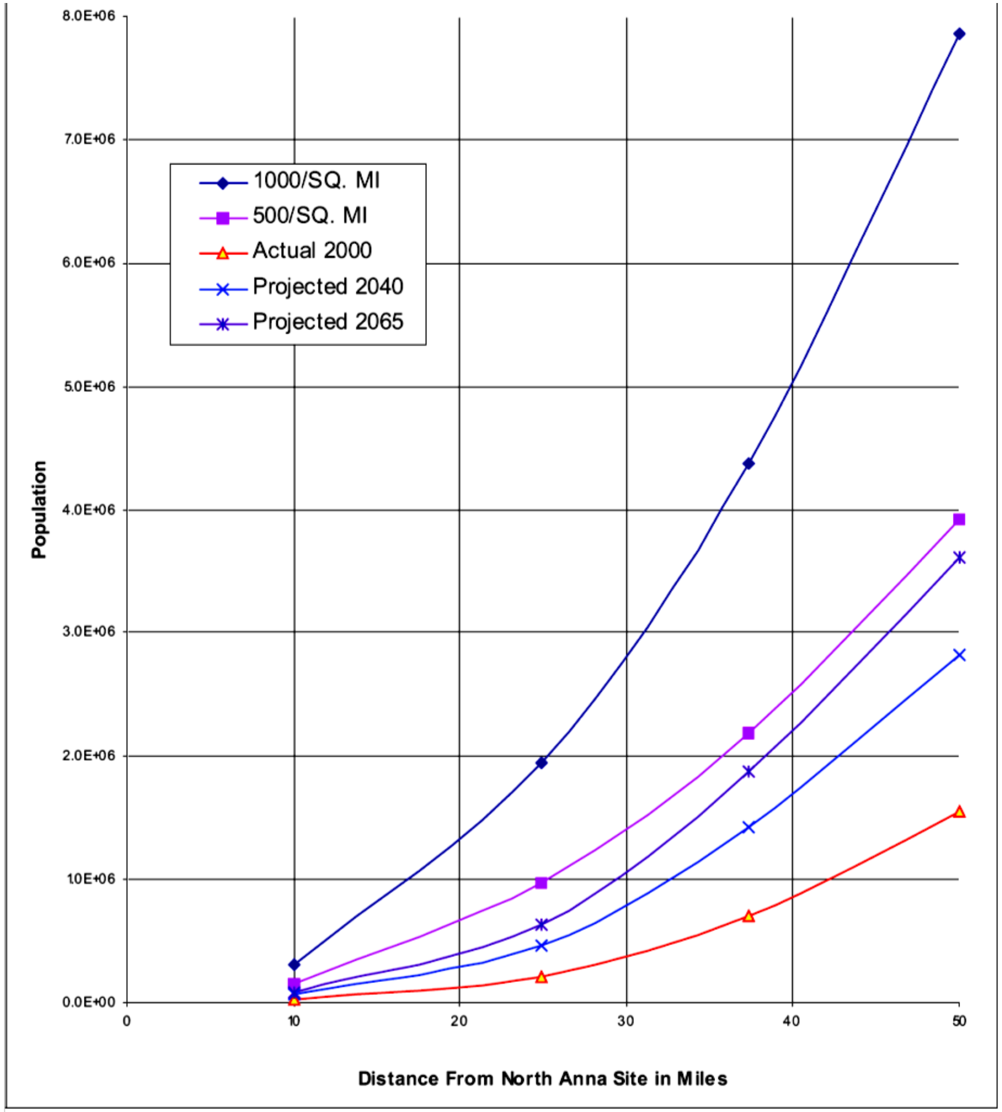
Population

- Nearest population center (10 CFR 100.3)
  - City of Charlottesville (2000 Census population of 45,049)
- Meets requirement of 10 CFR 100.21(b)
  - Low Population Zone (LPZ) is the same as the LPZ for the existing units, a 6-mile-radius circle centered at the Unit 1 containment building
  - Distance between closest point of Charlottesville to the site is 36 miles
  - Requirement that population center distance is at least one and one-third times distance from Unit 3 reactor to outer boundary of LPZ is met
- Meets population density per Regulatory Guide 4.7
  - Actual 2000 population and projected 2065 population densities, including weighted transient population, averaged over any radial distance out to 20 miles, are less than the 500 person-per-square-mile density criterion

Population center distance criterion (10 CFR 100.21(b)) and population density criterion (RG 4.7) are met.

Dominion

Population Density (Section 2.1)



Source: SSAR Figure 2.1-14

Dominion

North Anna 3

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Evacuation Time Estimates

October 20, 2016

Dominion

Evacuation Time Estimates (ETEs)

History of ETEs related to the North Anna site:

- Co-located Part 50 licensee conducted ETEs using 1980, 1990, 2000 and 2010 decennial census data
- ESP Major Features Emergency Plan included ETE based on 2000 census data
- COLA Part 5 – Emergency Plan (Rev 0, 2007) included ETE based on combination of survey-based household size factor and resident addresses for four counties, and 2000 census data with projected increase based on county growth rate for one county
- COLA Part 5 – Emergency Plan (Rev 4, 2013) included ETE based on 2010 census data and incorporated ETE-related 2011 EP Rule provisions

Dominion

2011 EP Rule
10CFR50 Appendix E Part IV Changes

Provisions for applicants and COL licensees prior to fuel load:

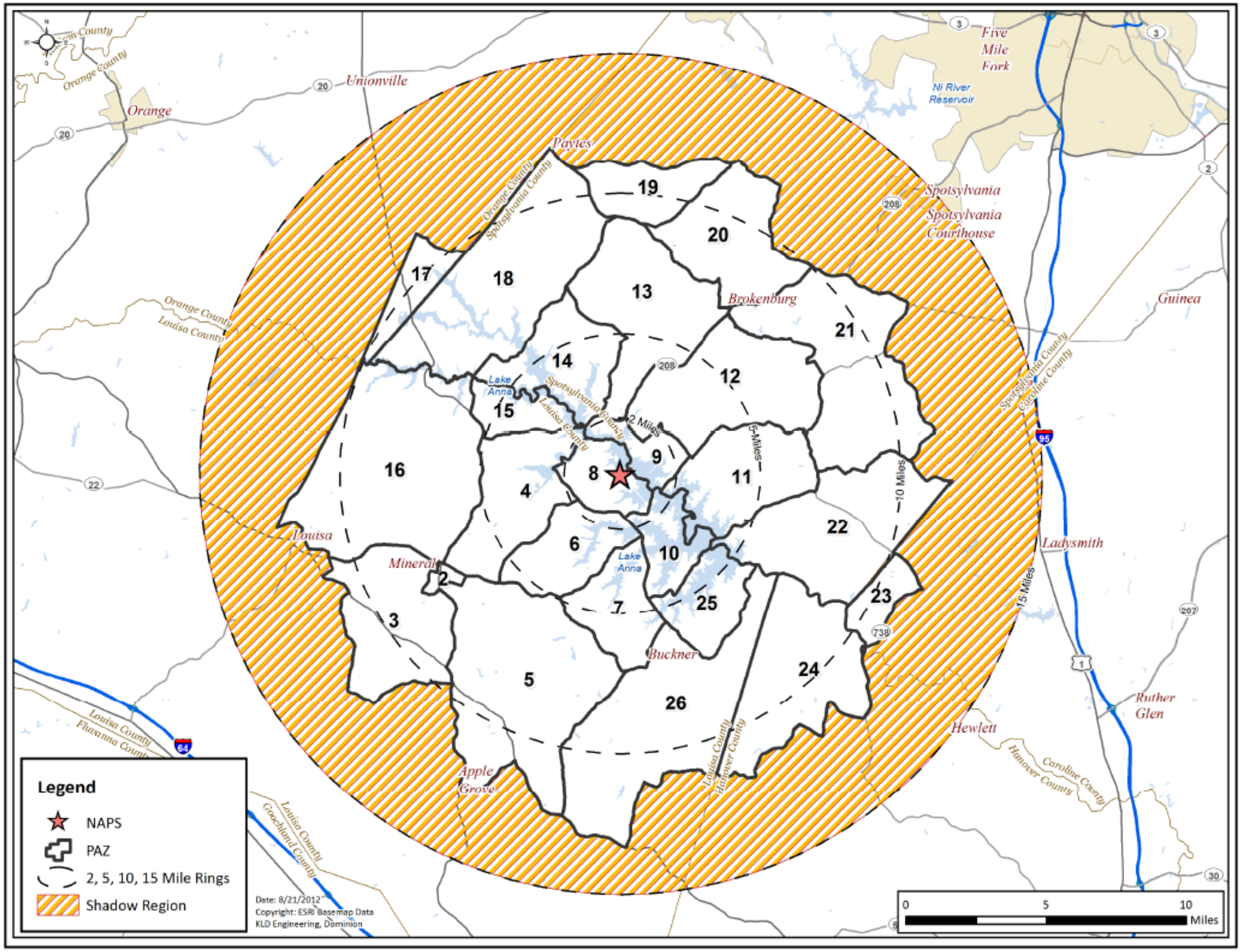
- Application shall include ETE using most recent U.S. Census Bureau data
- After COL applicant receives license, EPZ population changes shall be reviewed at least 365 days prior to scheduled fuel load

Provisions for co-located Part 50 licensee:

- Develop ETE within 365 days of when new decennial census data becomes available and submit to NRC & offsite authorities
- Use ETE to develop protective action recommendations and provide to offsite authorities for protective action strategies
- Estimate EPZ population changes once a year
- Update ETE if population change estimate exceeds established thresholds, submit to NRC within 365 days of determining update needed, and provide to offsite authorities

Dominion

Emergency Planning Zone (EPZ)



2010 EPZ Permanent Resident Population

PAZ	2000 Population	2008 Population (Estimated)[1]	2010 Population
2	418	645	466
3	1,241	1,843	1,490
4	837	1,842	1,107
5	1,331	1,740	1,472
6	308	727	484
7	318	939	484
8	287	885	409
9	117	426	203
10	245	1,151	429
11	740	1,345	981
12	1,222	1,467	1,561
13	991	1,312	1,364
14	541	1,719	803
15	451	1,589	697
16	1,138	2,153	1,601
17	50	223	144
18	1,664	3,624	2,416
19	246	352	383
20	894	1,025	1,026
21	1,901	2,125	2,232
22	1,355	1,639	1,538
23	263	341	260
24	716	989	946
25	312	902	464
26	1,729	2,420	2,242
TOTAL	**19,315**	**33,423**	**25,202**
EPZ Population Growth:		**2000-2010**	**30.48%**
EPZ Population Difference:		**2008-2010**	**-24.60%**

Based on decennial census data, EPZ population grew from 19,315 to 25,202 between 2000-2010 (30.48% -- increase).

2008 estimate was high (33,423).

Sensitivity study determined a 150% increase or 85% decrease in population would meet the threshold for triggering an ETE update prior to the 2020 census.

2015 annual estimate indicated a 4.3%, 5.7% and 5.6% population increase in the 2-, 5- and 10-mile regions, respectively.

Dominion

2010 ETE Results

Scenario	Region 1 2 mile EPZ	Region 2 5 mile EPZ	Region 3 10 mile EPZ
Summer Midweek Mid-day Good Weather	2:30	2:30	2:35
Summer Midweek Mid-day Rain	2:30	2:30	2:40
Summer Weekend Mid-day Good Weather	1:45	1:45	2:00
Summer Weekend Mid-day Rain	1:50	1:50	2:00
Summer Evening Good Weather	1:50	1:50	1:55
Winter Midweek Mid-day Good Weather	2:30	2:30	2:40
Winter Midweek Mid-day Rain	2:30	2:35	2:40
Winter Midweek Mid-day Snow	3:20	3:25	3:30
Winter Weekend Mid-day Good Weather	1:50	1:50	2:00
Winter Weekend Mid-day Rain	1:50	1:50	2:00
Winter Weekend Mid-day Snow	2:50	2:55	3:05
Winter Evening Good Weather	1:50	1:55	2:00
Winter Weekend Mid-day Special Event	1:50	1:50	2:00
Winter Weekend Mid-day Road Impacted	2:30	2:30	2:35

10CFR50.47 Emergency Planning

(b) The onsite and … offsite emergency response plans for nuclear power reactors must meet the following standards:

10. A range of protective actions has been developed for the plume exposure pathway EPZ for emergency workers and the public. …. Evacuation time estimates have been developed by applicants and licensees. Licensees shall update the evacuation time estimates on a periodic basis. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place, and protective actions for the ingestion exposure pathway EPZ appropriate to the locale have been developed.

ETE for Unit 3 provides information for the prospective licensee to develop protective action recommendations in accordance with Federal guidance and for offsite authorities to develop protective action strategies.

Dominion

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Section 2.5.2 Vibratory Ground Motion

October 20, 2016

Section 2.5.2 Introduction

- Areas Addressed:
  - Overview of methodology for site-specific seismic hazard
  - Summary of events and guidance changes affecting Section 2.5.2
  - Summary of COLA changes to address these events and guidance changes
  - More detailed discussions:
    - Updated seismic sources
    - Summarize Probabilistic Site Hazards Analysis (PSHA) development/results
    - Describe new site-specific response spectra using Central and Eastern US Seismic Source Characterization (CEUS-SSC)
    - Discuss new Ground Motion Response Spectra (GMRS) and Foundation Input Response Spectra (FIRS)
    - Discuss Certified Seismic Design Response Spectra (CSDRS) exceedances; conclusions

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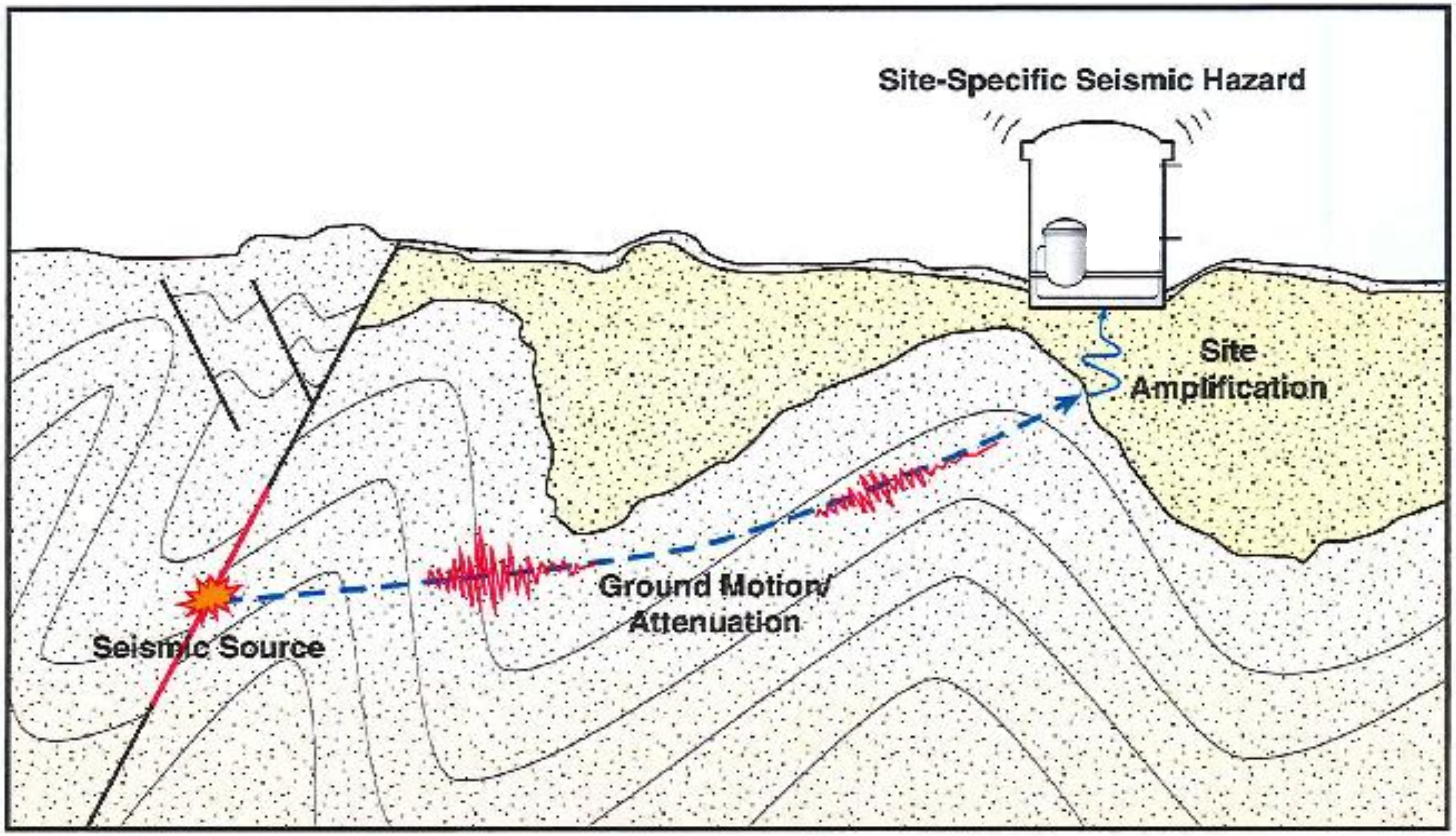
Section 2.5.2 Methodology

Elements of the Site-Specific Seismic Hazard



Graphic Source: SIGMA Project Plan

Dominion

Section 2.5.2
Summary of Events/Guidance Changes

- August 23, 2011 Mineral earthquake
- New CEUS-SSC (NUREG-2115)
- Updated Ground Motion Model (GMM)
- DC/COL-ISG-017, “Ensuring Hazard-Consistent Seismic Input for Site Response and Soil Structure Interaction Analyses”

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Section 2.5.2 Reanalysis Resulting from Events/Guidance Changes

- Updated seismic sources using CEUS SSC and updated seismicity, including 2011 Mineral earthquake
- Revised PSHA, using updated CEUS SSC and updated EPRI 2013 GMM
- Developed new site-specific response spectra using revised PSHA
- Developed new GMRS and FIRS; redefined using new site-specific response spectra and new DC/COL-ISG-017 guidance
- Because of CSDRS exceedances, structures and multiple components were reevaluated

Seismic Development Chronology

Time Line	Regulatory Activity	Site Specific Event	Consequence
2009	ACRS Committee meeting held - Based on FSAR Revision 2. FIRS bounded by CSDRS	Dominion announced change in technology to APWR	
2010	NRC issued DC/COL-ISG 017		
2011		Mineral Earthquake (August 23, 2011)	Investigation and Characterization of Mineral earthquake
2012	EPRI issued CEUS-SSC (NUREG 2115)		Dominion commited to developing new Site Response Spectra using CEUS-SSC which results in further exceedance of APWR CSDRS
2013	EPRI issued Updated Ground Motion Model (NRC approval Accession No. ML13233A102)	Dominion announced change of technology back to ESBWR Use of concrete fill under FWSC-RCOLA	Dominion redeveloped FIRS for ESBWR structures. NEI check performed per DC/COL-ISG-017 guidelines. Because of CSDRS exceedances structures and multiple components reevaluated
2014	NRC issued SRP 2.5.2 Rev 5 & SRP 3.7.1 Rev 4		FSAR Rev 7 (Reset for ESBWR)
2016			Revision 9 of FSAR issued; FIRS redefined using EPRI 2013 GMM; addresses all seismic structure and component reanalysis for ESBWR

Dominion

Section 2.5.2 Content & Purpose

2.5.2 Vibratory Ground Motion

2.5.2.1 Seismicity

Characterize the seismicity of the site region

2.5.2.2 Geologic and Tectonic Characteristics of the Site and Region

Characterize sources of potential earthquake hazard in the site region

2.5.2.3 Correlation of Seismicity with Seismic Sources

Characterize the correlation of seismic sources to observed seismicity

2.5.2.4 Probabilistic Seismic Hazard Analysis and Controlling Earthquakes

Characterize seismic hazard by performing a probabilistic seismic hazard analysis for the site location

2.5.2.5 Seismic Wave Transmission Characteristics of the Site

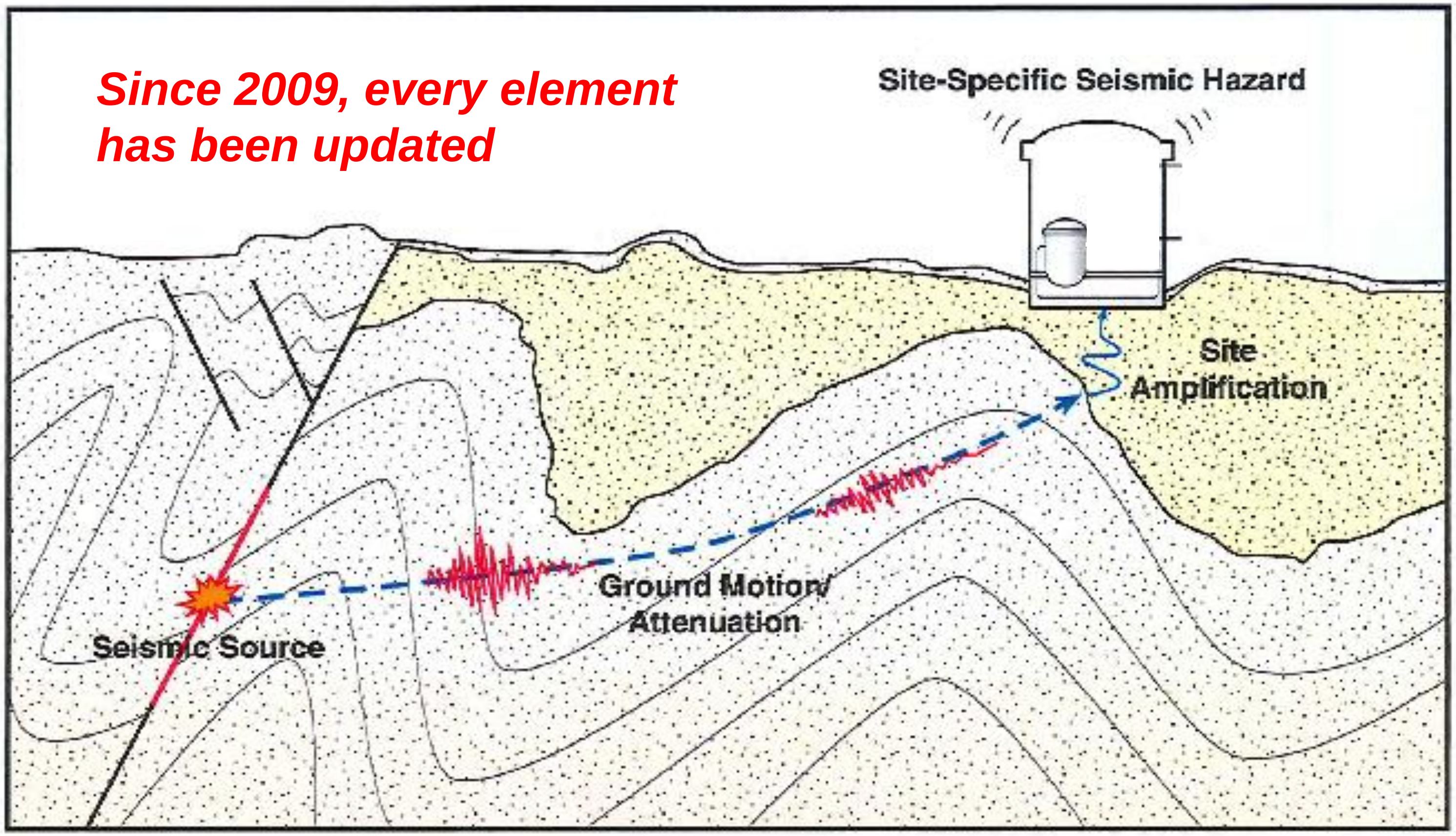
Characterize the seismic response of the site to input design motions

2.5.2.6 Design Response Spectra

Characterize the GMRS and FIRS

Section 2.5.2 Methodology

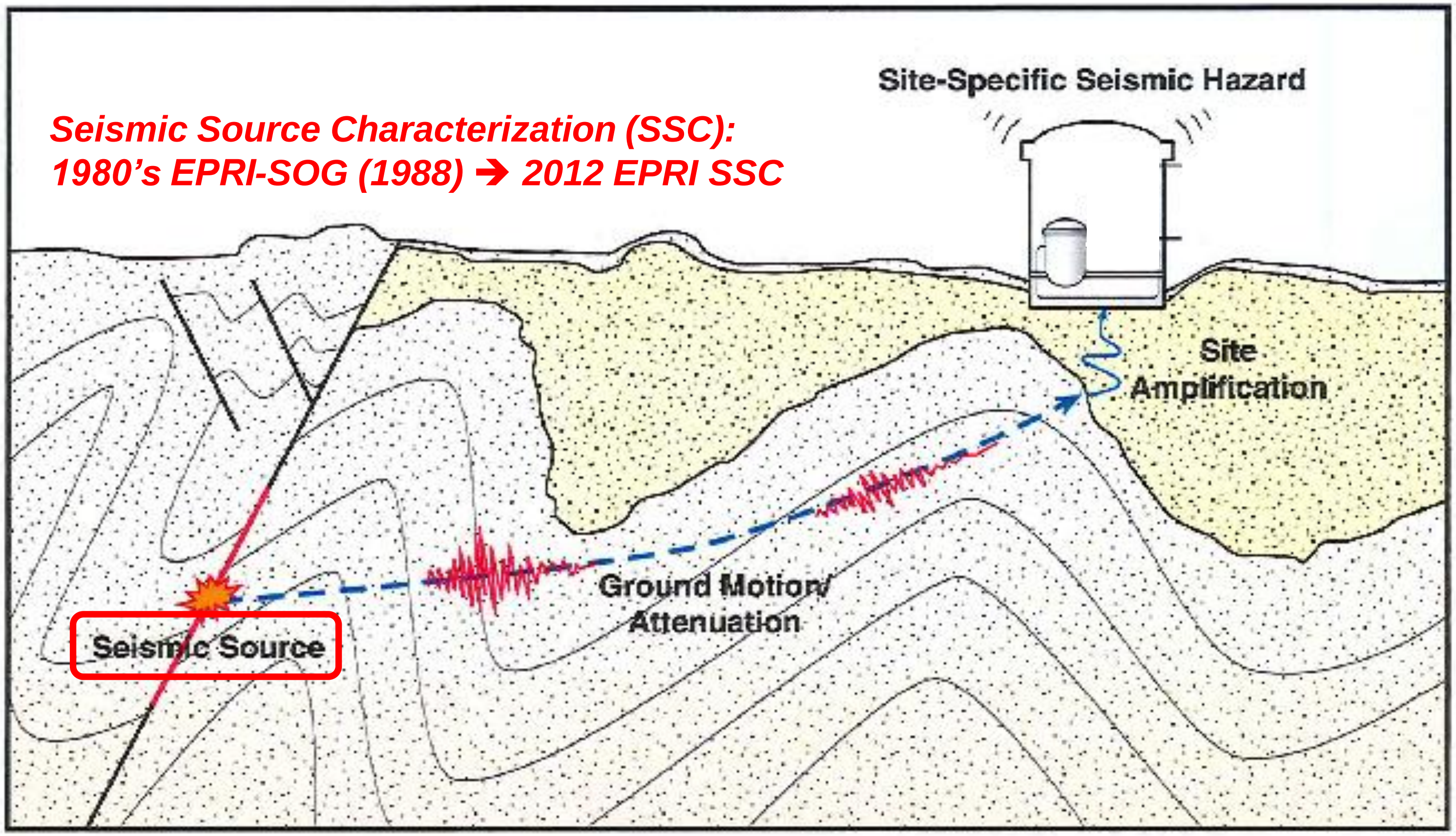
Elements of the Site-Specific Seismic Hazard



Graphic Source: SIGMA Project Plan

Section 2.5.2 Methodology

Elements of the Site-Specific Seismic Hazard

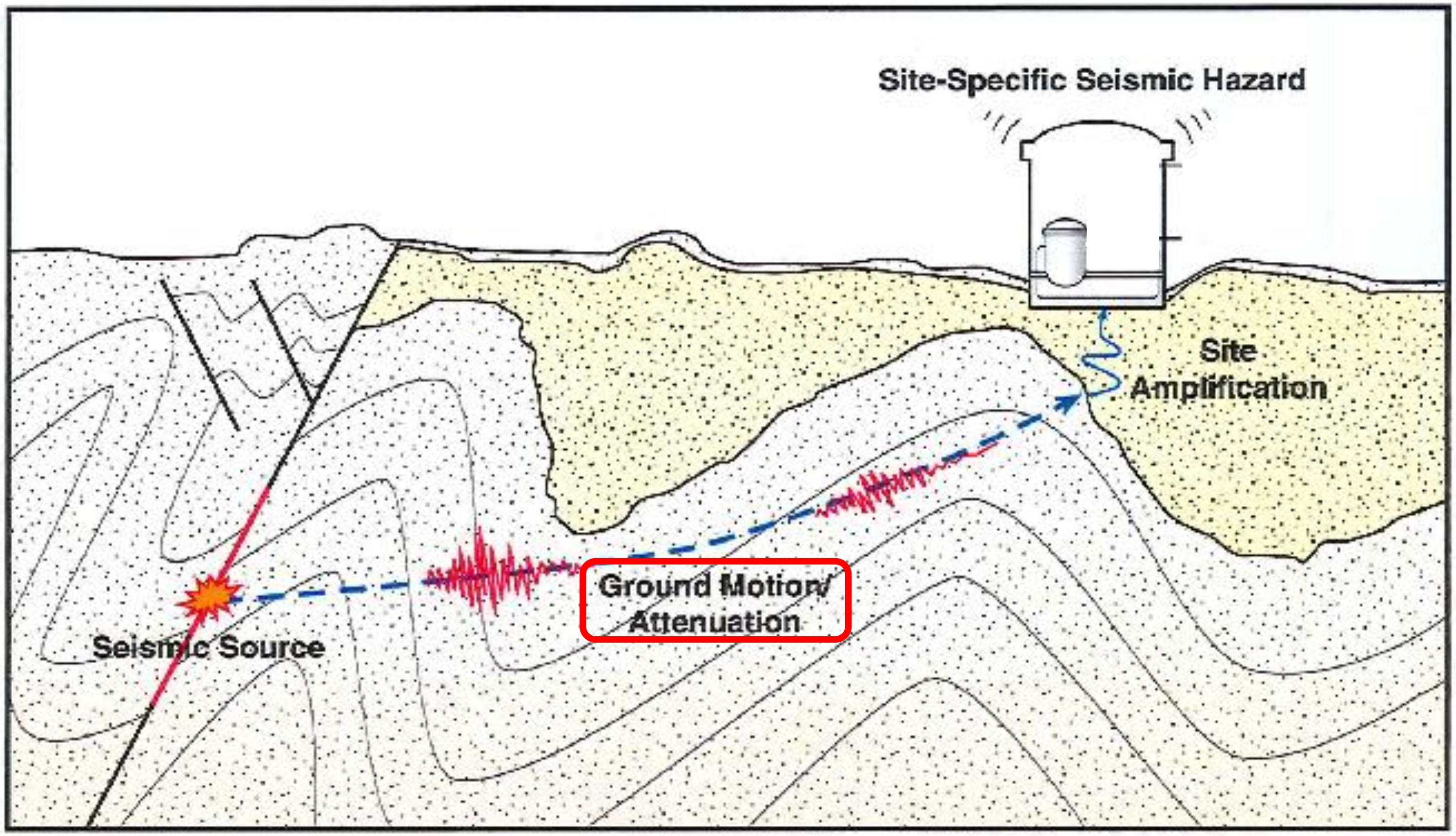


Graphic Source: SIGMA Project Plan

Dominion

Section 2.5.2 Methodology

Elements of the Site-Specific Seismic Hazard



Graphic Source: SIGMA Project Plan

Ground Motion Model (GMM):
EPRI (2004) ➔ EPRI (2013)

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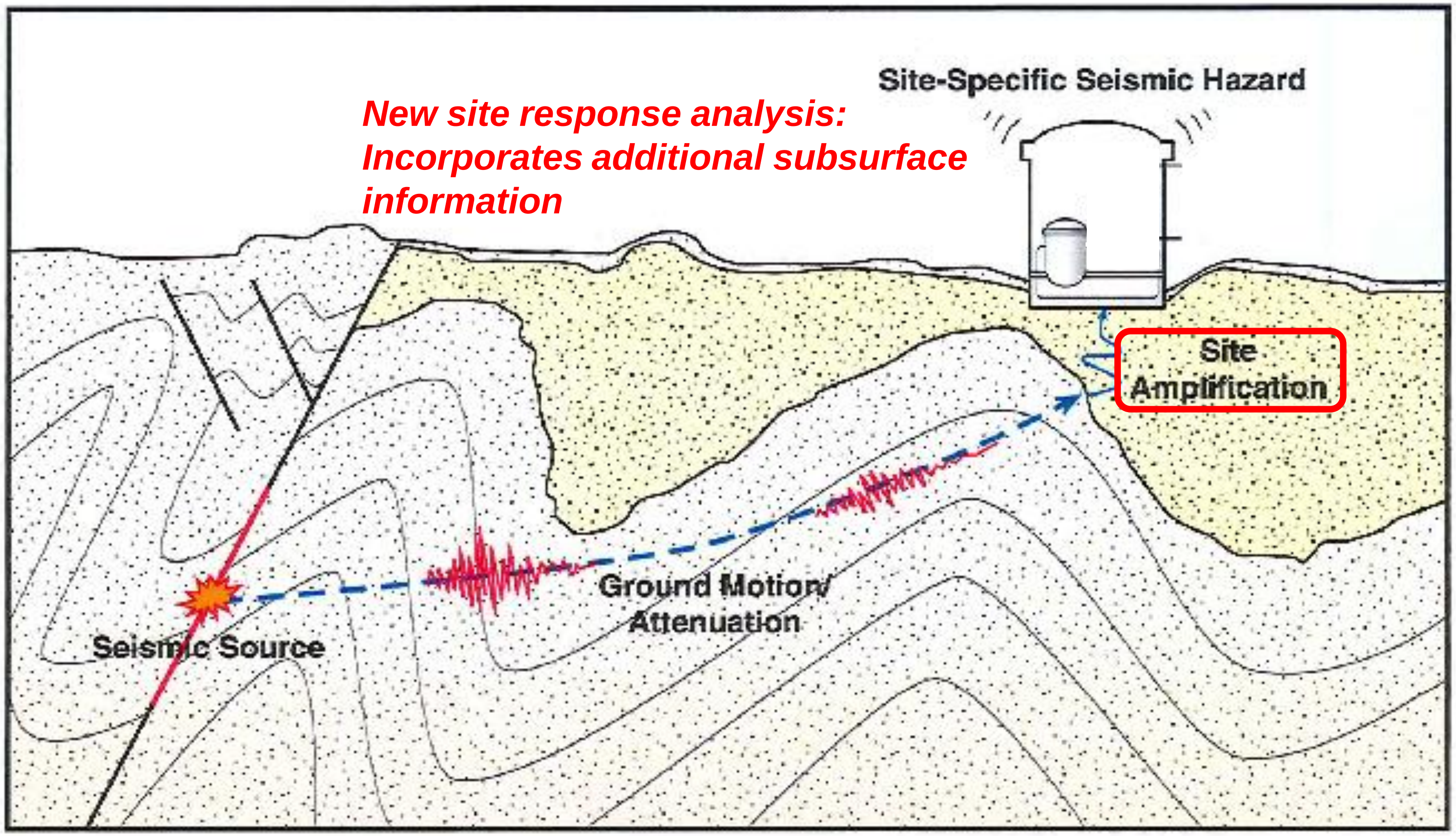
Section 2.5.2 Methodology

Elements of the Site-Specific Seismic Hazard

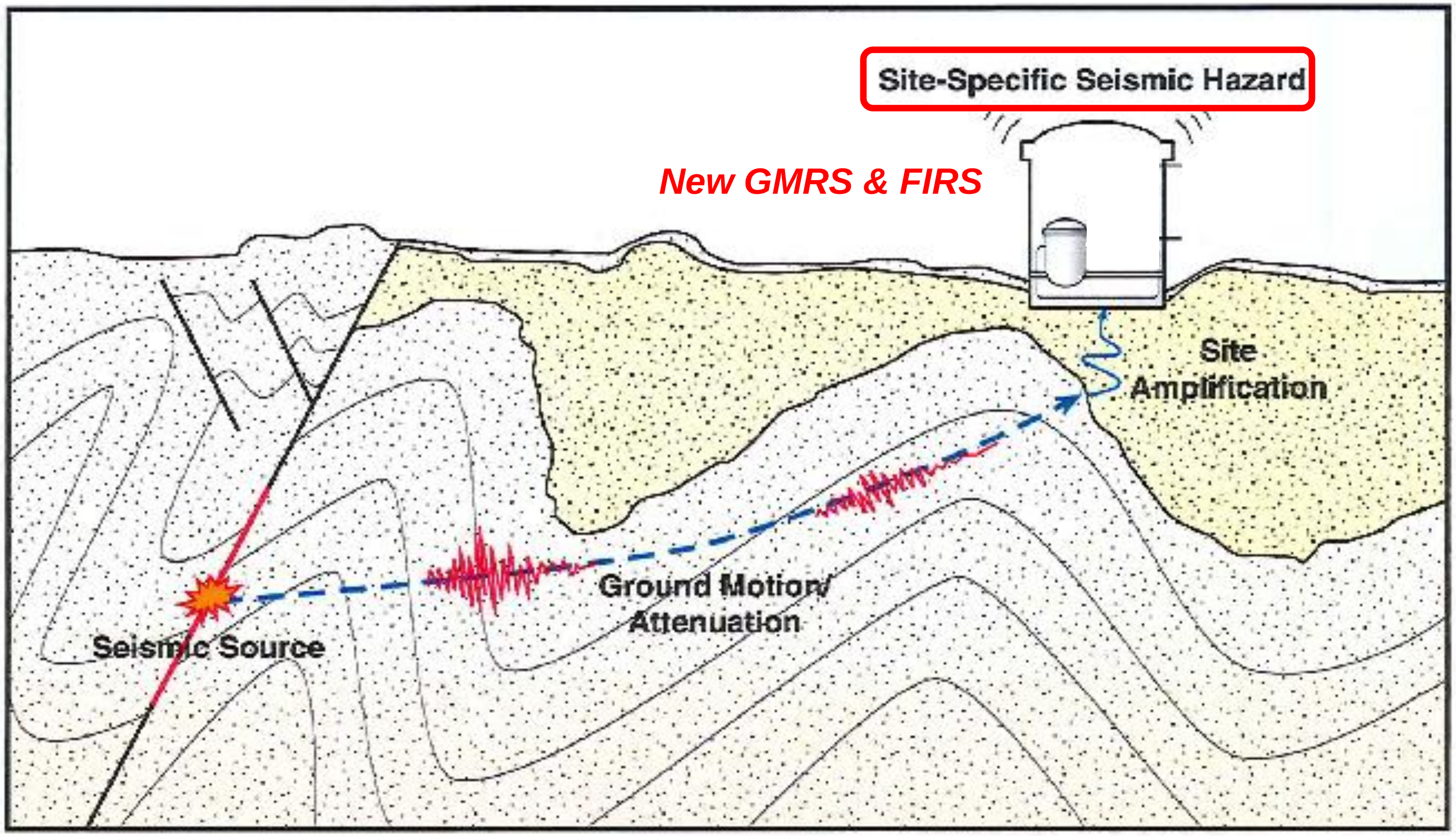


Graphic Source: SIGMA Project Plan

Dominion

Section 2.5.2 Methodology

Elements of the Site-Specific Seismic Hazard



Graphic Source: SIGMA Project Plan

Dominion

Section 2.5.2 Methodology

- Started with CEUS SSC model and databases (EPRI et al., 2012; NUREG-2115)
- Updated the EPRI et al. (2012) earthquake catalog
- Followed NUREG-2117 Senior Seismic Hazard Analysis Committee (SSHAC) guidance to incorporate new information into seismic hazard model
- Used EPRI (2013) Ground Motion Models
- Performed PSHA to assess hard rock seismic hazard
- Developed site-specific site amplification functions considering additional subsurface information and new plant configuration
- Determined horizontal and vertical GMRS and FIRS following RG 1.208

Section 2.5.2.1 Seismicity

Updated Earthquake Catalog

- EPRI et al. (2012) presents an NRC-approved seismic source characterization [SSC] and associated databases for the central and eastern US [CEUS], including an earthquake catalog of events from 1568 through 2008

- CEUS earthquake catalog was updated:
  - RG 1.208 requires evaluation of new information
  - Occurrence of 2011 M 5.8 Mineral, VA earthquake

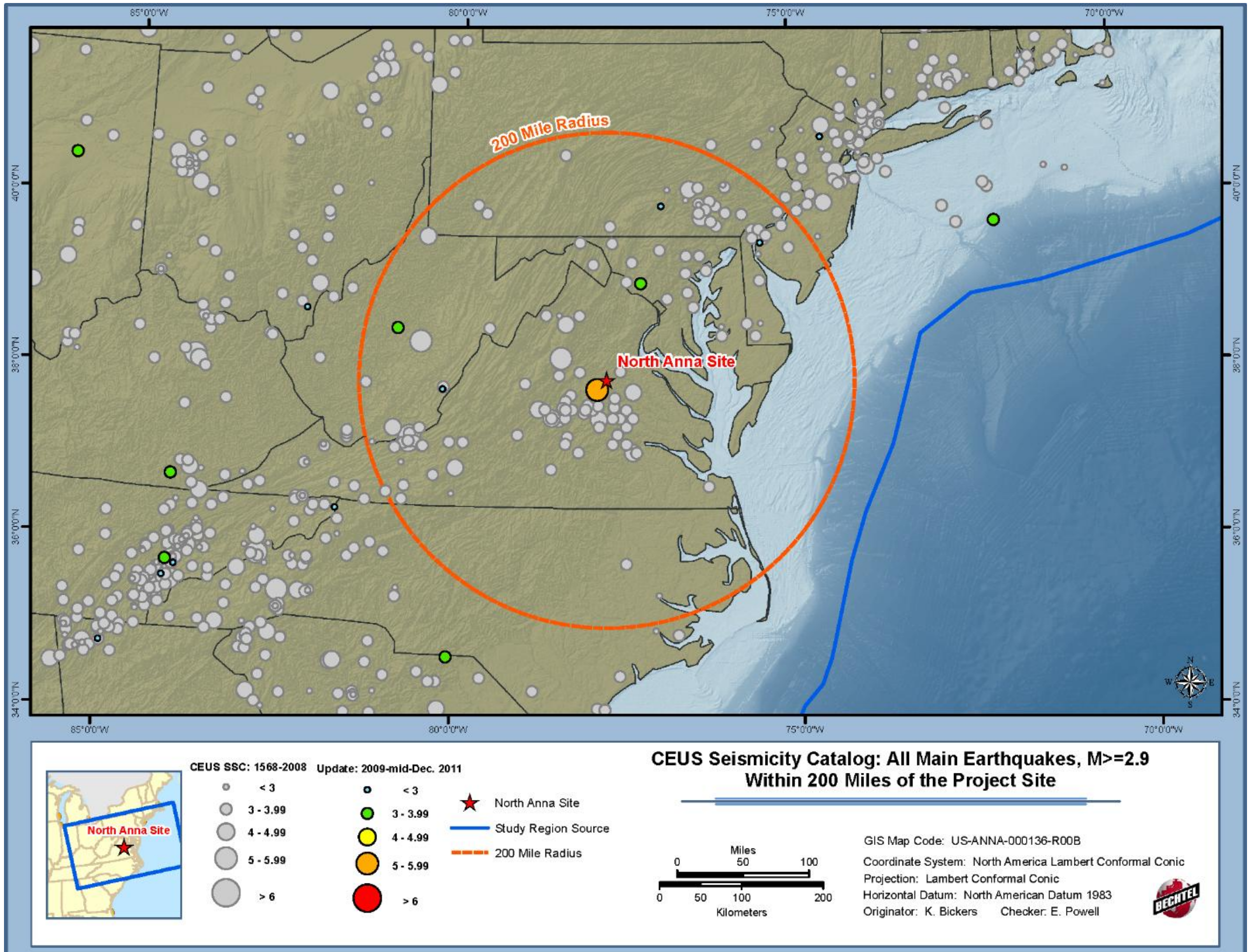
- Following same methodology as EPRI et al. (2012), the CEUS SSC earthquake catalog was updated through mid-December 2011

- **Objective**: Develop an updated earthquake catalog with uniform moment magnitude E[**M**] ≥ 2.2

Dominion

Section 2.5.2.1 Seismicity

Earthquakes within 322-km (200-mi) of the North Anna 3 Site



141 mainshock earthquakes with E[**M**] ≥ 2.9 within 322-km (200-mi) of the North Anna 3 Site

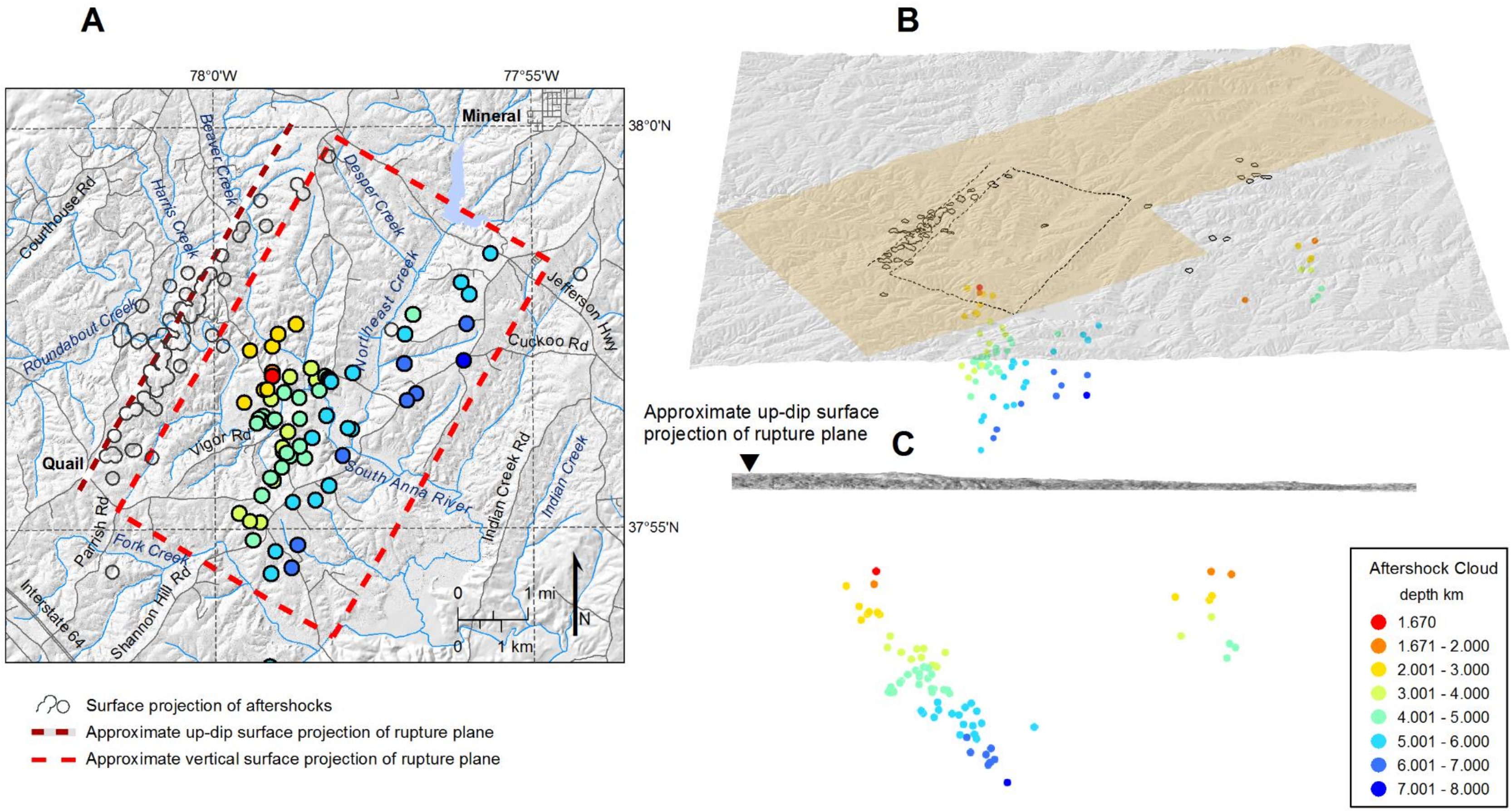
Dominion

2011 Mineral, VA Earthquake

M 5.8 (E[**M**] 5.71) Mineral, VA earthquake, August 23, 2011

- Largest historical event in region and largest instrumentally recorded earthquake in eastern North America since 1988 **M** 5.9 (E[**M**] 5.84) Saguenay, Canada earthquake
- Epicentral region lies within the Appalachian Piedmont, about 130 km southwest of Washington, D.C., and within or near the Central Virginia Seismic Zone (CVSZ)
- Located about 18 km southwest of North Anna
- Main event and aftershocks, including events up to **M** 3.9 (E[**M**] 3.91), illuminated a rupture plane:
  - ranging in depth from about 2 to 8 km
  - mostly reverse motion, striking approximately N26°-30°E,
  - dipping 37°-55°SE
  - extending to a length of 8 to 10 km along strike

Mineral Earthquake Aftershocks



FSAR Fig 2.5.1-203

2011 Mineral, VA Earthquake

Investigations and Conclusions on Surface Deformation

- Based on Dominion's field reconnaissance of the epicentral region, as well as from work performed by other researchers immediately following the earthquake, it was concluded that the **M** 5.8 Mineral earthquake did not produce any discernible rupture or deformation at the ground surface

- Mineral earthquake does not appear to have occurred on a previously mapped fault

No evidence of surface rupture, surface fault features, or geomorphic expression of surface rupture or coseismic surface tectonic deformation exists for the **M** 5.8 Mineral earthquake.

Dominion

Section 2.5.2.2 Geologic and Tectonic Characteristics of the Site and Region

Seismic Source Model

- **Starting model: EPRI et al. (2012) CEUS SSC**
  - Smoothed, gridded background sources
    - Mmax Zones
    - Seismotectonic Zones
  - RLME (Repeated Large Magnitude Earthquakes) source
  - Hazard contributing sources out to 1000 km [within 1% of total hazard]
- **Updated the CEUS SSC model**
  - Reg. Guide 1.208 requires evaluation of new information
  - Occurrence of 2011 **M** 5.8 Mineral, VA earthquake
    - Slight update of Mmax for host ECC-AM Seismotectonic Zone source
  - Updated seismicity used to update activity rates and b-values of background sources
  - Upon geologic investigations, neither of the following warranted defining a new RLME:
    - Fault source for the 2011 Mineral, VA earthquake
    - Eastern Tennessee Seismic Zone [ETSZ]

Section 2.5.2.2 Geologic and Tectonic Characteristics of the Site and Region

SSHAC Level 2: Does Mineral earthquake warrant a distinct seismic source?

- Field reconnaissance
- Geomorphic analysis of LiDAR data
- Solicitation of expert opinions
- Review of recent published literature

Conclusions

- Mineral earthquake did not exhibit evidence of surface rupture
- No evidence associated with the subsurface structure for this event that would suggest a repeated large magnitude [**M** ≥ 6.5] earthquake warranting a new RLME model
- No available recurrence or slip rate information
- Experts recommended against consideration of the Mineral earthquake rupture as a new CEUS seismic source

No: Mineral earthquake does not warrant a distinct seismic source

Dominion

Section 2.5.2.2 Geologic and Tectonic Characteristics of the Site and Region

Seismic Source Model Updates

- Mineral earthquake did lead to a slight update in the Mmax distribution of the host seismic source ECC-AM

Weights	0.101	0.244	0.310	0.244	0.101
EPRI et al. 2012	6.0	6.7	7.2	7.7	8.1
FSAR	**6.1**	6.7	7.2	7.7	8.1

- Updated the activity rates and b-values of the background seismic sources using the updated earthquake catalog [including 2011 Mineral earthquake], resulting in localized increases on the rates per unit area and both increases and decreases in b-values for grid cells in the vicinity of the project site.

The 2011 Mineral, VA earthquake is adequately considered in the CEUS SSC model.

Dominion

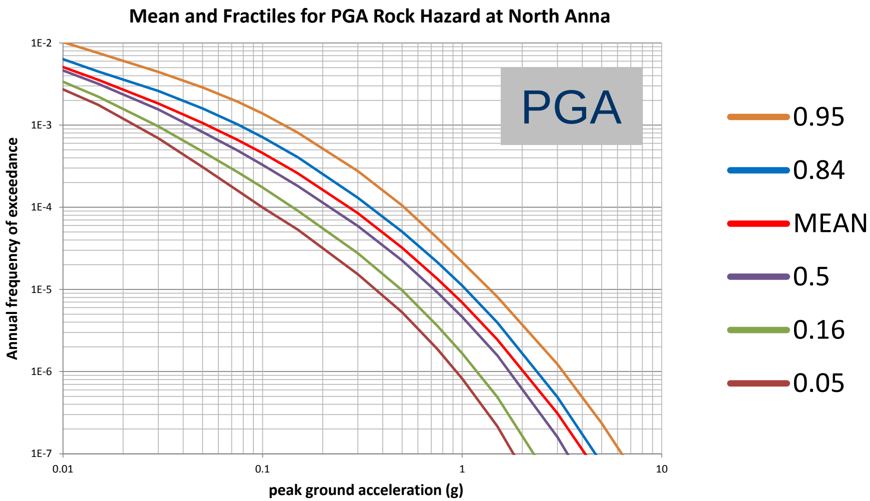
Section 2.5.2.4 PSHA and Controlling Earthquakes

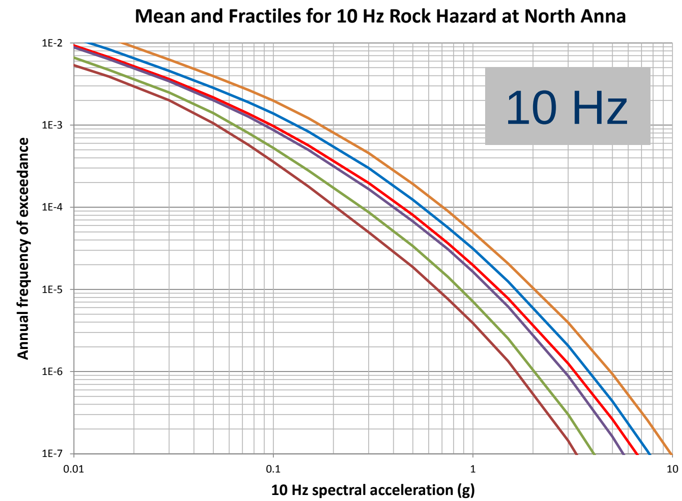
- Horizontal Hard Rock Ground Motions
  - EPRI (2013) GMM attenuation curves: PGA, 25, 10, 5, 2.5, 1, & 0.5 Hz
  - Midcontinent model
  - “Hard rock”: shear-wave velocity of 9,200 ft/sec

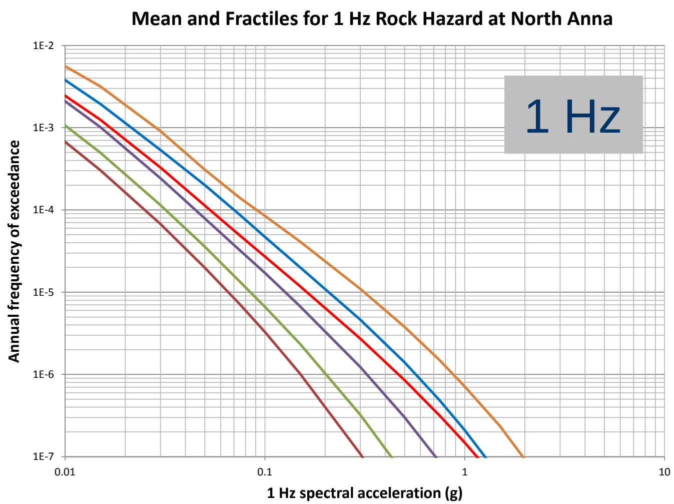
- PSHA Deaggregation
  - Magnitude and Distance
    - “Controlling earthquakes” for portions of the ground motions for a given mean hazard level:
      - high-frequency [HF: 5 to 10Hz]
      - low-frequency [LF: 1 to 2.5Hz]
    - Following Reg. Guide 1.208, separate HF and LF rock response spectra are used for input to site response per Approach 2A of NUREG/CR-6728
  - Seismic Sources
    - Hazard curves from discrete sources give an alternate view of the seismic sources contributing most to the total hazard
      - HF and LF hazard at 10^{-4} and 10^{-5} dominated by local sources
      - LF hazard at 10^{-4} has low hazard contribution from Charleston and New Madrid Fault System RLME sources

Dominion

Section 2.5.2.4 PSHA and Controlling Earthquakes







From Figures 2.5.2-231, -234, & -236 Mean and Fractile Rock Seismic Hazard Curves

UHRS

Table 2.5.2-217 Horizontal Rock Spectral Accelerations from the PSHA for MAFEs of 10-4, 10-5, and 10-6

5% Critically-Damped Spectral Acceleration, g

Spectral Frequency	10^{-4}	10^{-5}	10^{-6}
PGA (100 Hz)	0.271	0.854	2.03
25 Hz	0.560	1.77	4.37
10 Hz	0.442	1.35	3.23
5.0 Hz	0.269	0.811	1.96
2.5 Hz	0.137	0.421	1.10
1.0 Hz	0.0531	0.162	0.466
0.5 Hz	0.0315	0.0853	0.254

PSHA: probabilistic seismic hazard analysis
MAFE: mean annual frequency of exceedance
PGA: peak ground acceleration

Dominion

Section 2.5.2.4 PSHA and Controlling Earthquakes

M and R Deaggregation

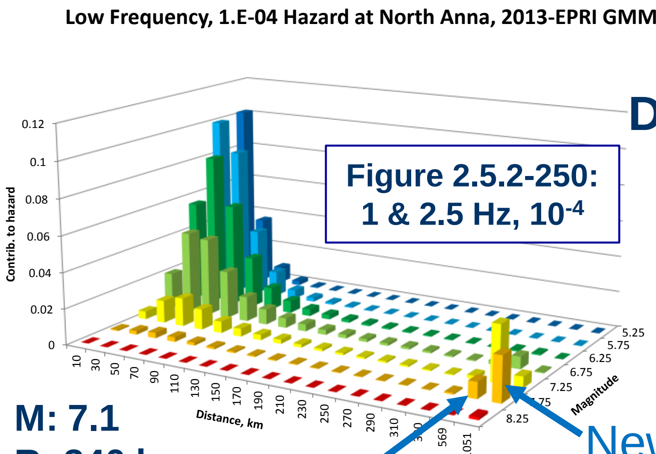


Figure 2.5.2-250: 1 & 2.5 Hz, 10^{-4}

M: 7.1
R: 340 km

New Madrid

Charleston

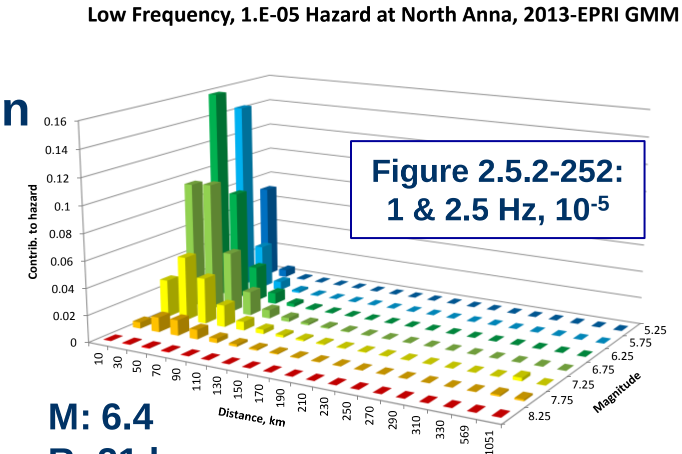


Figure 2.5.2-252: 1 & 2.5 Hz, 10^{-5}

M: 6.4
R: 21 km

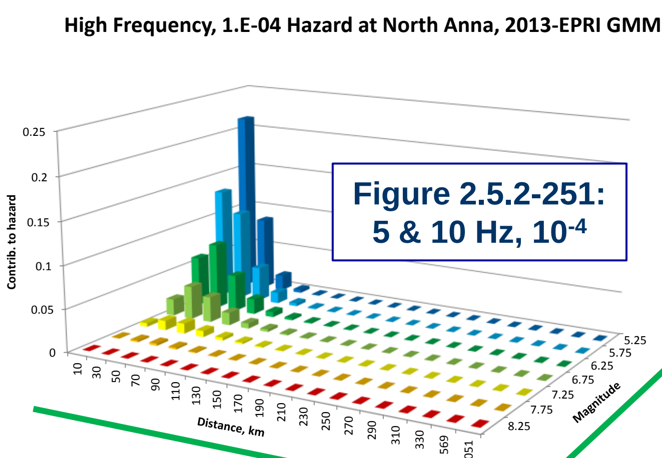


Figure 2.5.2-251: 5 & 10 Hz, 10^{-4}

M: 5.9
R: 22 km

R M

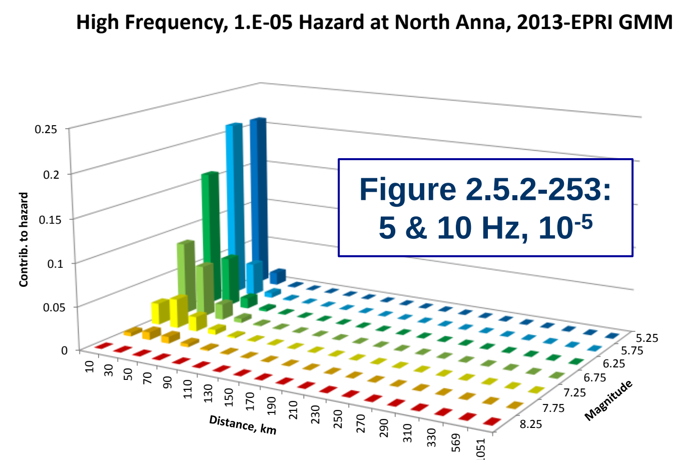


Figure 2.5.2-253: 5 & 10 Hz, 10^{-5}

M: 6.1
R: 15 km

M & R values from Table 2.5.2-218

Dominion

Section 2.5.2.4 HF and LF Rock UHRS

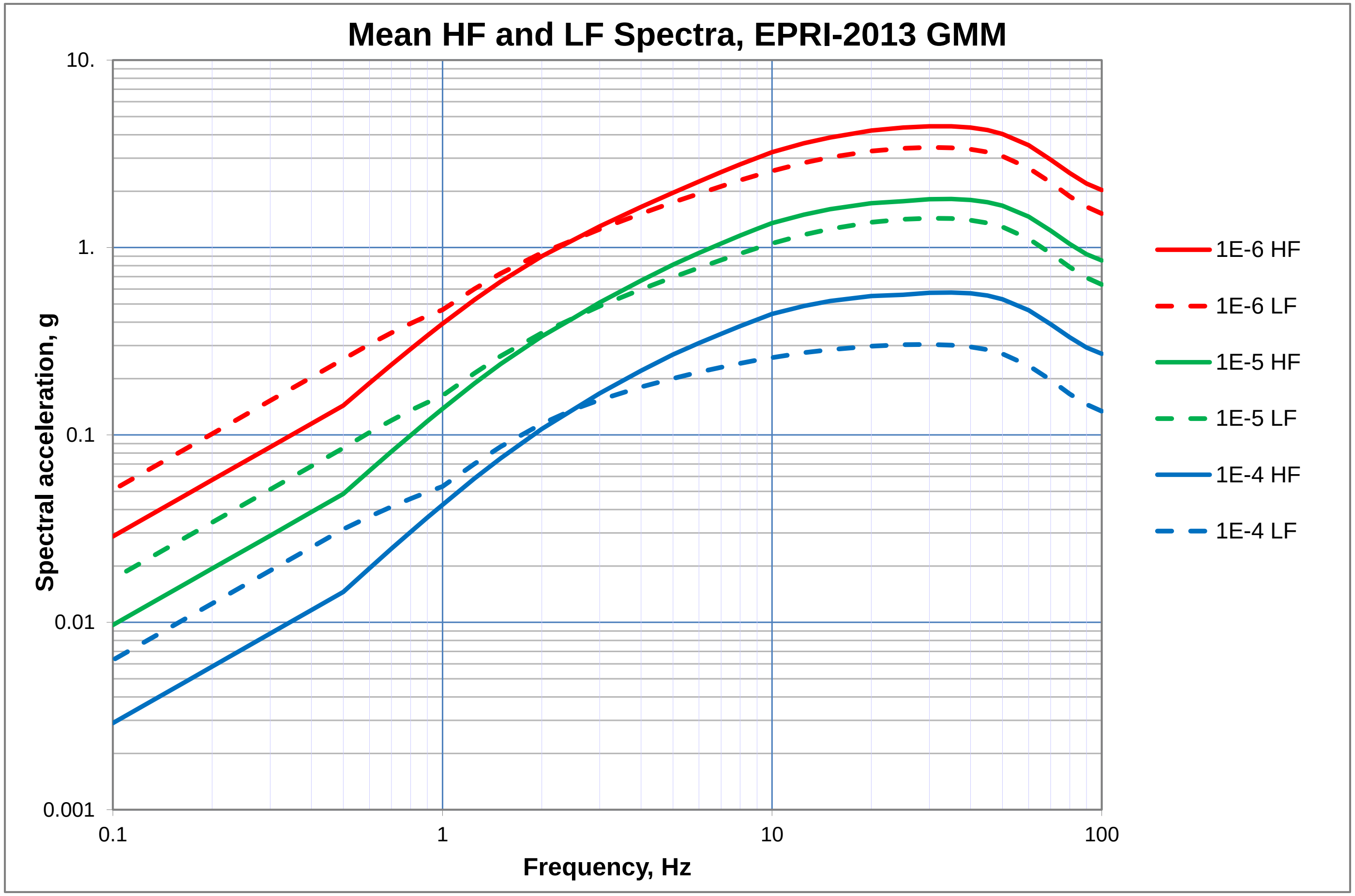


Figure 2.5.2-256 HF and LF Mean Rock UHRS for 1E-04, 1E-05, and 1E-06

Section 2.5.2.5 Purpose

This section discusses the seismic wave transmission characteristics of the site from hardrock to building foundation elevations and finished ground surface

- The hard rock motion was provided through the PSHA results (hazard curves) in Section 2.5.2.4 (hard rock is defined with Vs≥9200 fps and located between 155 ft and 165 ft–finished grade is at El. 290 ft (NAVD 88)).
- The results of site geotechnical investigations and dynamic subgrade properties were provided in Section 2.5.4
- Site amplification factors and soil UHRS at 10^{-4} and 10^{-5} annual frequencies of exceedance were calculated in this section

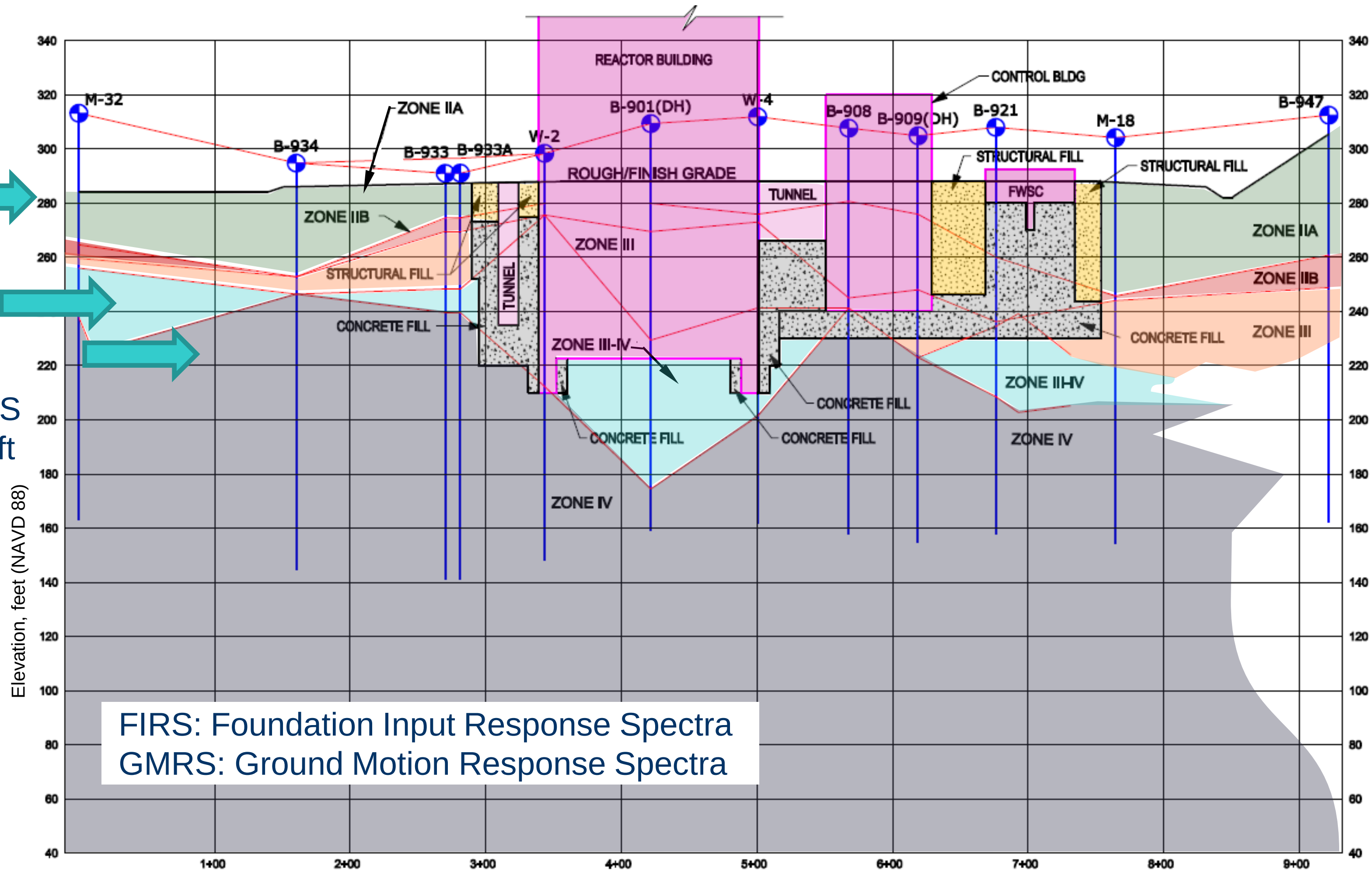
Dominion

Section 2.5.2.5 FIRS and GMRS Horizons

FWSC FIRS at El. 282 ft

CB FIRS at El. 241 ft

GMRS & RB/FB FIRS at El. 224 ft



FIRS: Foundation Input Response Spectra
GMRS: Ground Motion Response Spectra

Vertical Exaggeration = 2:1

Adapted from FSAR Figure 2.5.4-228

Section 2.5.2.5 FIRS and GMRS Horizons

- Ground Motion Response Spectra (GMRS) were defined at El. 224 ft at the deepest excavation at the site on competent material
- FIRS elevations were defined at the bottom of foundation for each building
  - El. 224 ft for RB/FB
  - El. 241 ft for CB
  - El. 282 ft for FWSC
- Foundation Input Response Spectra (FIRS) calculations were consistent with the SSI analysis assumptions per DC/COL-ISG-17
  - Partial column outcrop FIRS for partially embedded SSI analyses that only considers building embedment in rock (partial column analysis)
  - Full column outcrop FIRS for fully embedded SSI analyses that considers full embedment of the building in rock and soil (full column analysis)

- Performance-Based Surface Response Spectra (PBSRS) were defined at finished grade (El. 290 ft) and on top of each truncated partial soil column

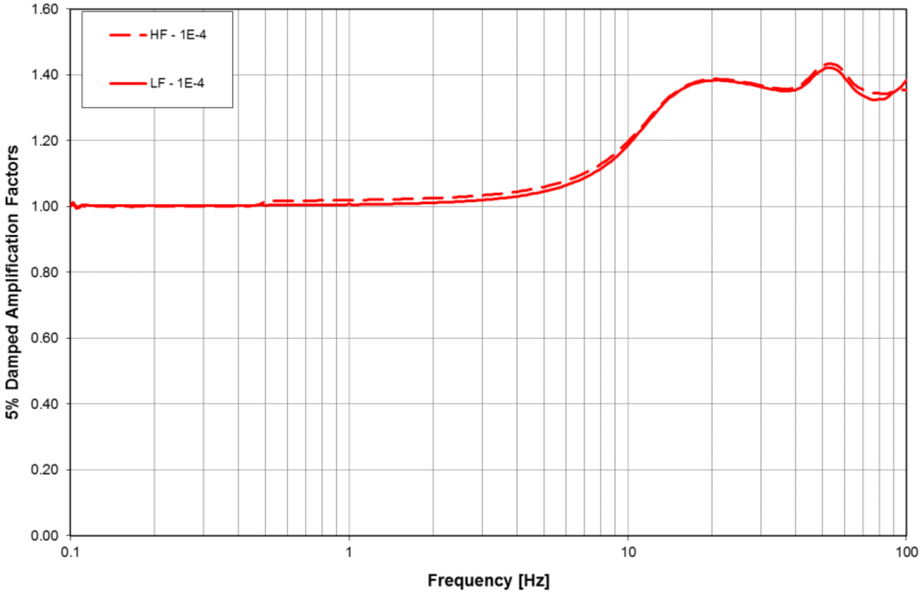
Dominion

Section 2.5.2.5 Methodology

- Site amplification calculations were performed following requirements of NUREG/CR 6728 (Approach 2A), RG 1.208, and ISG-17
  - LF and HF rock motion at 10^{-4} and 10^{-5} annual frequencies of exceedance were propagated through site soil columns
- Site amplifications were performed for three base soil columns based on information provided in Section 2.5.4
  - RB/FB Soil Column
  - CB Soil Column
  - FWSC Soil Column
- The envelopes of site amplifications for RB/FB and CB soil columns were used in calculation of GMRS and RB/FB and CB FIRS
- The site amplifications for FWSC soil column were used in calculation of FWSC FIRS

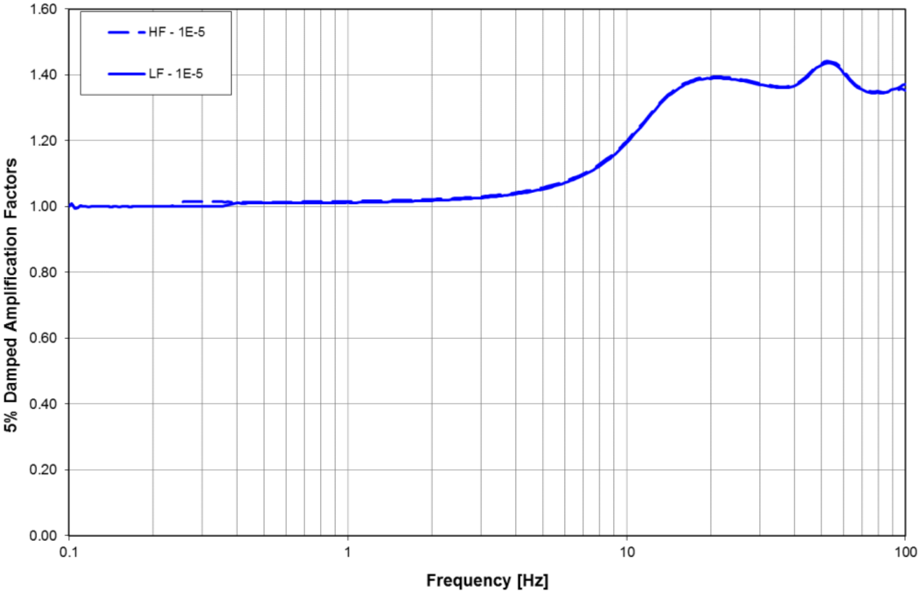
Section 2.5.2.5 Spectral Amplifications

Mean Geologic Outcrop ARS Amplification Factors for RB/FB Soil Column at 10^{-4} Hazard Level Input Ground Motion at GMRS Horizon



FSAR Figure 2.5.2-286

Mean Geologic Outcrop ARS Amplification Factors for RB/FB Soil Column at 10^{-5} Hazard Level Input Ground Motion at GMRS Horizon



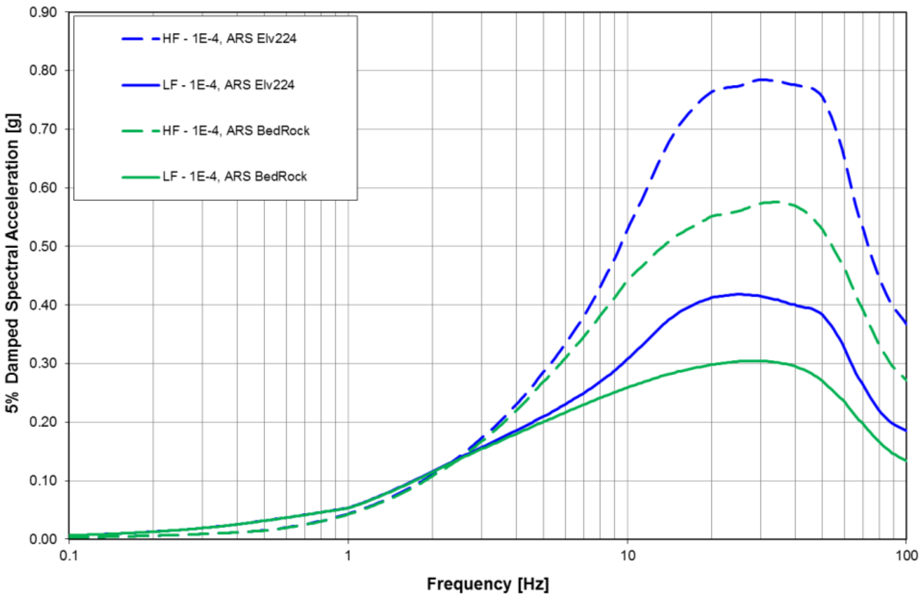
FSAR Figure 2.5.2-287

- Similar results are shown in FSAR Section 2.5.2 for all other soil columns and horizons of interest

Dominion

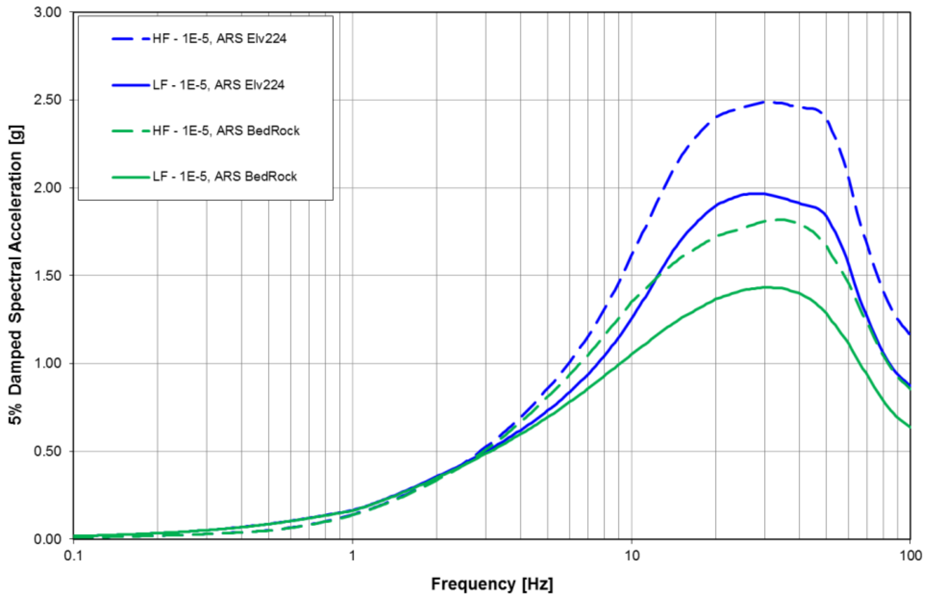
Section 2.5.2.5 Response at GMRS Horizon

Mean Geologic Outcrop ARS for RB/FB Soil Column at 10^{-4} Hazard Level Input Ground Motion at GMRS Horizon



FSAR Figure 2.5.2-288

Mean Geologic Outcrop ARS for RB/FB Soil Column at 10^{-5} Hazard Level Input Ground Motion at GMRS Horizon



FSAR Figure 2.5.2-289

- UHRS were calculated as the envelope of HF and LF
- Similar results are shown in FSAR Section 2.5.2 for all other soil columns and horizons of interest

Dominion

Section 2.5.2.5 Conclusions

- Site amplification factors and UHRS at 10^{-4} and 10^{-5} hazard levels were calculated at GMRS horizon and at each FIRS horizon consistent with the SSI analysis models for each building

- The UHRS were used in calculation of FIRS and GMRS as discussed in Section 2.5.2.6

Section 2.5.2.6 Purpose

In this section the performance-based Design Response Spectra (DRS) are calculated for:

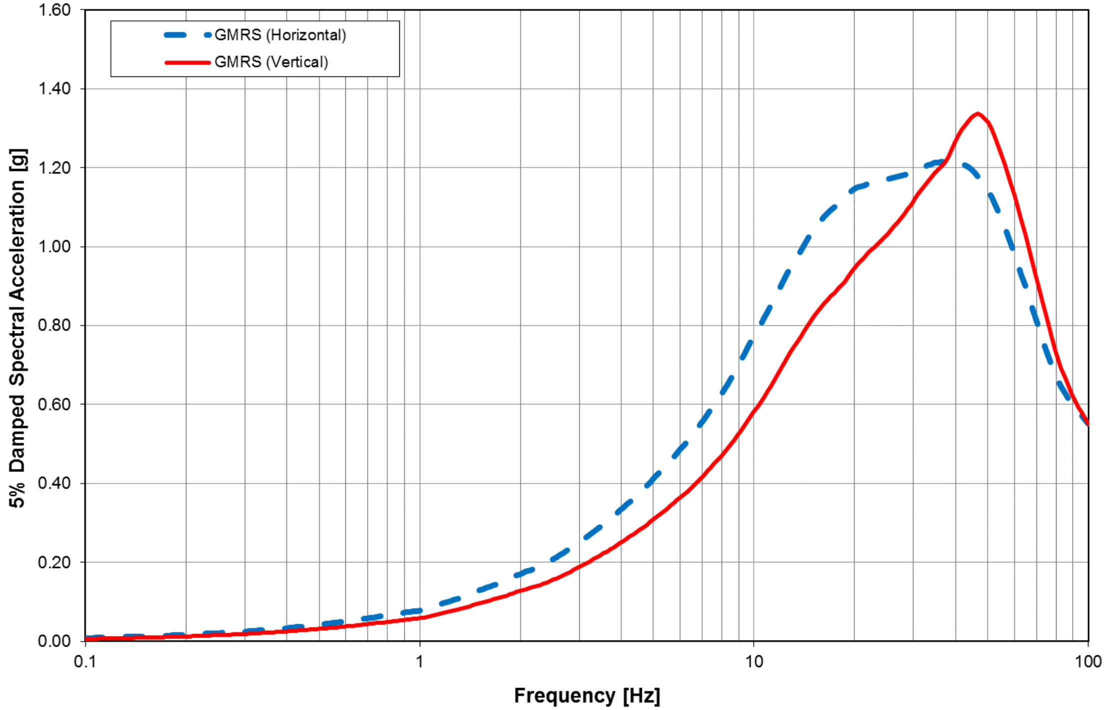
- Horizontal and vertical GMRS for the site
- Horizontal and vertical FIRS and PBSRS for each building

Section 2.5.2.6 Methodology

- DRS were calculated following performance-based requirements of RG 1.208
- Horizontal GMRS, FIRS, and PBSRS were obtained from 10^{-4} and 10^{-5} UHRS at their corresponding horizons by applying appropriate frequency dependent design factors per RG 1.208
- Results from RB/FB and CB soil columns were enveloped in calculation of GMRS, RB/FB and CB FIRS
- Vertical GMRS, FIRS, and PBSRS were calculated using appropriate V/H ratio determined following NUREG/CR-6728 procedure

Section 2.5.2.6 GMRS

Horizontal and Vertical GMRS

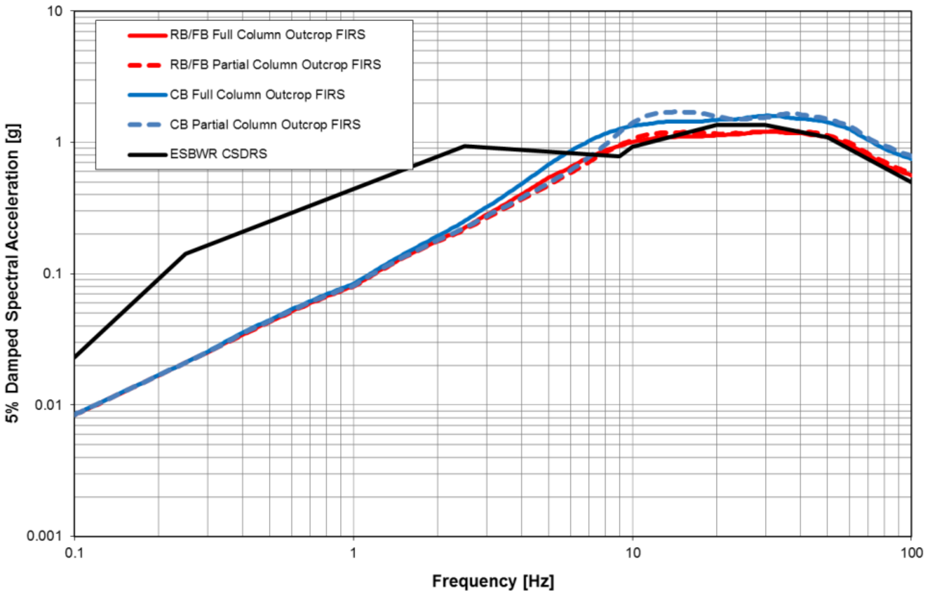


FSAR Figure 2.5.2-313

- Similar results are obtained for all FIRS and PBSRS of interest

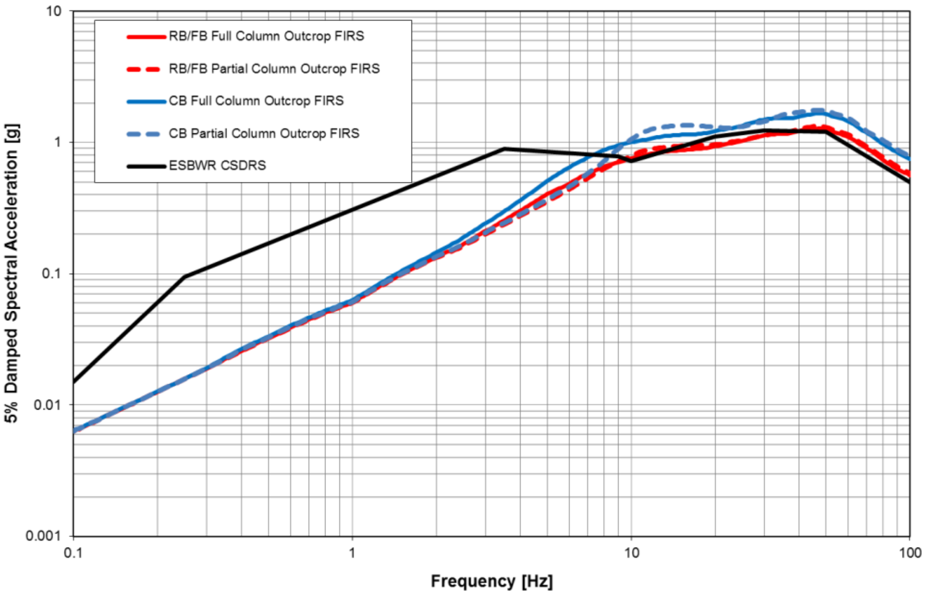
Section 2.5.2.6 FIRS for RB and CB

Comparison of Horizontal CSDRS with Unit 3 FIRS for RB/FB and CB



FSAR Figure 2.0-201

Comparison of Vertical CSDRS with Unit 3 FIRS for RB/FB and CB

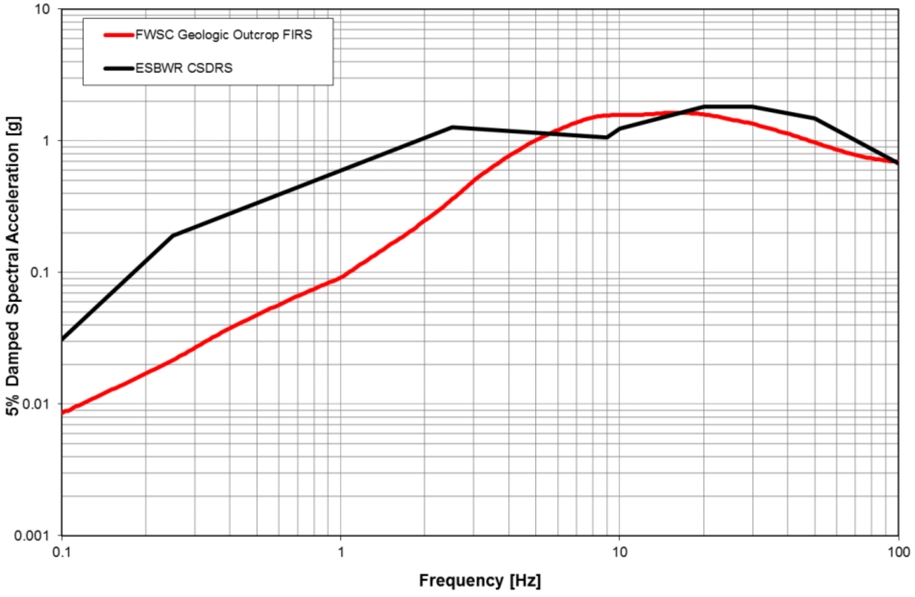


FSAR Figure 2.0-202

Dominion

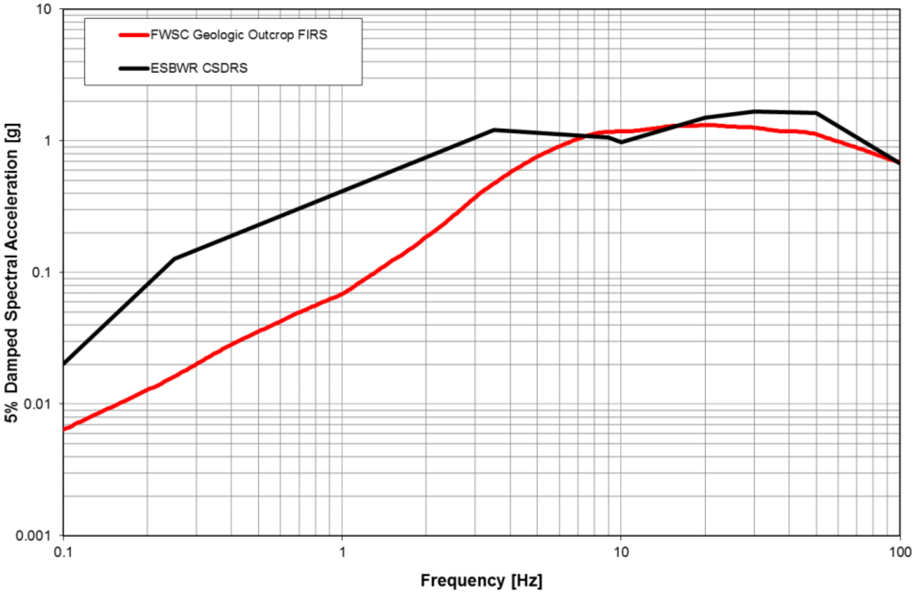
Section 2.5.2.6 FIRS for FWSC

Comparison of Horizontal CSDRS with Unit 3 FIRS for FWSC



FSAR Figure 2.0-203

Comparison of Vertical CSDRS with Unit 3 FIRS for FWSC



FSAR Figure 2.0-204

Dominion

Section 2.5.2.6 Conclusions

- GMRS and PBSRS for the site were calculated
- FIRS were calculated for each building at horizon consistent with its SSI analysis approach as discussed in Section 3.7.2
- GMRS and FIRS exceed, for some frequencies, CSDRS - NA3 Departure NAPS DEP 3.7-1
- Based on NAPS DEP 3.7-1, site specific seismic analyses of Seismic Category I structures were performed as discussed in Section 3.7.1 and 3.7.2.

North Anna 3

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Seismic Design Parameters (Section 3.7.1)

October 20, 2016

Dominion

Section 3.7.1 Purpose

Seismic design parameters were developed in this section

- Safe Shutdown Earthquakes (SSE) for the purpose of seismic design, analysis, and qualification of plant SSCs were established
- Operating Basis Earthquake (OBE) for the purpose of plant shutdown determination was established
- SSI input response spectra and corresponding spectrum matched time-histories and SSI input strain compatible soil profiles were developed for:
  - SSI analysis of RB/FB (partial and full column analyses)
  - SSI analysis of CB (partial and full column analyses)
  - SSI analysis of FWSC (surface and deep motion analyses)
- Changes to NUREG 0800, SRP 3.7.1 (Rev.4) were addressed

Section 3.7.1 Methodology

- Based on departure NAPS DEP 3.7-1, SSE design motion was defined by two sets of ground motion response spectra:
  - ESBWR CSDRS, and
  - Site specific FIRS for each building

  SSE is exceeded if both sets of response spectra are exceeded
- OBE was defined as 1/3 of the SSE. OBE exceedance checks are performed at grade. Spectra associated with OBE is exceeded if both (a) and (b) are exceeded as described in Section 3.7.4.
  a) 1/3 of ESBWR CSDRS
  b) 1/3 of Site-dependent SSE manifestation at grade
- OBE and SSE definitions are exemptions from Tier 1 and covered in NAPS DEP 3.7-1

Dominion

Section 3.7.1 Methodology

- SSI strain compatible soil profiles for the in-situ material were developed following RG 1.208 methodology
  - Results from site-response analysis in Section 2.5.2.5 were used
  - LB, BE, and UB strain compatible profiles were developed for each building
  - Minimum variation requirements of ASCE 4-98 were met
  - P-wave velocities below nominal site-specific groundwater table elevation were adjusted to account for effect of water
- LB, BE and UB strain compatible properties of engineered fill materials around each building were also developed from results of site response analyses using same methodology

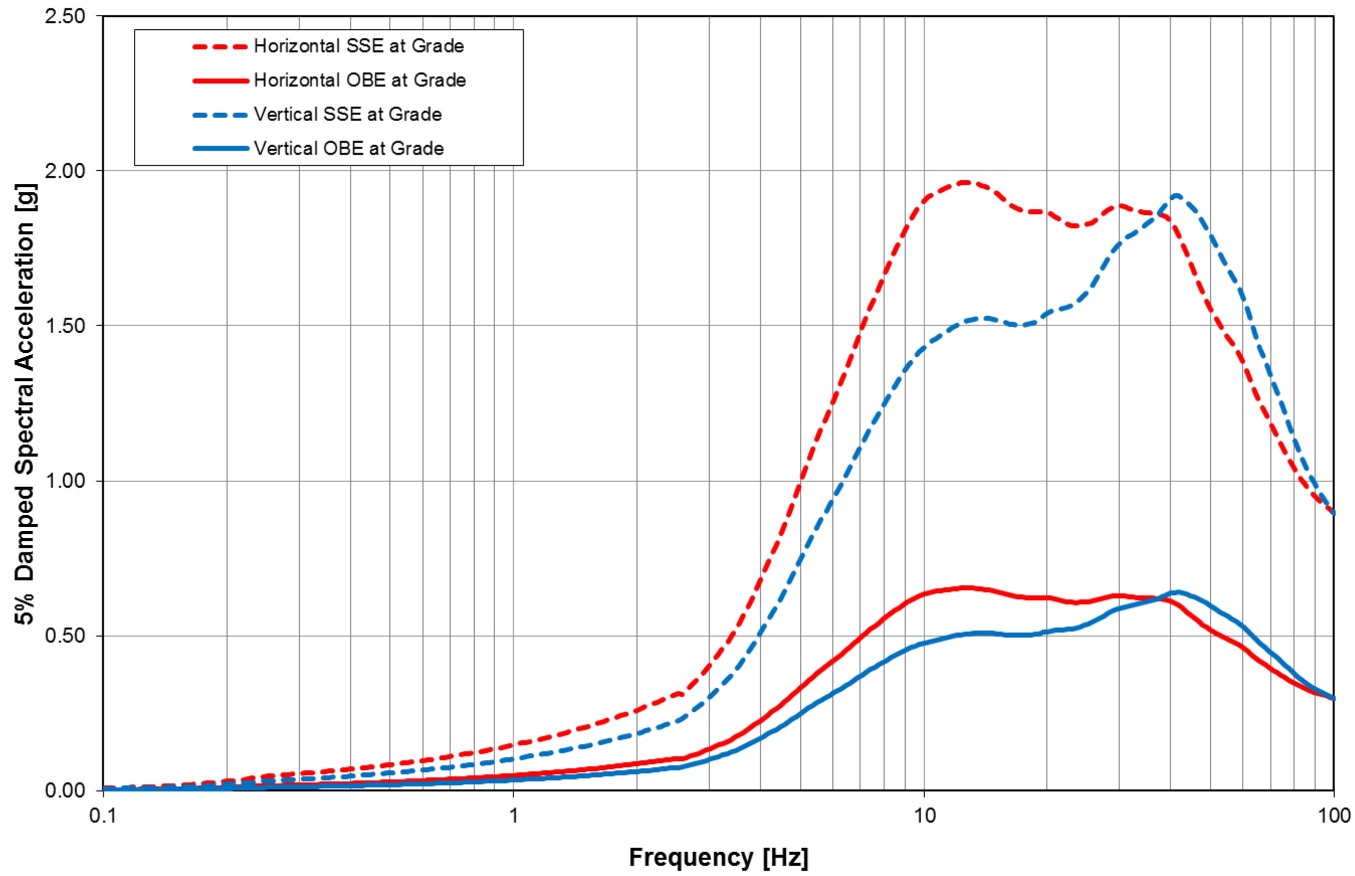
Dominion

Section 3.7.1 Methodology

- Development of SSI input response spectra
  - Requirements
    - NEI Check (DC/COL-ISG-017)
    - Minimum Required Spectrum (per 10 CFR 50, App. S)
  - RB/FB and CB SSI input response spectra were calculated as partially embedded and fully embedded foundations per DC/COL-ISG-017
  - FWSC SSI input response spectra were calculated to meet DC/COL-ISG-017
    - At El. 282 ft as a surface foundation
    - At El. 220 ft corresponding to the bottom of the fill concrete considering it as an embedded foundation
    - Note that the concrete fill below FWSC is a site specific feature included in departure NAPS DEP 3.7-1
  - Development of spectrum compatible acceleration time histories follows Option 1, Approach 2 of SRP 3.7.1 (Rev.4)

Section 3.7.1 SSE and OBE

Site-Dependent SSE Manifestation at Grade and OBE at Grade

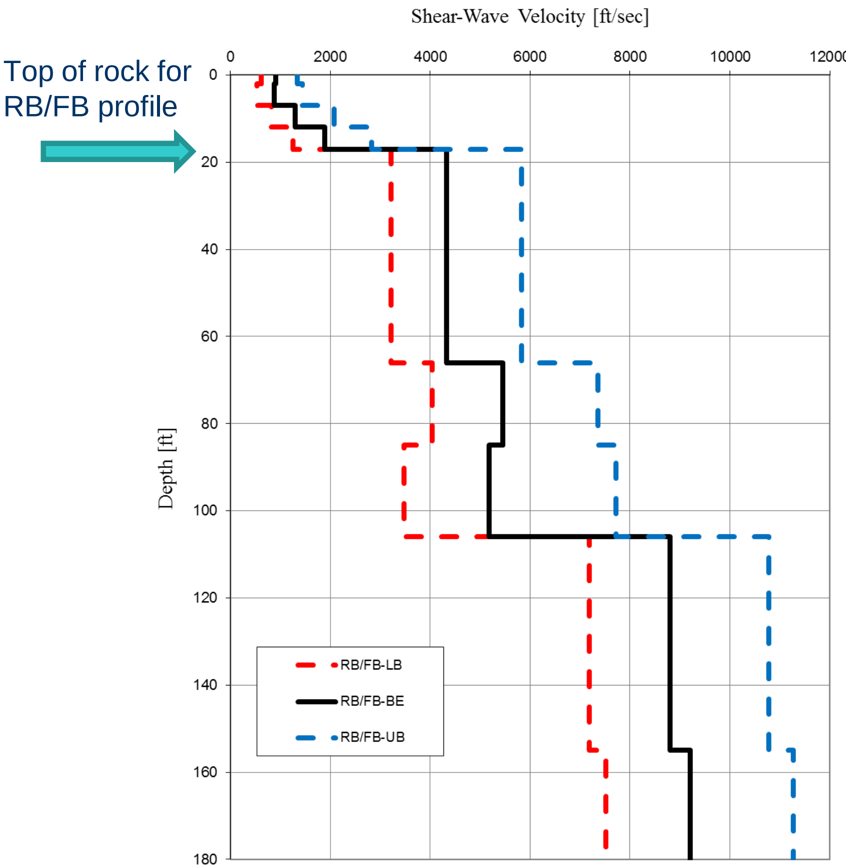


FSAR Figure 3.7.1-267

Dominion

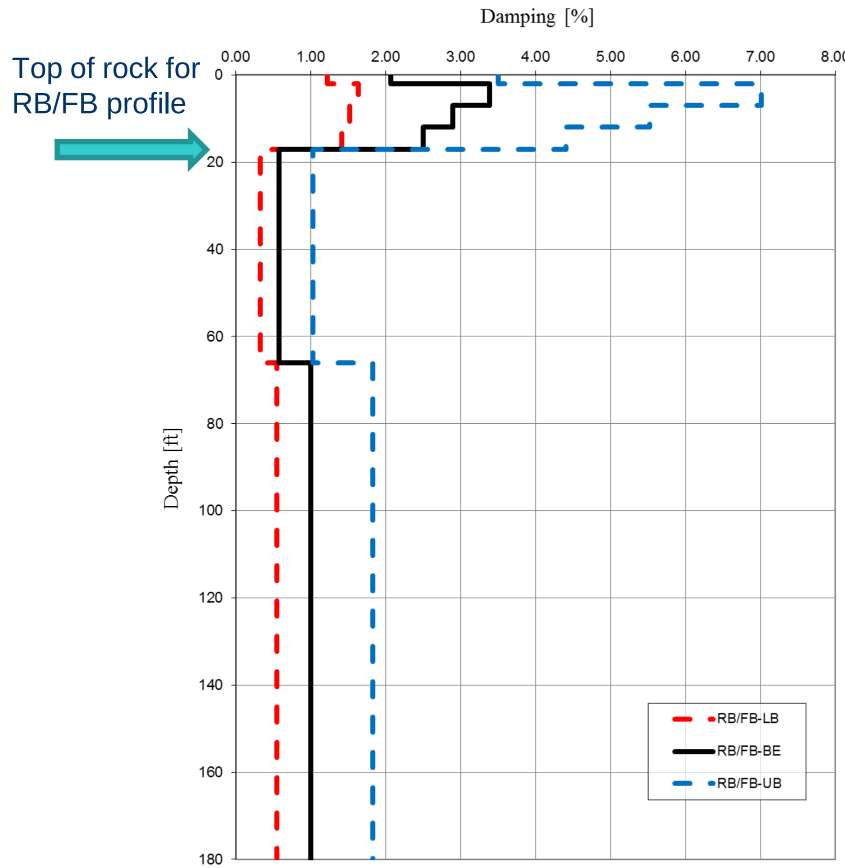
Section 3.7.1 Strain Compatible SSI Input Soil Profiles

SSI Input Strain Compatible Shear-Wave Velocity Profiles – RB/FB



FSAR Figure 3.7.1-201

SSI Input Strain Compatible Damping Profiles – RB/FB



FSAR Figure 3.7.1-202

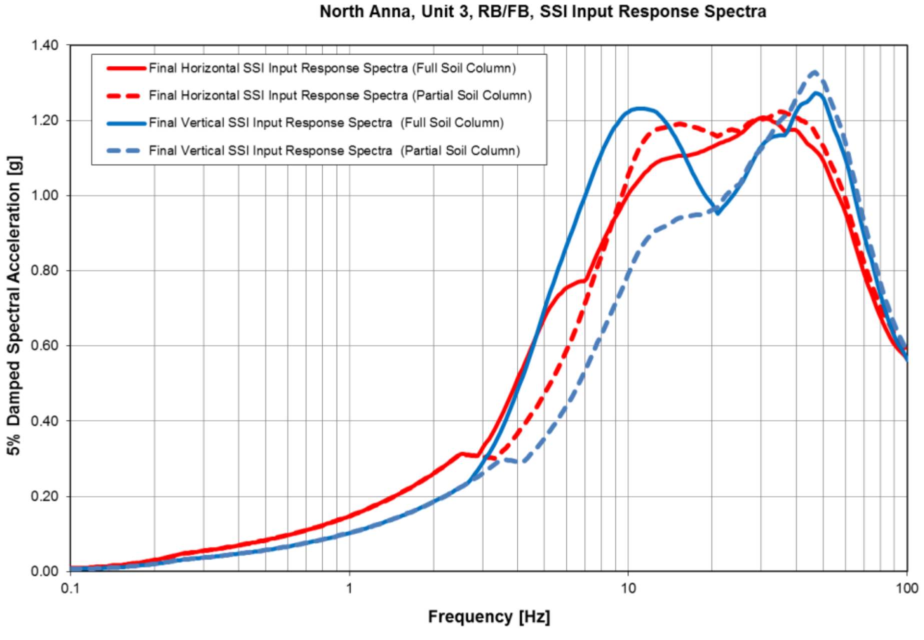
- Similar results are obtained for other buildings

Depth of 0 ft corresponds to the finished grade at El. 290 ft.

Dominion

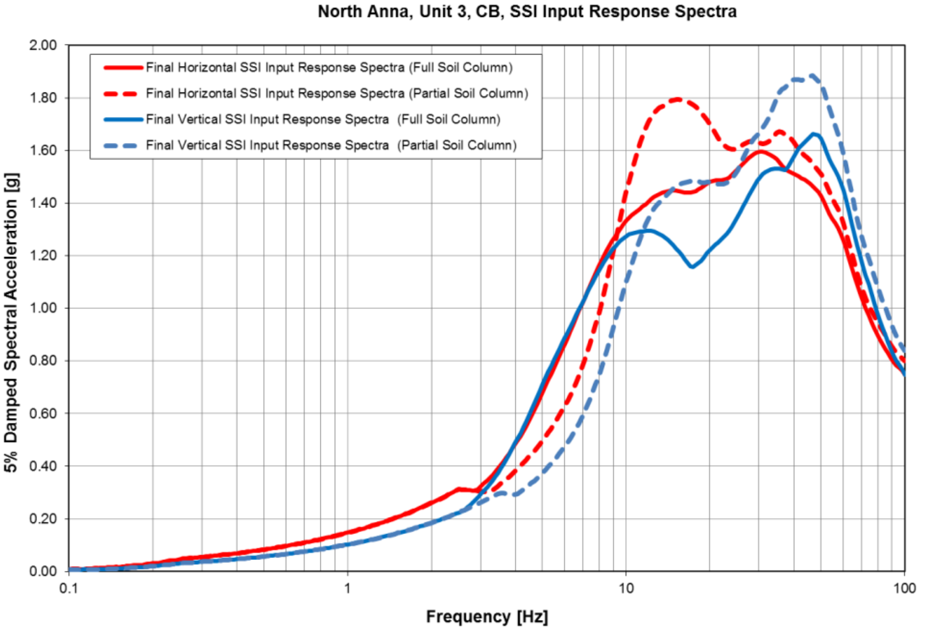
Section 3.7.1 SSI Input Response Spectra for RB/FB and CB

5% Damped Final SSI Input Response Spectra for RB/FB



FSAR Figure 3.7.1-220

5% Damped Final SSI Input Response Spectra for CB

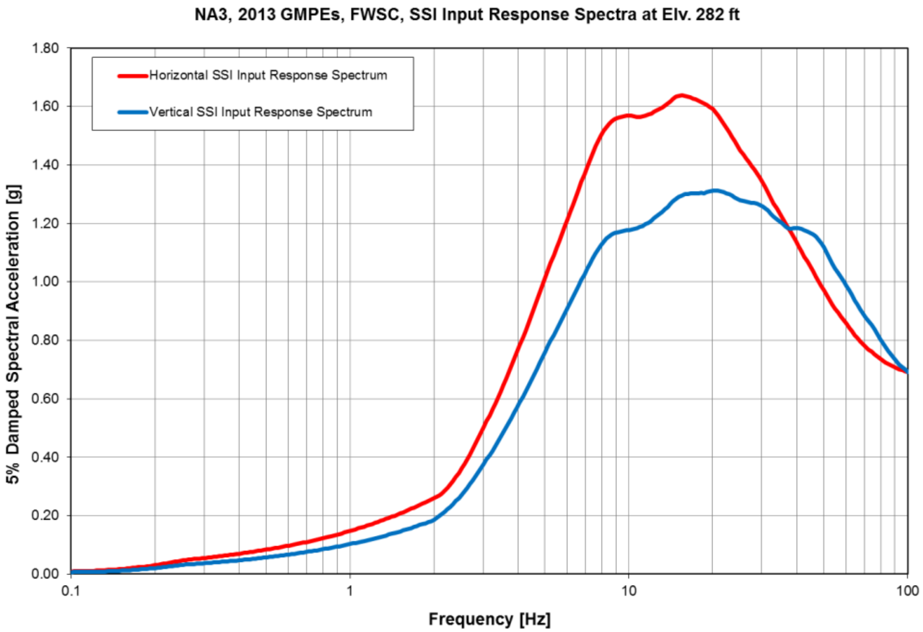


FSAR Figure 3.7.1-231

Dominion

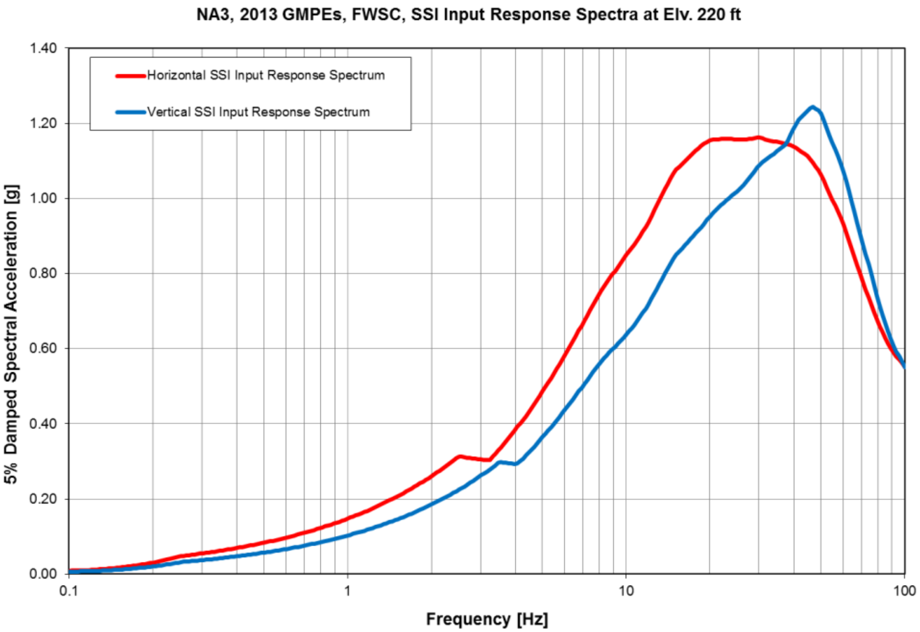
Section 3.7.1 SSI Input Response Spectra for FWSC

5% Damped Final SSI Input Response Spectra at El. 282 ft for FWSC



FSAR Figure 3.7.1-234

5% Damped Final SSI Input Response Spectra at El. 220 ft for FWSC



FSAR Figure 3.7.1-285

Dominion

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North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Seismic Analyses (Sections 3.7.2, 3.7.3, & 3.8)

October 20, 2016

Dominion

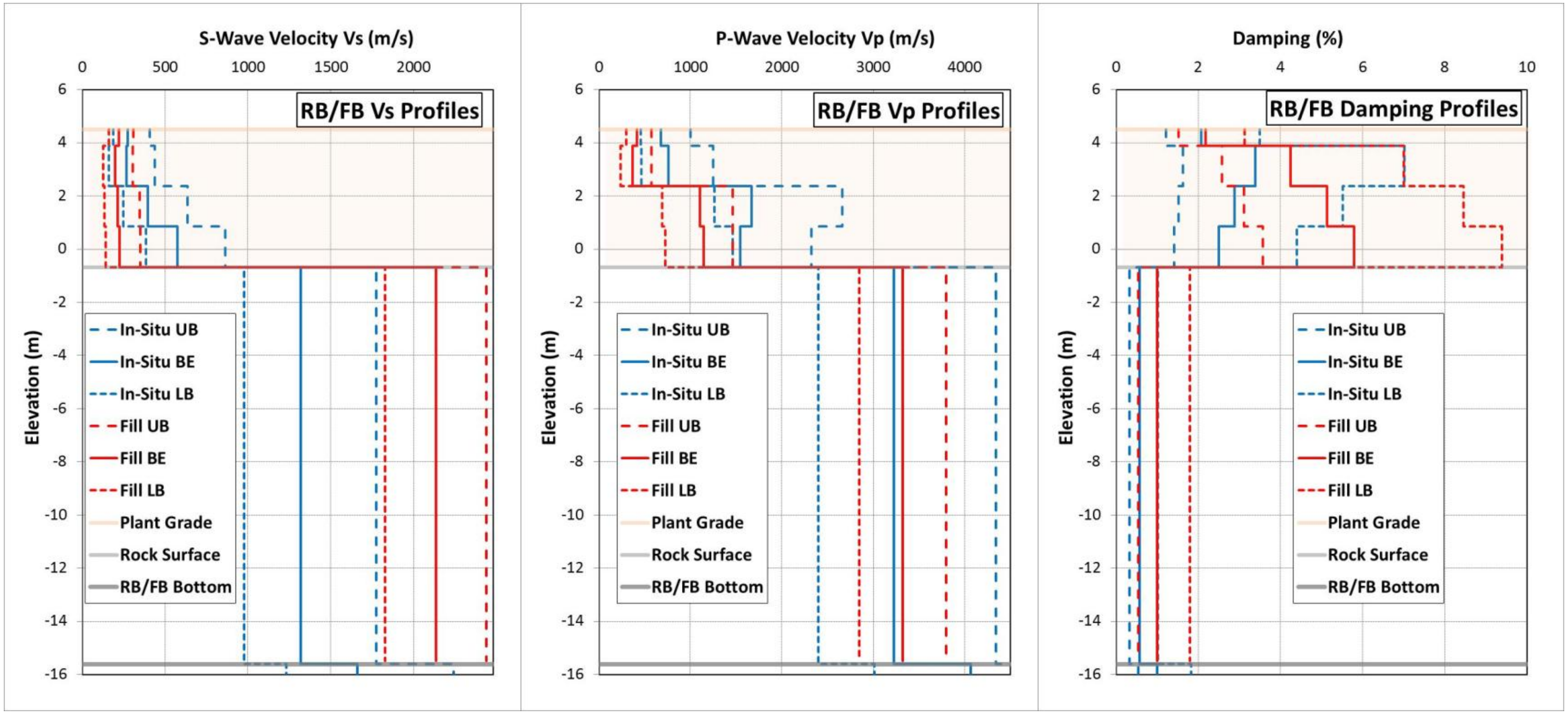
3.7.2 Seismic System Analysis

Based on the departure NAPS DEP 3.7-1:

- NA3 site-specific soil-structure interaction (SSI) and structure-soil-structure interaction (SSSI) analyses were performed to evaluate SC I RB/FB, CB, and FWSC structures for site-specific ground motion and soil properties, considering embedment and fill materials
  - Followed methods presented in DCD using ESBWR dynamic models
  - Used SASSI Direct Method (DM) or Modified Subtraction Method (MSM) validated to address concerns identified with Subtraction Method
- Results from design basis analyses were enveloped and then enhanced using sensitivity analyses results to determine site-specific seismic demands that bound effects of subgrade properties and structural stiffness variations, soil separation, and SSSI
- Site-specific analyses and evaluations of structures and components were performed using bounding site-specific seismic demands

3.7.2 Seismic System Analysis

- RB/FB, CB and FWSC SSI analyses considered Best Estimate(BE), Lower Bound (LB), and Upper Bound (UB) strain compatible properties of in-situ and fill materials to account for variations of subgrade properties

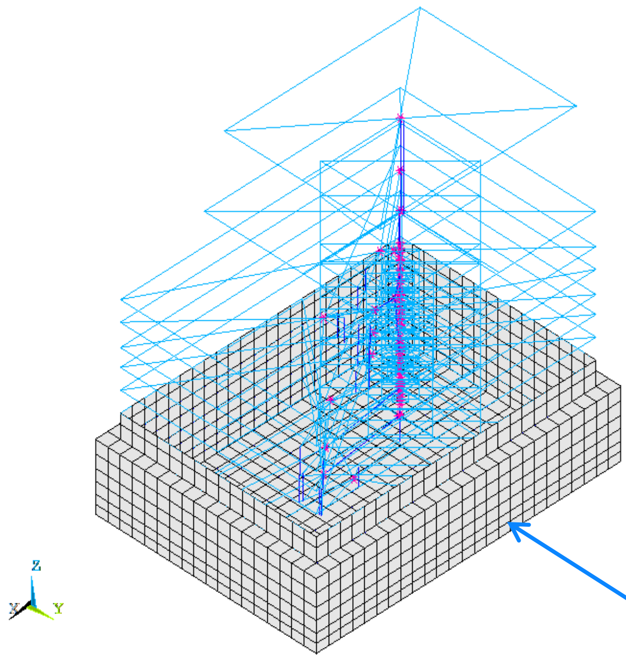


Profile surface is at standard design plant-grade elevation of 4.5 m corresponding to plant finished grade elevation of 290 ft NAVD88

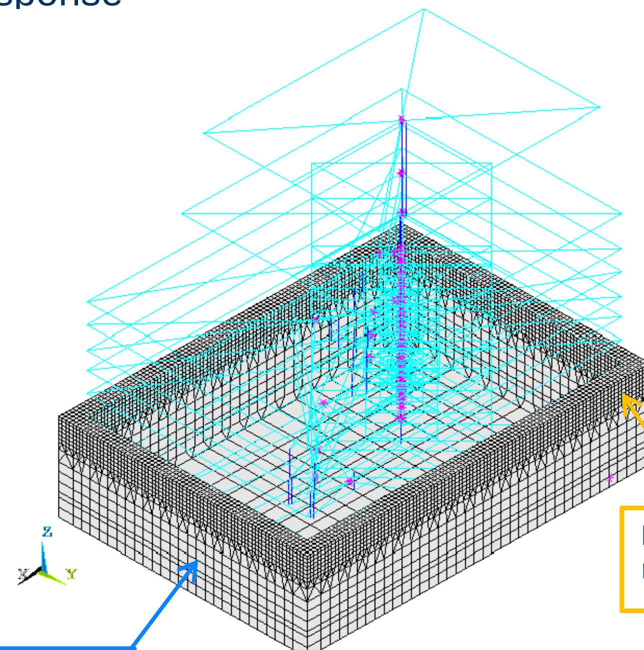
Dominion

3.7.2 Seismic System Analysis

- RB/FB and CB SSI models included near field elements to represent limited horizontal extent of concrete and structural fill placed around and below structures
- Results obtained from analyses of two embedment configurations are enveloped to account for effects of soil separation and variations of fill horizontal extent, and water table elevation on RB/FB and CB seismic response



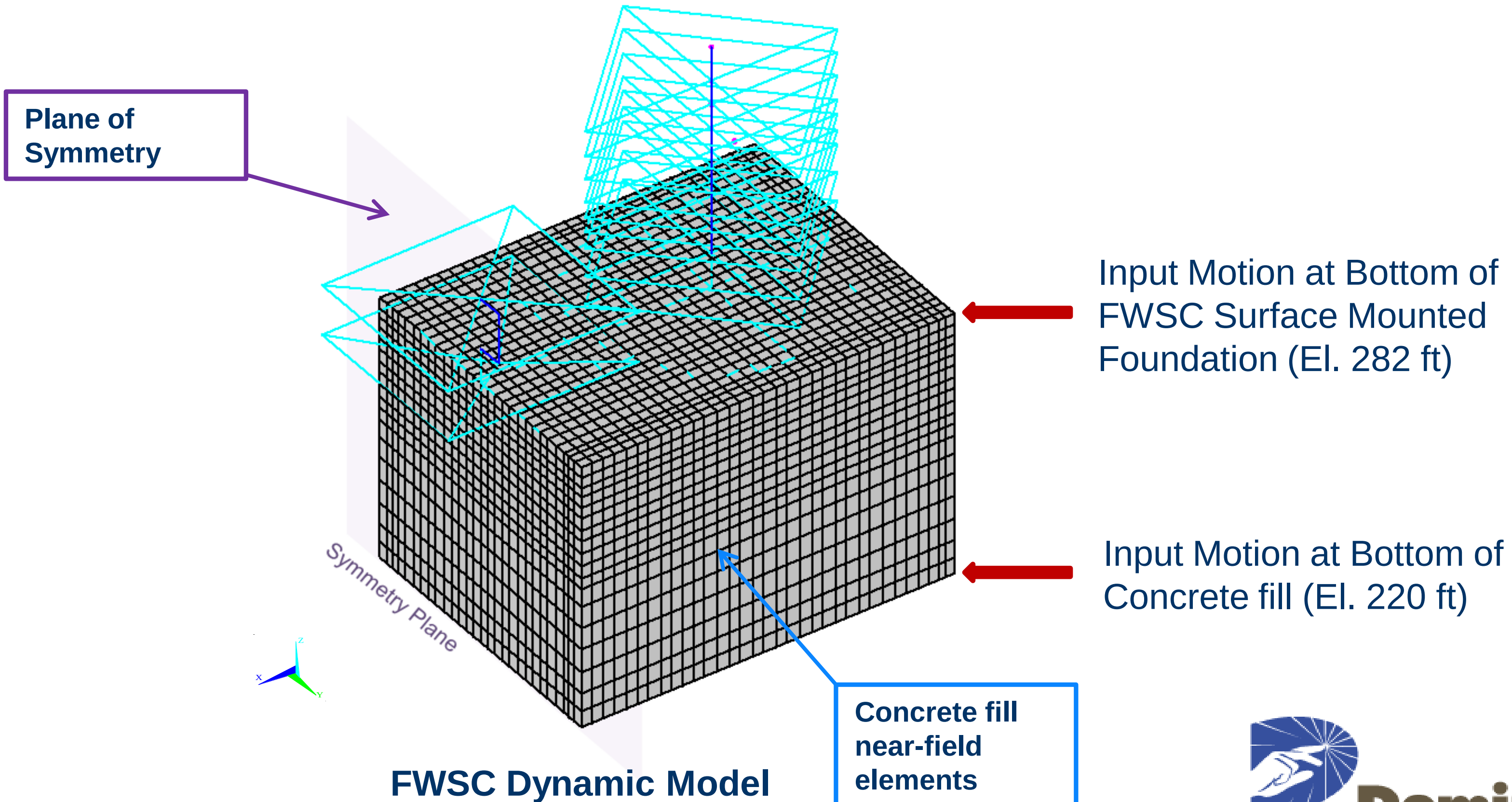
RB/FB Model Partially Embedded in Rock



RB/FB Model Fully Embedded in Rock and Saprolite

3.7.2 Seismic System Analysis

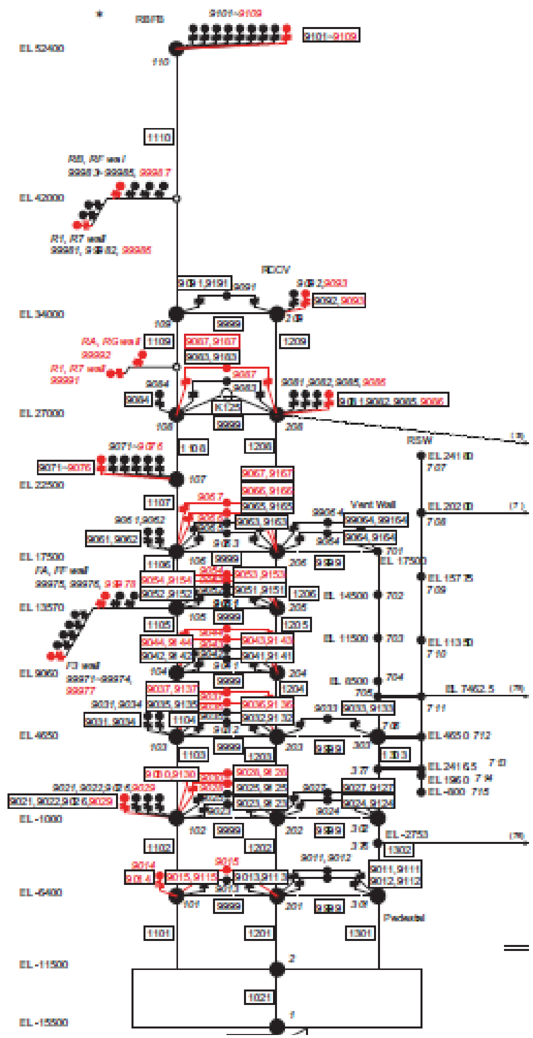
- Site-specific SSI analysis of symmetric FWSC was performed on half-model that included near field elements representing concrete fill placed below basemat mounted on surface of subgrade profile
- Results from SSI analyses performed using input motion at two different elevations were enveloped to ensure effects of seismic waves transmitted through concrete fill are appropriately captured



FWSC Dynamic Model

Dominion

3.7.2 Seismic System Analysis



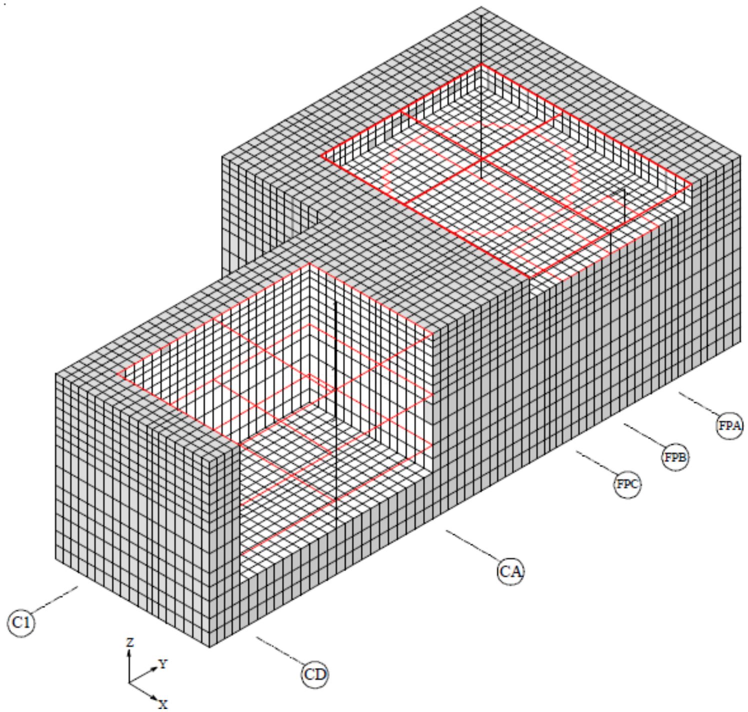
Dynamic Model of RB/FB structures for fully cracked concrete conditions

- Base case analyses were performed on models with upper bound structural stiffness properties representative of uncracked concrete conditions that provide bounding seismic responses for NA3 Hard Rock-High-Frequency (HRHF) site
- Sensitivity analyses were performed for full variety of subgrade conditions on structural models with reduced stiffness properties representative of fully cracked concrete conditions
- Reduced stiffness models also included additional oscillators (shown in red) to capture out-of-plane response of cracked slabs and walls
- Sensitivity analyses of reduced stiffness models showed that concrete cracking reduces global responses at NA3 HRHF site
- Site-specific demands were enhanced to bound small local response amplifications

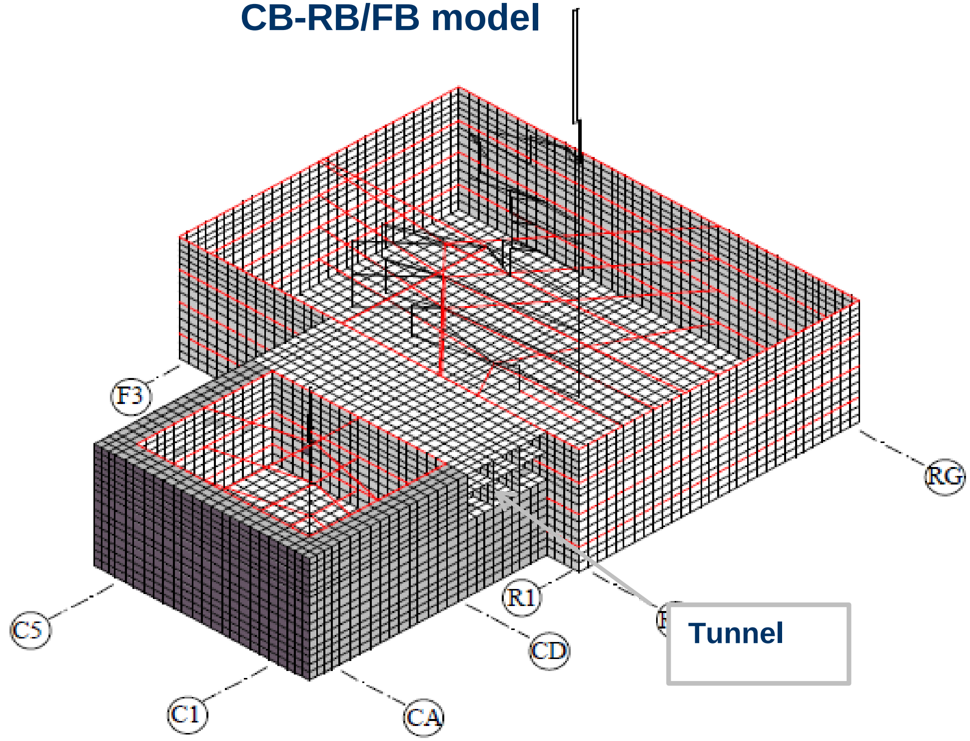
3.7.2 Seismic System Analysis

- Site-specific SSSI effects of RB/FB and FWSC on CB and CB on FWSC were evaluated based on results of CB-RB/FB, FWSC-CB and FWSC-CB SSSI analyses
- SSSI analyses results showed that effects of SSSI at NA3 HRHF site are relatively small
- Site-specific demands were enhanced to bound SSSI amplifications

CB-FWSC model



CB-RB/FB model



3.7.2 Seismic System Analysis

- Performed site-specific evaluation of effects of separation between concrete fill supporting FWSC foundation and surrounding soil
- This evaluation was based on results of SSI and SSSI analysis of FWSC standalone and FWSC-CB combined models representing conditions of maximum separation between concrete fill and surrounding soil
- Results of this evaluation show that soil separation effects can:
  - amplify horizontal and vertical load demands on FWS water tank structure
  - amplify horizontal load demand on FWSC shear key
  - result in peak exceedances of FWSC ISRS
- FWSC site-specific demands were enhanced to bound effects of soil separation

Dominion

3.7.2 Seismic System Analysis

Site-Specific design basis for RB/FB was developed based on results of:

18 RB/FB SSI Analysis Cases

<table>
<tr><th colspan="2">Analysis</th><th>Structural Model*</th><th colspan="2">Subgrade Profile</th><th>Motion El.</th></tr>
<tr><td rowspan="6">Design Basis</td><td>1</td><td rowspan="6">Uncracked RC 100% in-fill concrete contribution w/ OBE damping</td><td rowspan="3">Partial Column</td><td>LB</td><td rowspan="18">224 ft</td></tr>
<tr><td>2</td><td>BE</td></tr>
<tr><td>3</td><td>UB</td></tr>
<tr><td>4</td><td rowspan="3">Full Column</td><td>LB</td></tr>
<tr><td>5</td><td>BE</td></tr>
<tr><td>6</td><td>UB</td></tr>
<tr><td rowspan="12">Structural Stiffness Evaluation</td><td>1</td><td rowspan="6">Cracked RC 50% in-fill concrete contribution w/ SSE damping</td><td rowspan="3">Partial Column</td><td>LB</td></tr>
<tr><td>2</td><td>BE</td></tr>
<tr><td>3</td><td>UB</td></tr>
<tr><td>4</td><td rowspan="3">Full Column</td><td>LB</td></tr>
<tr><td>5</td><td>BE</td></tr>
<tr><td>6</td><td>UB</td></tr>
<tr><td>7</td><td rowspan="6">Cracked RC 0% in-fill concrete contribution w/ SSE damping</td><td rowspan="3">Partial Column</td><td>LB</td></tr>
<tr><td>8</td><td>BE</td></tr>
<tr><td>9</td><td>UB</td></tr>
<tr><td>10</td><td rowspan="3">Full Column</td><td>LB</td></tr>
<tr><td>11</td><td>BE</td></tr>
<tr><td>12</td><td>UB</td></tr>
</table>

* Structural models with uncracked and cracked Reinforced Concrete (RC) members and different % contribution of in-fill concrete to stiffness of concrete filled steel members.

Dominion

3.7.2 Seismic System Analysis

Site-Specific design basis for CB was developed based on results of:

18 CB SSI Analysis Cases

Analysis		Structural Model	Subgrade Profile		Motion El.
Design Basis	1	Uncracked w/ OBE damping	Partial Column	LB	241 ft
	2			BE	
	3			UB	
	4		Full Column	LB	
	5			BE	
	6			UB	
	7	Uncracked w/ SSE damping	Partial Column	LB	
	8			BE	
	9			UB	
	10		Full Column	LB	
	11			BE	
	12			UB	
Structural Stiffness Evaluation	1	Cracked w/ SSE damping	Partial Column	LB	
	2			BE	
	3			UB	
	4		Full Column	LB	
	5			BE	
	6			UB	

5 CB-RB/FB and CB-FWSC SSSI Analysis Cases

Analysis		Structural Model	Subgrade Profile		Motion El.
CB-RB/FB	1	Uncracked w/ OBE damping	Partial Column	LB	241 ft
	2			UB	
	3		Full Clmn.	UB	
CB-FWSC	1	Uncracked w/ OBE damping	Full Column	LB	241 ft
	2			UB	

Dominion

3.7.2 Seismic System Analysis

Site-Specific design basis for FWSC was developed based on results of:

18 FWSC SSI Analysis Cases

Analysis		Structural Model	Subgrade Profile		Motion El.
Design Basis	1	Uncracked w/ OBE damping	Concrete Fill-Soil Fully Bonded	LB	282 ft
	2			BE	
	3			UB	
	4			LB	220 ft
	5			BE	
	6			UB	
	7	Uncracked w/ SSE damping		LB	220 ft
	8			BE	
	9			UB	
Structural Stiffness Evaluation	1	Cracked w/ SSE damping		LB	282 ft
	2			BE	
	3			UB	
	4			LB	220 ft
	5			BE	
	6			UB	
Soil Separation	1	Uncracked w/ SSE damping	Max. Soil Separation	LB	220 ft
	2			BE	
	3			UB	

12 FWSC-CB SSSI Analysis Cases

Analysis		Subgrade Profile		Motion El.
Design Basis	1	Concrete Fill-Soil Fully Bonded	LB	282 ft
	2		BE	
	3		UB	
	4		LB	220 ft
	5		BE	
	6		UB	
	7		LB	220 ft
	8		BE	
	9		UB	
Soil Separation	1	Max. Soil Separation	LB	220 ft
	2		BE	
	3		UB	

Dominion

3.7.2 Seismic System Analysis

- Site-specific seismic load demands on RB/FB structures were developed as envelope of results from analyses of models with different structural stiffness properties to bound exceedances due to structural stiffness variation effects

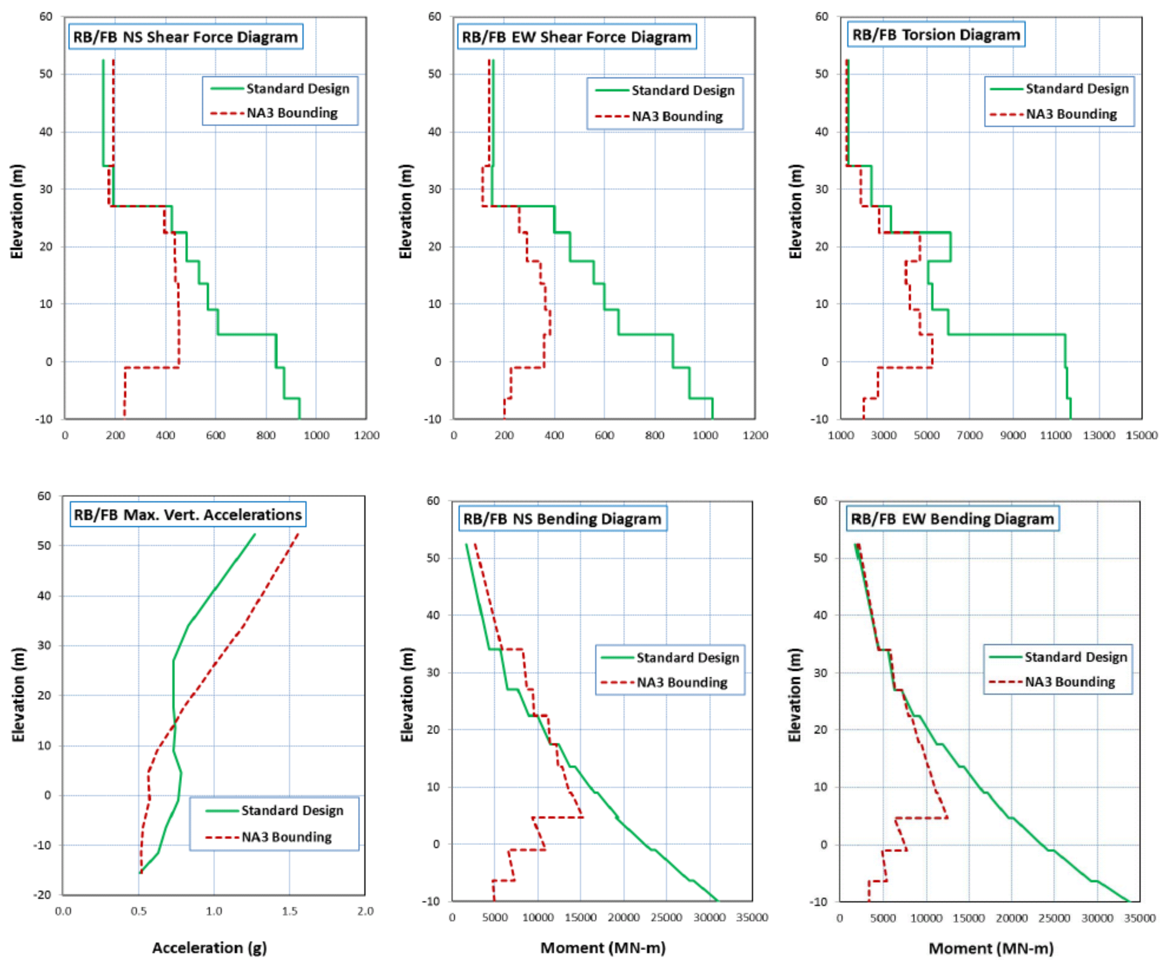
- Site-specific seismic load demands on CB structure were developed as envelope of results from analyses of models with different structural stiffness properties to bound exceedances due to structural stiffness variation effects
  - Site-specific evaluations showed that SSSI effects of RB/FB and FWSC have negligible effect on design of CB structure

- Site-specific seismic load demands on FWSC structures were developed as envelope of results of SSI and SSSI analyses of FWSC standalone and FWSC-CB combined models representing fully bonded and maximum separated conditions at concrete fill-surrounding soil interfaces
  - These enveloping loads were amplified using cracking amplification factors ($CR_{amp} \geq 1$) to obtain loads that also bound effects of concrete cracking

Dominion

3.7.2 Seismic System Analysis

- Site-specific seismic load demands on RB/FB shear walls exceed loads used for standard design:



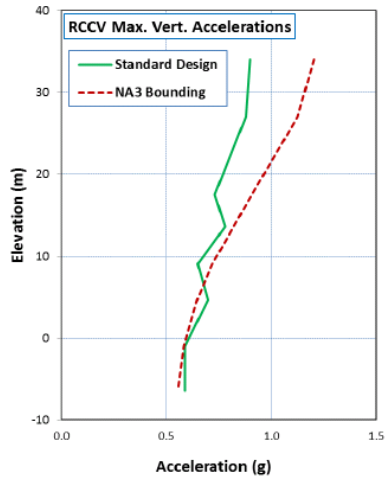
RB/FB NS shear loads exceed DCD loads at higher (> 34 m) elevation by ≈ 25%

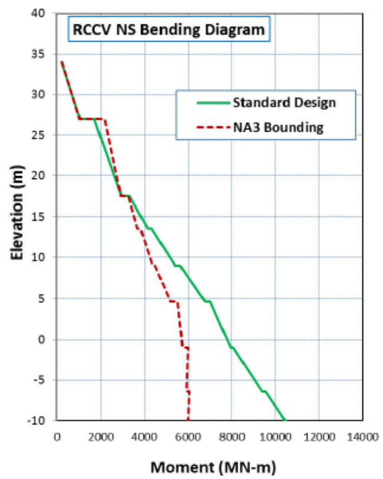
RB/FB vertical loads exceed DCD loads at higher (> 13.6 m) elevation by ≈ 35%

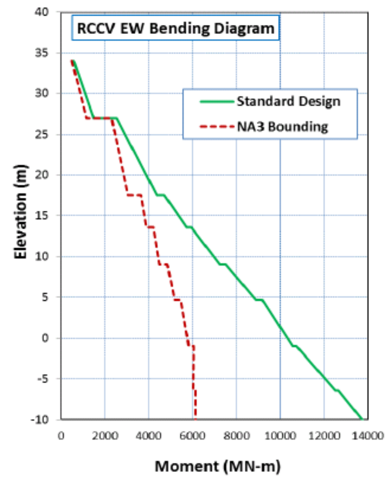
Plots show standard design elevations with 4.5 m corresponding to plant finished grade elevation of 290 ft NAVD88

3.7.2 Seismic System Analysis

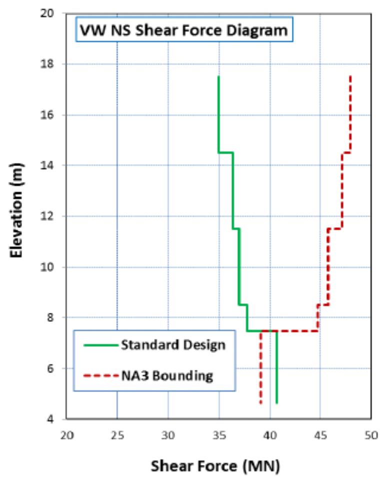
- Site-specific seismic load demands on Reinforced Concrete Containment Vessel (RCCV) and Vent Wall (VW) exceed loads used for standard design:

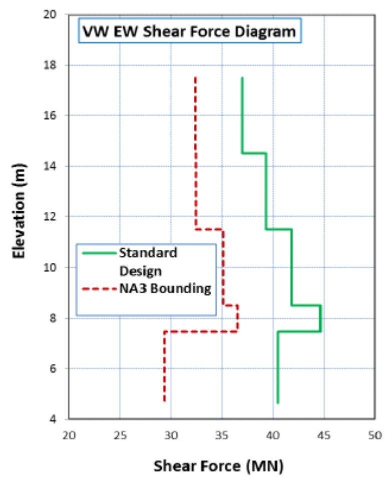


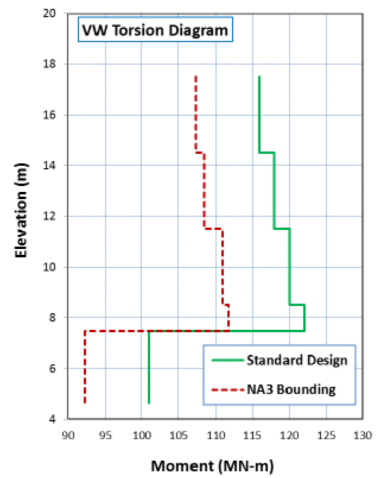




RCCV Vertical Loads exceed DCD loads by ≈ 25%







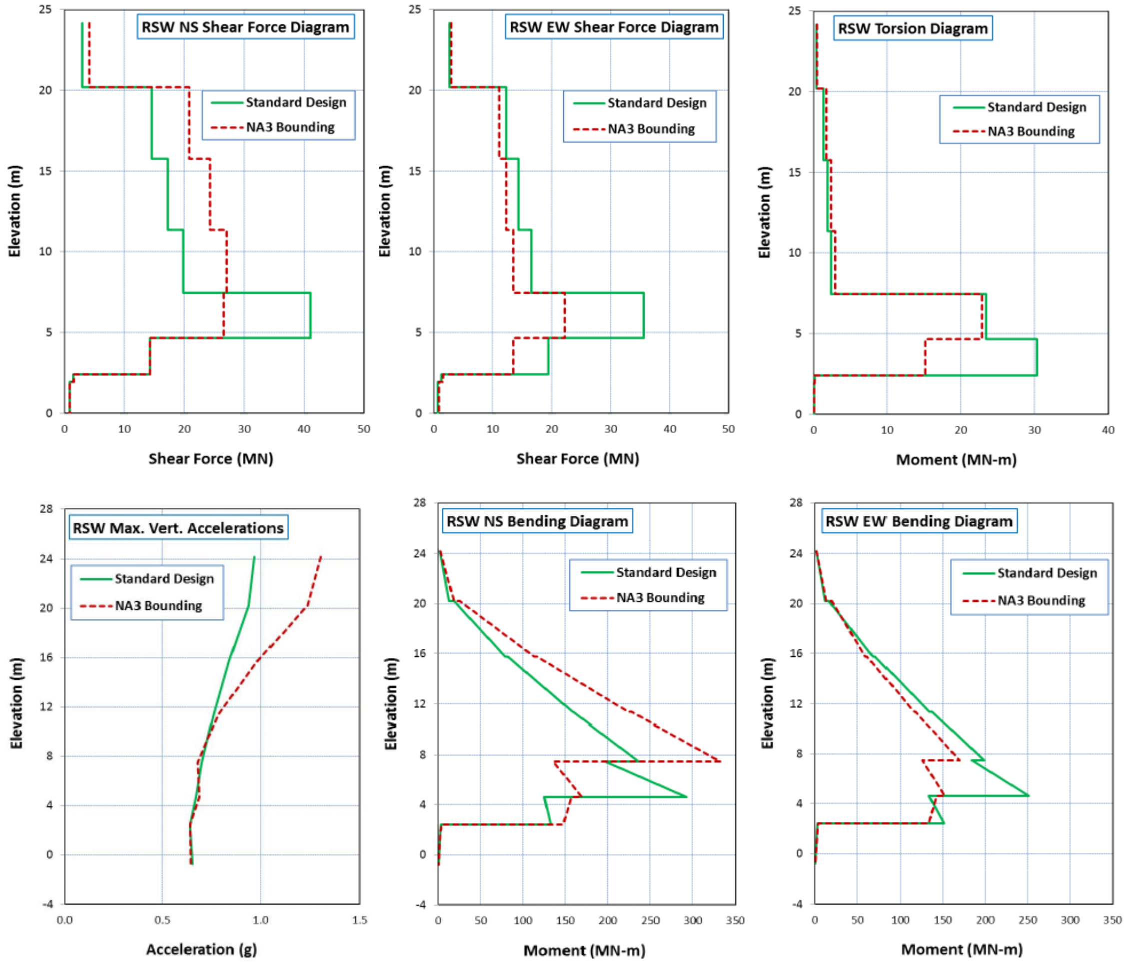
VW NS shear loads exceed DCD loads by ≈ 35%

Plots show standard design elevations with 4.5 m corresponding to plant finished grade elevation of 290 ft NAVD88

Dominion

3.7.2 Seismic System Analysis

- Site-specific seismic load demands on Reactor Shield Wall (RSW) exceed loads used for standard design:



RSW NS shear loads exceed DCD loads by ≈ 40%

RSW vertical loads exceed DCD loads by ≈ 20%

Plots show standard design elevations with 4.5 m corresponding to plant finished grade elevation of 290 ft NAVD88

3.7.2 Seismic System Analysis

- Site-specific out-of-plane seismic load demands on RB/FB slabs can exceed loads used for standard design

EL (m)	Location	Slab Equivalent Out-of-Plane Acceleration Load (sAave) (g)					Difference
		UC100 Env.	CR00 Env.	CR50 Env.	NA3 Bounding	Standard Design	
52.40	RB Roof	1.51	0.75	0.74	1.51	1.64	-8%
34.00	RB-RCCV	1.23	0.88	0.93	1.23	0.90	37%
	RCCV	1.30	0.95	1.00	1.30	0.93	40%
27.00	Top Slab	1.37	1.09	1.19	1.37	0.98	40%
	RB-RCCV	1.06	0.81	0.90	1.06	0.77	37%
	M/S tunnel roof	1.13	0.80	0.88	1.13	0.82	38%
22.50	FB Roof	1.31	0.74	0.77	1.31	1.47	-11%
17.50	M/S tunnel slab	1.74	1.15	1.14	1.74	1.10	58%
	RB-RCCV	0.94	0.79	0.84	0.94	0.78	20%
	DF *	1.53	2.38	1.23	2.38	1.84	29%
13.57	RB-RCCV	0.89	0.79	0.84	0.89	0.84	6%
9.06	RB-RCCV	0.79	0.76	0.78	0.79	0.82	-4%
4.65	FB	1.11	0.82	0.81	1.11	1.03	8%
	RB-RCCV	0.87	0.84	0.86	0.87	0.95	-9%
	RCCV-Pedestal	0.82	0.77	0.77	0.82	0.80	2%
-1.00	FB	0.71	0.70	0.69	0.71	0.88	-19%
	RB-RCCV	0.73	0.70	0.69	0.73	0.85	-14%
	RCCV-Pedestal	0.70	0.72	0.70	0.72	0.71	1%
-6.40	RCCV-Pedestal	0.60	0.61	0.59	0.61	0.63	-3%
	RB-RCCV	0.57	0.65	0.66	0.66	0.71	-7%
	FB	-	0.58	0.57	0.58	-	Add. Load *

* DF load calculated conservatively considering only flexible mode response

Equivalent average acceleration calculated considering flexible and rigid mode responses is **1.53g** < 1.84g (standard design load)

* Additional out-of-plane load to account for response under fully cracked conditions

3.7.2 Seismic System Analysis

- Site-specific out-of-plane seismic load demands on RB/FB walls can exceed loads used for standard design

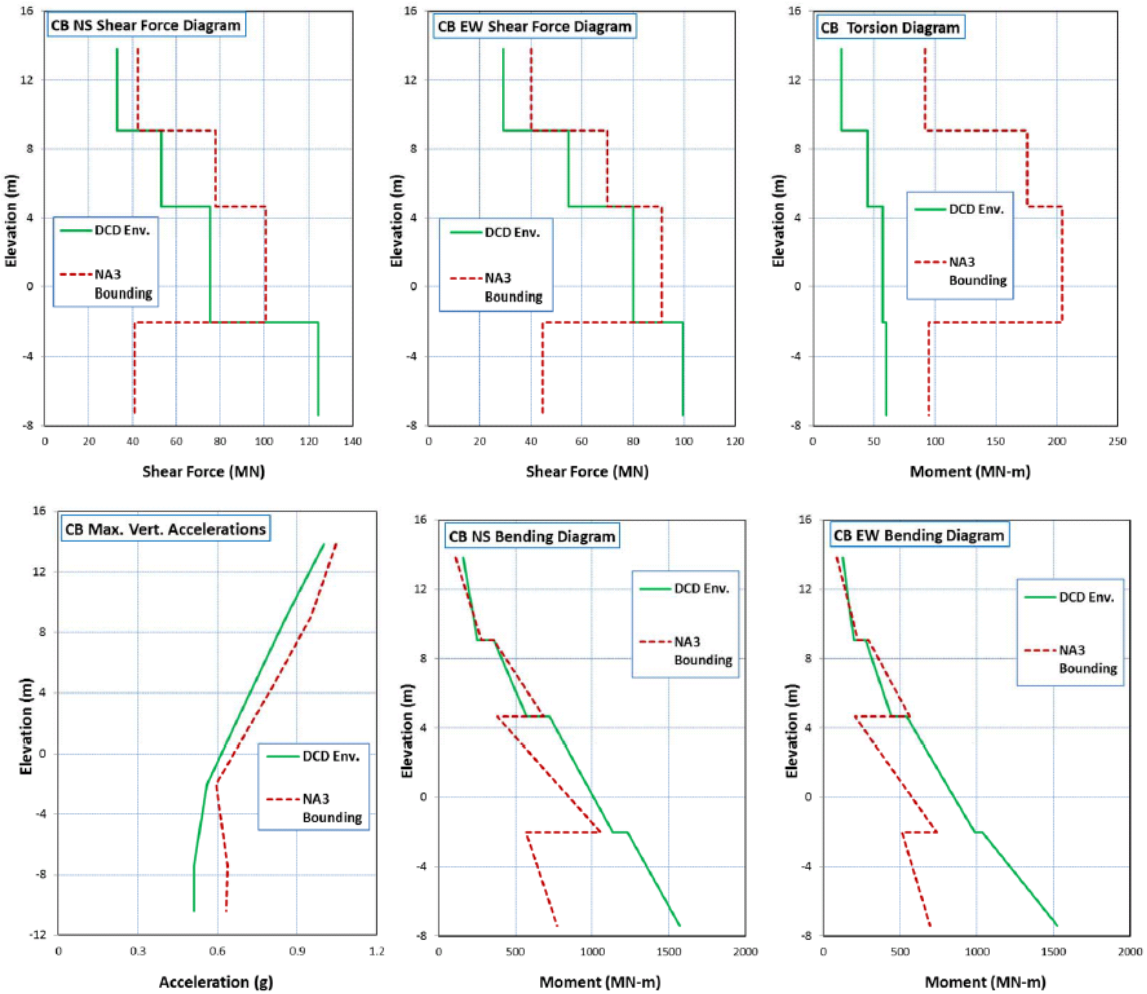
EL (m)	Location	Wall Equivalent Out-of-Plane Acceleration Load (sAave) (g)					Difference
		UC100 Env.	CR00 Env.	CR50 Env.	NA3 Bounding	Standard Design	
42.00	R1 and R7 walls	2.10	1.77	1.88	2.10	1.48	42%
	RB and RF walls	1.27	0.87	0.91	1.27	1.52	-16%
30.50	R1 and R7 walls (Additional Oscillator)	0.00	0.58	0.57	0.58	0.00	Add. Load*
	RA and RG walls (Additional Oscillator)	0.00	0.54	0.54	0.54	0.00	Add. Load*
13.57	F3 wall	1.48	0.94	0.95	1.48	1.19	25%
	FA and FF walls	1.55	0.89	0.95	1.55	1.09	42%

* Additional out-of-plane loads included to account for response under fully cracked conditions

Dominion

3.7.2 Seismic System Analysis

- Site-specific seismic load demands on CB shear walls exceed loads used for standard design:



CB shear loads exceed DCD loads by **≈ 40%**

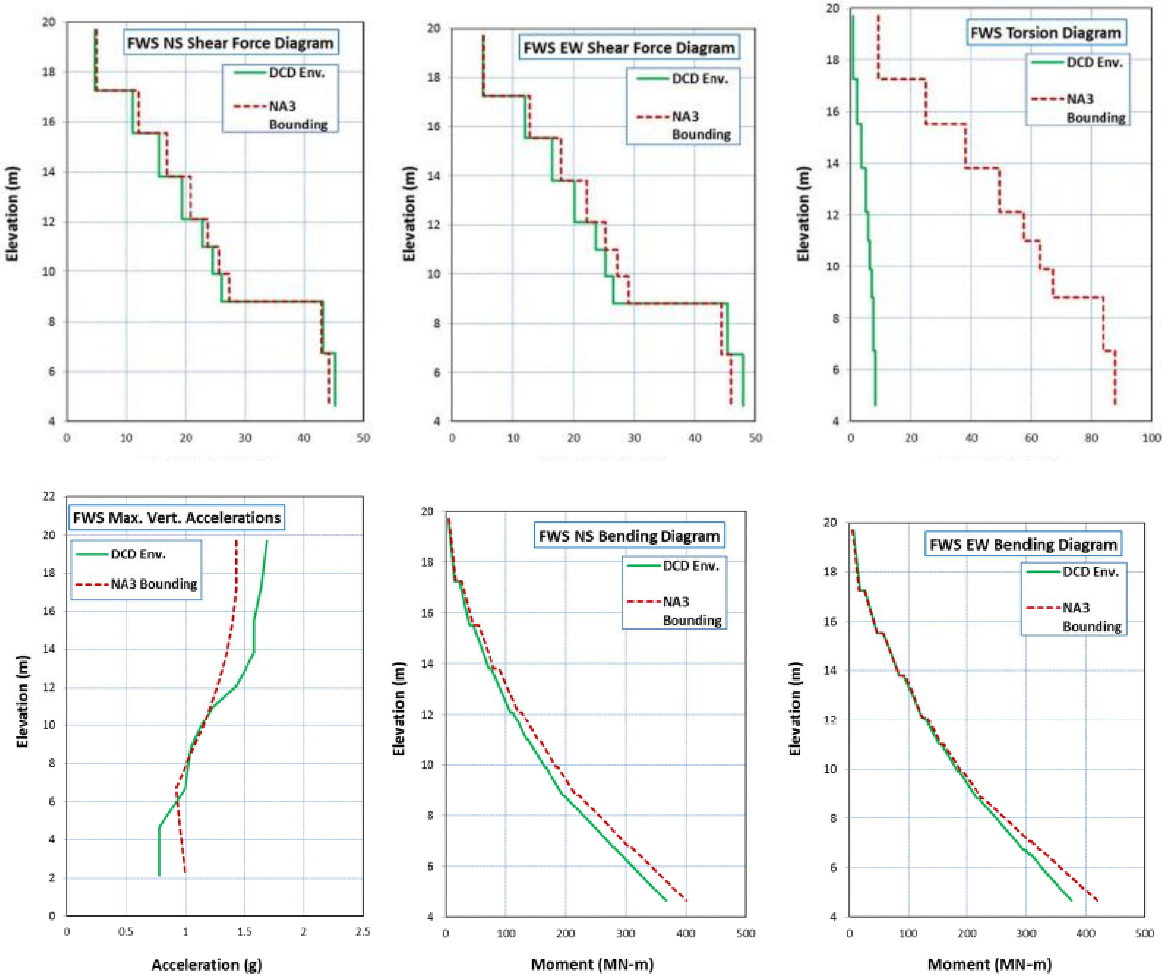
CB vertical loads exceed DCD loads by ≈ 15%

Plots show standard design elevations with 4.5 m corresponding to plant finished grade elevation of 290 ft NAVD88

Dominion

3.7.2 Seismic System Analysis

- Site-specific seismic load demands on FWS Tank wall exceed loads used for standard design:



FWS horizontal shear loads exceed DCD loads

FWS vertical Loads exceed DCD loads on FWSC basemat by ≈ 20%

Plots show standard design elevations with 4.5 m corresponding to plant finished grade elevation of 290 ft NAVD88

Dominion

3.7.2 Seismic System Analysis

- Site-specific out-of-plane seismic load demands on CB slabs exceed DCD loads

El. (m)	Location	Slab Equivalent Out-of-Plane Acceleration Load (g)		Difference
		NA3 Bounding	Standard Design	
13.80	Roof	1.53	1.39	9%
9.06	CA-CD	1.21	1.08	11%
4.65	CA-CD	1.03	0.87	16%
-2.00	CA-CD	0.69	0.66	4%

- Site-specific out-of-plane seismic load demands on FWSC roofs exceed DCD loads:

Slab		Eq. Ave. Acc. (g)		Difference
Elev. (m)	Location	NA3 Bounding	Standard Design	
19.7	FWS Roof	2.30	1.74	24%
8.25	FPE Roof	1.10	-	Add. Load

Additional load on FPE roof included to account for response under fully cracked conditions

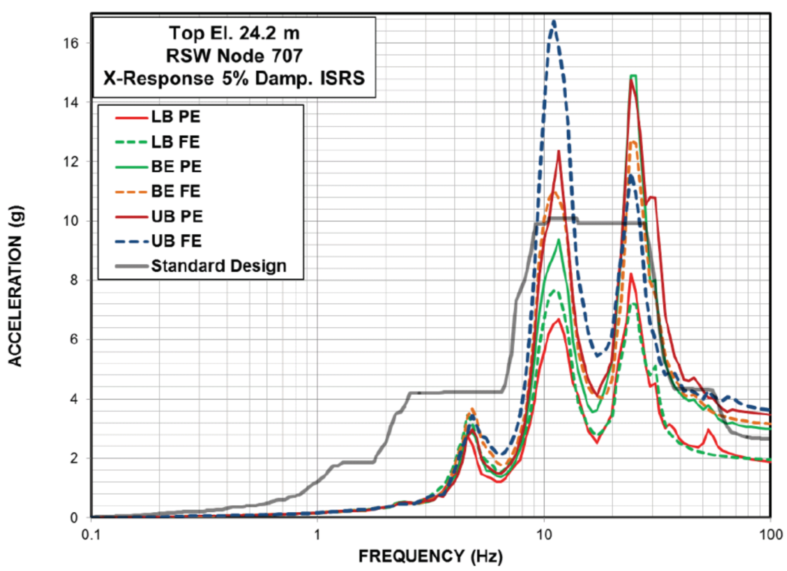
- Site-specific seismic shear load demands on FWSC shear keys exceed DCD loads:

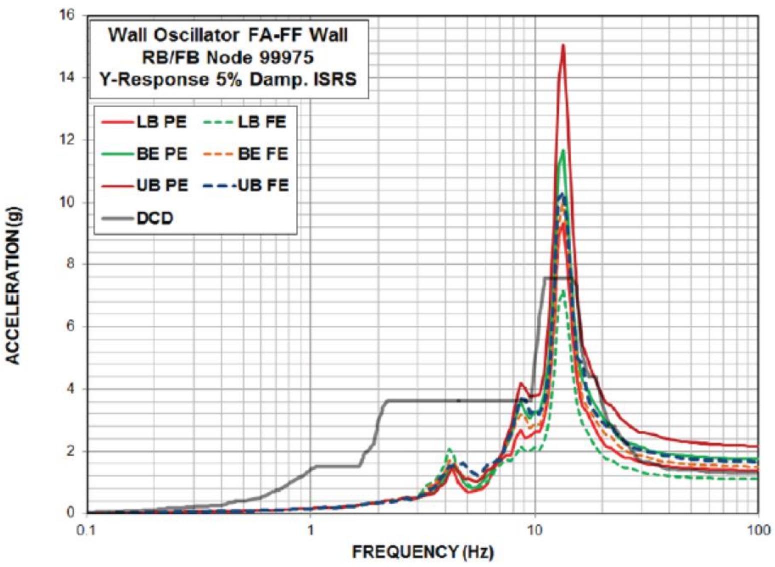
Load Direction	Load Magnitude (MN)		Difference
	NA3 Bounding	Standard Design	
NS	82	58	41%
EW	71	58	23%

Dominion

3.7.2 Seismic System Analysis

- Comparisons of 5% damped standard design ISRS with results from site-specific RB/FB SSI analyses show exceedances mainly at higher frequencies (> 10 Hz) where site-specific FIRS exceed CSDRS
- Examples of site-specific exceedances of RB/FB standard design ISRS

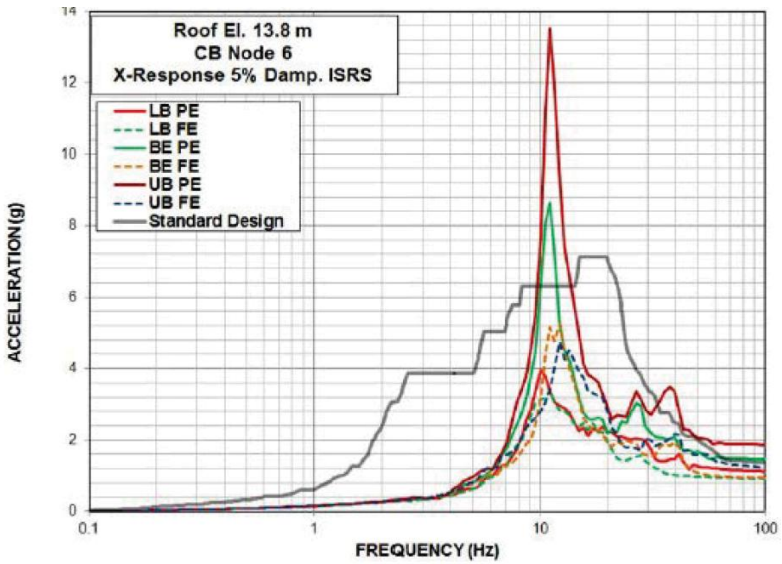


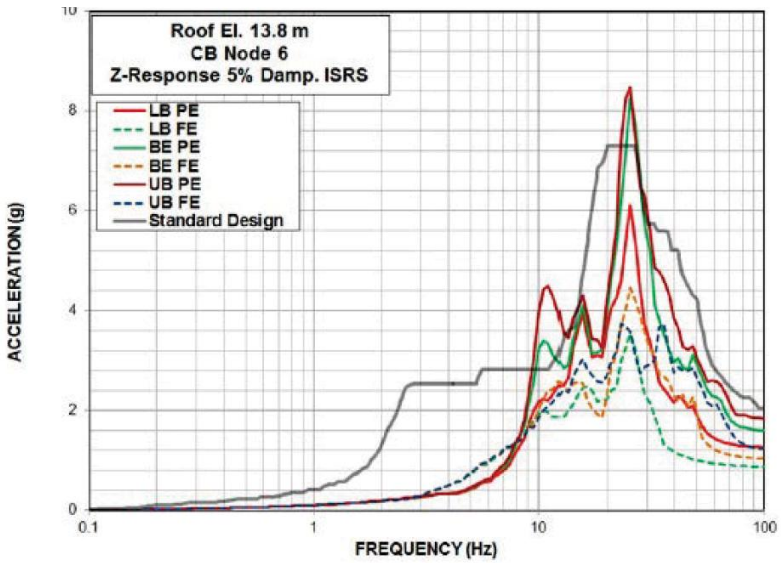


Dominion

3.7.2 Seismic System Analysis

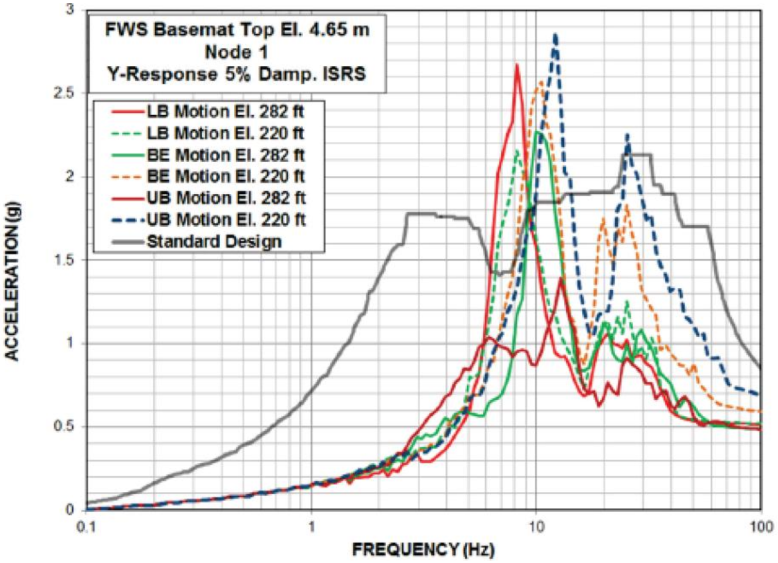
- Comparisons of 5% damped standard design ISRS with results from site-specific CB SSI analyses show exceedances at higher frequencies (> 10 Hz) where site-specific FIRS exceed CSDRS
- Examples of site-specific exceedances of CB standard design ISRS

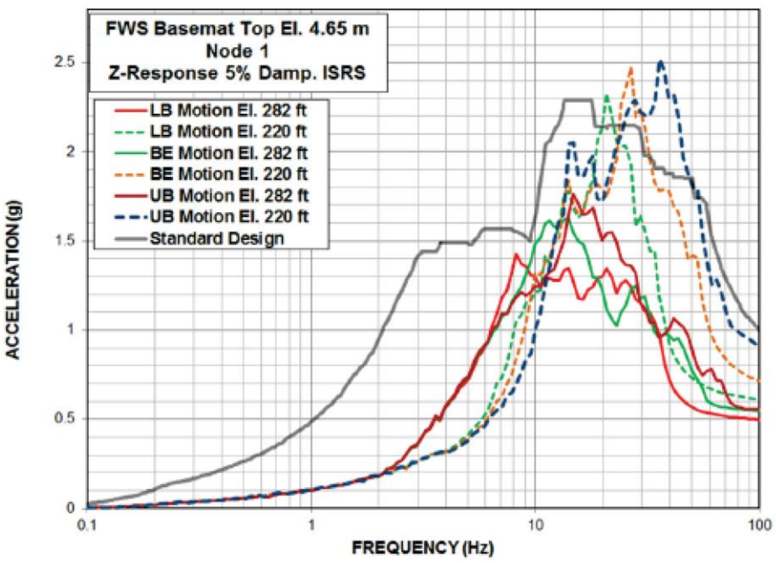




3.7.2 Seismic System Analysis

- Comparisons of 5% damped standard design ISRS with results from site-specific FWSC SSI analyses show exceedances at frequencies higher than 5 Hz
- Examples of site-specific exceedances of FWSC standard design ISRS





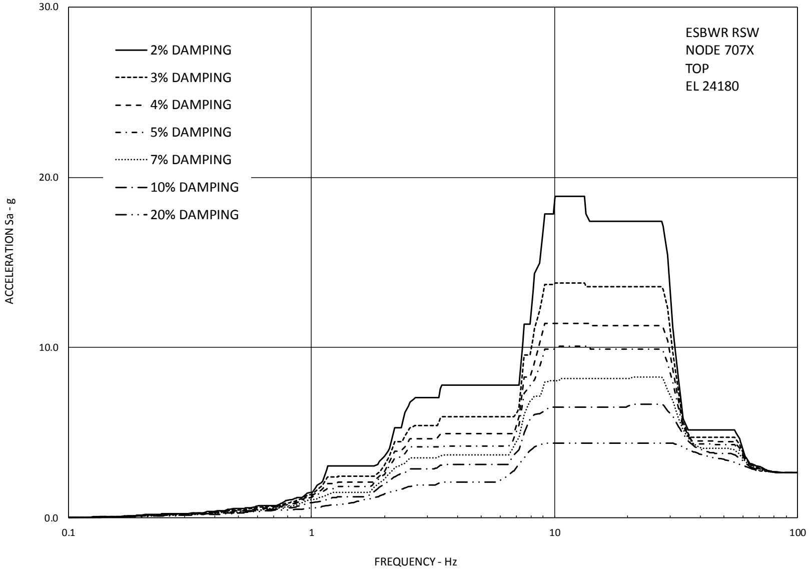
Dominion

3.7.2 Seismic System Analysis

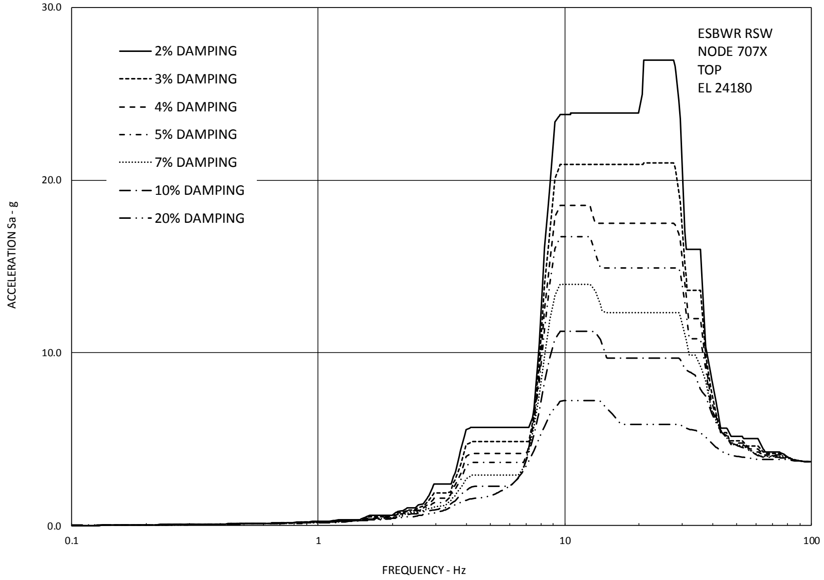
- Site-specific ISRS for RB/FB and CB were developed as envelope of results from design basis SSI analyses of standalone models with upper bound structural stiffness properties
  - RB/FB and CB ISRS were enhanced to bound all significant (> 10%) exceedances up to 50 Hz due to structural stiffness variations using results from analyses of models with reduced stiffness properties
  - CB ISRS were further enhanced to bound all exceedances up to 50 Hz due to RB/FB and FWSC SSSI on CB response using amplification factors $SSSI_{amp} \geq 1$
- FWSC ISRS were developed as envelope of results of design basis SSI and SSSI analyses of FWSC standalone and FWSC-CB combined models to bound SSSI effects of CB on FWSC seismic response
  - FWSC ISRS were enhanced to bound all significant (> 10%) exceedances up to 50 Hz due to soil separation by enveloping results from analyses of models representing fully bonded and maximum separation conditions
  - FWSC ISRS were further enhanced to bound all significant (> 10%) exceedances up to 50 Hz due to concrete cracking using amplification factors $CR_{amp} \geq 1$

3.7.2 Seismic System Analysis

- Site-specific design ISRS for 7 damping values for design and evaluation of SSCs located at selected key locations



Standard Design ISRS
RSW Top El. 24.28 m
DCD Section 3A.9



Site-Specific Design ISRS
RSW Top El. 24.28 m
FSARSection 3A.18.2

3.7.2 Seismic System Analysis

Interaction of Non-Category I Structures with Seismic Category I Structures

- Turbine Building, Service Building, Ancillary Diesel Building (Seismic Category II structures) and the Radwaste Building (RW-IIa structure) will be analyzed and designed to avoid adverse interactions by following the same process used for SC I structures
- ITAAC are included for these buildings to identify the SSI and SSSI site-specific analyses that are to be done in conjunction with the DCD ITAAC to verify that as-built structures meet acceptance criteria
- Additional requirements to have a static wall pressure capacity of at least 3 psi are imposed on Radwaste Building exterior walls to meet safe distance separation from liquid hydrogen storage tanks (verified by ITAAC)

3.7.3 Seismic Subsystem Analysis

3.7.3.13 Seismic Category I Buried Piping, Conduits, and Tunnels

- ITAAC are included in COLA Part 10, Tables 2.4.20-1, 2.4.21-1 and 2.4.22-1 to verify site-specific analyses of SC I and RW-IIa buried piping, conduits, and tunnels follow requirements of DCD Section 3.7.3
- Design and analysis of SC I and RW-IIa buried piping, conduits, and tunnels will be performed for SSE design motions defined by:
  - CSDRS adjusted using applicable scale factors per ESBWR DCD, and
  - Site-specific FIRS developed following the process described in Sections 2.5.2 for development of full column FIRS for SC I buildings
- Site-specific FIRS will be amplified as necessary to include the effects of the adjacent heavy foundations on the free field motion and address the SSSI effects

Section 3.8 Seismic Category I Structures

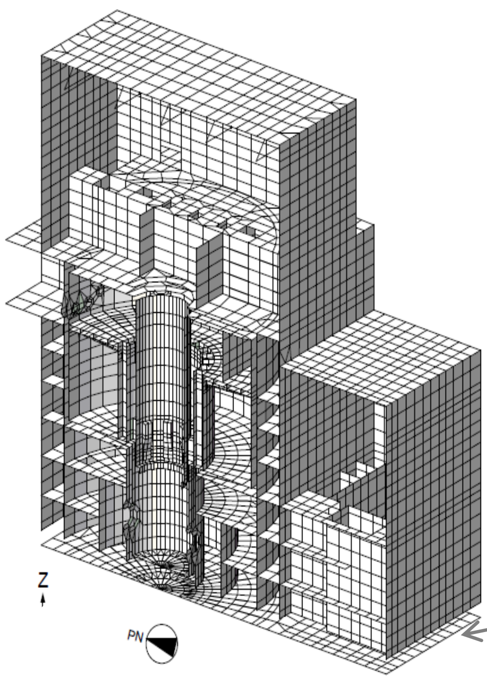
Site-specific evaluations were performed to address exceedances in site-specific seismic load demands and demonstrate adequacy of RB/FB, CB, and FWSC structures for site-specific conditions

- Site-specific finite element (FE) stress analyses provided seismic member force and moment demands on RB/FB, CB and FWSC structural members
- FE analyses were performed following standard design methodology using seismic loads developed from results of site-specific seismic response analyses
  - Site-specific seismic loads were used that bound site-specific effects of subgrade stiffness variations, soil separation, structural stiffness variations (concrete cracking), and SSSI
- Seismic load demands were combined with demands from standard design non-seismic loads that bound corresponding site-specific demands

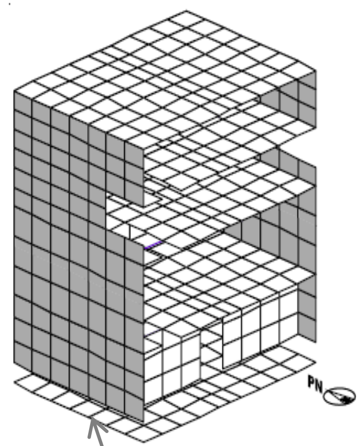
Section 3.8 Seismic Category I Structures

- Site-specific structural evaluations were performed on the same NASTRAN FE analyses models as those used for standard design

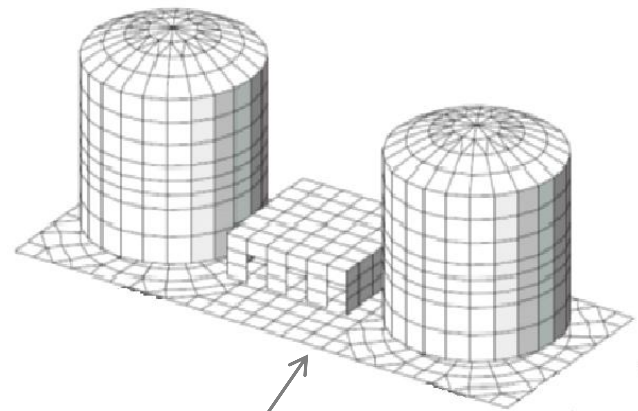
RB/FB NASTRAN FE Model (Cut View)



CB NASTRAN FE Model (Cut View)



FWSC NASTRAN FE Model



3 independent spring elements at each basemat node with DCD soft soil subgrade stiffness properties provided conservative site-specific stress demands

- Structural evaluations of certain components were performed separately using local models, consistent with standard design

Dominion

Section 3.8 Seismic Category I Structures

- Stress checks were performed for site-specific demands using same standard design methodology to demonstrate ASME BPVC, Section III, Division 2, Subsection CC and ACI 349-01 acceptance criteria are met, with the following exceptions:
  - Parabolic instead of linear concrete stress-strain relationship and applicable ASME allowable stresses were used for evaluation of some RB/FB cross sections subjected to high membrane loads and moments
- In addition to elements selected in DCD, site-specific stress checks were also performed for additional elements that experience site-specific seismic load demands that exceed loads used for standard design
  - Additional stress checks demonstrated that site-specific seismic demands do not result in changes to the DCD concrete member properties (e.g., wall and slab thicknesses, and beam and column sizes)

Section 3.8 Seismic Category I Structures

Seismic stability evaluations demonstrated stability of RB/FB, CB, and FWSC foundations for site-specific seismic conditions

- Seismic driving forces were used that were developed from site-specific seismic response analyses results
- Base sliding resistance calculated using effective weight of building and minimum value of 0.60 for coefficient of friction among those of concrete fill, Zone III rock, and Zone III-IV rock
- Used effective weight of building equal to dynamic model weight minus buoyancy based on site-specific groundwater level values
- Neglected lateral resistance from softer soil above rock and RB/FB shear keys, as well as skin friction resistance at basemat sides, below grade exterior walls, and RB/FB and FWSC shear keys
- Site-specific evaluations demonstrated that capacity of concrete fill, rock subgrade, FWSC shear keys, RB/FB and CB below grade walls is sufficient to resist lateral passive pressure demands required for sliding stability of SC I foundations
- It was also demonstrated that bearing capacity of subgrade is sufficient to resist site-specific dynamic bearing pressure demands

Dominion

Section 3.8 Seismic Category I Structures

Site-specific evaluations demonstrated seismic adequacy of RB/FB structures with following changes from standard design identified in Departure NAPS DEP 3.7-1:

- Arrangement of shear ties for a small portion of RB exterior wall at Elevation 22.50 m to 24.60 m was changed to withstand site-specific seismic loads
- Arrangements of shear ties and reinforcement of FB exterior wall at Elevations 4.65 m to 6.60 m were updated to withstand site-specific seismic loads
- Refined calculation, which was performed by applying equivalent average acceleration consistent with the one used for development of the out-of-plane loads on other slabs, demonstrated that the site-specific stress demands for the upper and lower radial plates of diaphragm floor remain within allowable limits

Dominion

Section 3.8 Seismic Category I Structures

Site-specific evaluations demonstrated seismic adequacy of CB and FWSC structures with following changes from standard design identified in Departure NAPS DEP 3.7-1:

- Size of one CB steel girder was changed to withstand the site-specific seismic loads
- Rebar and shear ties were added to FWSC shear keys to withstand the site-specific seismic loads
- Rebar was added to a portion of FWSC basemat elements located close to shear keys to withstand the site-specific seismic loads

Dominion

Section 3.8 Seismic Category I Structures

Site-specific evaluations demonstrated seismic adequacy of equipment and components with following changes from standard design identified in Departure NAPS DEP 3.7-1:

- Support saddle bolts and their embedment of PCCS Condenser were changed to withstand site-specific seismic loads
- The following design changes were necessary for new fuel storage racks in the buffer pool to withstand the site-specific seismic loads:
  - size of the anchor bolts was increased, and
  - loads in final embedment were increased
- The following design changes were necessary for spent fuel storage racks in the buffer pool deep pit to withstand the site-specific seismic loads:
  - size of anchor bolts was increased
  - welds from enveloping plate to the base plates were increased, and
  - loads in final embedment were increased

North Anna 3

North Anna 3 COLA

ACRS ESBWR Subcommittee Meeting

Seismic Components and Seismic Margin Analysis (Sections 4.2, 9.1, & Chapter 19)

October 20, 2016

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Seismic Components: Fuel System Design (Section 4.2)

Evaluation performed for GE14E fuel considering seismic demands obtained from site-specific analyses using approved DCD methods:

- Considers combined effects of SSE, LOCA, and SRV accelerations
- Limiting fuel accelerations from combined seismic and dynamic loads are compared to bounding limits given in DCD
- Results indicate that GE14E fuel design is adequate for use at NA3
- Final as-built information will be used in ITAAC verifying seismic and dynamic loads are within limits

GE14E fuel design is adequate for use at NA3.

Seismic Components: Fuel System Design (Section 4.2)

Structural evaluation of ESBWR Marathon control rods was performed using NA3 seismic demands following the DCD approved methodologies

- NA3 maximum horizontal fuel channel oscillation amplitude is less than 10% higher than DCD value
- Identified three evaluations that could be affected by ~10% higher seismic fuel channel oscillations (which could affect control rod scram times and maximum stresses and strains during insertion)
  - Control rod wing outer edge bending
  - Absorber tube to tie rod weld
  - Seismic scram testing
- Using conservative assumptions for fuel channel deflections due to LOCA and SRV, results of the three evaluations indicate that the ESBWR control rods structure is acceptable for NA3
  - Conservative assessment also demonstrates margin in Seismic Scram Testing and that control rod design is acceptable for use at NA3
  - New ITAAC added to verify acceptance with final as-built information

Control rod design is adequate for use at NA3.

Seismic Components: Fuel Storage and Handling (Section 9.1)

Fuel storage racks structural evaluated following DCD methodology, using site-specific seismic demands (Departure NAPS DEP 3.7-1), :

- New Fuel Storage: For the new fuel storage racks in the buffer pool, the size of the anchor bolts is increased and the loads in the final embedment are increased to withstand the site-specific seismic loads.
- Spent Fuel Storage: For the spent fuel storage racks in the buffer pool deep pit, the size of the anchor bolts is increased, the welds from the enveloping plate to the base plates are increased, and the loads in the final embedment are increased to withstand the site-specific seismic loads.

Fuel rack designs, as modified, are adequate for use at NA3.

Spent fuel stored in spent fuel pool storage racks evaluated following DCD methodology, using site-specific loads (Departure NAPS 3.7-1):

Spent fuel stored in racks can withstand NA3 seismic demands.

Seismic Margin Analysis:
Probabilistic Risk Assessment & Severe Accidents (Chapter 19)

- FSAR Sections 19.1, 19.2, and 19.5, and Appendix 19A discuss the NA3 seismic risk evaluation (Departure NAPS DEP 3.7-1)
- Site-specific Seismic Margin Analysis (SMA) update was performed to evaluate the impact of the peak ground acceleration on the DCD PRA risk insights in support of a plant-specific PRA assessment using DCD methodology and guidance for implementing SMA in NRC DC/COL-ISG-020
  - Site-specific seismic margin High Confidence, Low Probability of Failures (HCLPF) accident sequence analysis shows that NA3 is inherently capable of safe shutdown in response to beyond design basis earthquakes and has a plant level HCLPF of at least 1.67 times the peak ground acceleration of NA3 safe shutdown earthquake (SSE); as-built values will be compared and confirmed prior to fuel load
- Non-seismic structures that house RTNSS Criterion C systems are seismically designed to 2/3 NA3 SSE (as it is defined in Section 3.7.1)

Seismic margin analysis is acceptable for NA3.

North Anna 3

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Radwaste Discharge Piping Flow Path
(Sections 11.2 and 12.3)

October 20, 2016

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Radwaste Discharge Piping (Sections 11.2 & 12.3)

NA3 operational goal is zero liquid release plant - Liquid Waste Management System (LWMS) designed to recycle all processed water

Changes to FSAR:

- FSAR Rev 2 (Based on DCD Rev 5)
  - Section 11.2 - radioactive releases are discharged to circulating water system
  - Section 12.3 – cooling tower (CT) blowdown line is run underground due to radioactive content
  - Consistent with DCD
- FSAR Rev 9 (Based on DCD Rev 10)
  - Section 11.2 - radioactive releases are discharged using LWMS discharge line
  - Section 12.3 – LWMS discharge line is run underground

Radwaste Discharge Piping (Sections 11.2 & 12.3)

Departure NAPS 12.3-1

- FSAR 11.2 - Liquid radioactive releases will be discharged using the liquid radwaste effluent discharge pipeline to the discharge canal and not into the circulating water system's CT blowdown line
- FSAR 12.3 - LWMS discharge line is run underground
- Meets design requirements and regulations (10 CFR 20.1406); underground segments will be either enclosed within a guard pipe and monitored for leakage, or accessible for visual inspections via trench or tunnel

Radwaste Discharge Piping (Sections 11.2 & 12.3)

Exemption 4

- Tier 1, Section 2.10.1 - Revise the design description from “releases are to the environment via the circulating water system” to “discharges to the environment using the liquid radwaste effluent discharge pipeline”
- Dedicated discharge pipeline complies with 10 CFR 20.1406 to minimize, to the extent practicable, contamination of the facility and the environment

The RW discharge piping design is acceptable and assures sufficient dilution.

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RG 1.221 – Hurricane Wind and Missiles
(Sections 3.3, 3.5, and 19A)

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RG 1.221
Section 3.3 Wind and Tornado Loadings

NA3 extreme winds evaluated per RG 1.221, "Design-Basis Hurricane and Hurricane Missiles"

- The site-specific extreme hurricane wind speed is less than the maximum tornado wind speed
  - NA3 Site: Extreme hurricane wind speed 140 mph
  - NA3 Site: Maximum tornado wind speed 200 mph
  - DCD: Maximum tornado wind speed 330 mph
- No changes to seismic Category I structures

Seismic Category I structures are designed to withstand the tornado wind speed, which bounds the RG 1.221 hurricane wind speed.

RG 1.221
Section 3.5 Missile Protection

NA3 hurricane missile spectra and velocities evaluated per RG 1.221, "Design-Basis Hurricane and Hurricane Missiles"

- Potential missiles generated by the NA3 site-specific extreme hurricane wind are less severe than the missiles generated by the standard plant design basis tornado

Missile Description	DCD Tornado Missile Velocity	NA3 Hurricane Missile Velocity (ref. Table 3.5-201)
Heavy (~2 ton auto)	116 mph H 81 mph V	74 mph H 58 mph V
Intermediate (~300 lb shell/pipe)	116 mph H 81 mph V	55 mph H 58 mph V
Light (0.147 lb 1" steel ball)	116 mph H & V	48 mph H 58 mph V

- No changes to seismic Category I structures

Seismic Category I structures are designed for tornado missiles, which bounds RG 1.221 hurricane missiles.

RG 1.221 and 19A Regulatory Treatment of Non-Safety Systems (RTNSS)

In regard to RTNSS, NA3 extreme hurricane winds, and missile spectra and velocities evaluated per RG 1.221, "Design-Basis Hurricane and Hurricane Missiles"

- The maximum hurricane wind for NA3 as specified per RG 1.221 is less than maximum hurricane wind specified in DCD
  - NA3 Site: Extreme hurricane wind speed 140 mph
  - DCD: Extreme hurricane wind speed 195 mph
- Structures housing RTNSS functions/SSCs meet site-specific hurricane missile spectra (using most limiting as described in 19A)

Missile Description	DCD Hurricane Missile Velocity	NA3 Hurricane Missile Velocity	Limiting Missile Velocity
Heavy Mass (~2 ton auto)	68 mph H 48 mph V	74 mph H 58 mph V	74 mph H 58 mph V
Intermediate Mass (~300 lb shell/pipe)	68 mph H 48 mph V	55 mph H 58 mph V	68 mph H 58 mph V
Light Mass (0.147 lb 1" ball)	68 mph H & V	48 mph H 58 mph V	68 mph H & V

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RG 1.221 and 19A Regulatory Treatment of Non-Safety Systems (RTNSS) (continued)

Hurricane Wind and Missiles Impact on Structures Housing RTNSS

Departure NAPS 19A-1

- Maximum hurricane wind for NA3 as specified in RG 1.221 is bounded by maximum hurricane wind specified in DCD
- However, NRC guidance in RG 1.221 results in slightly higher velocities for certain hurricane wind generated missiles

Exemption 5

- For NA3, structures housing RTNSS equipment are designed to meet both the hurricane wind generated missile spectra specified in the DCD and the Unit 3 site-specific missile spectra and velocities per the guidance of RG 1.221
- Tier 1 Table 5.5-1, Footnote 7 - Add the requirement that the design of these structures account for higher missile velocities specified by the current guidance in RG 1.221 in addition to the missile spectra specified in the DCD

Structures housing RTNSS SSCs meet NA3 RG 1.221 wind speed and missile spectra.

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Zinc Injection System (Section 9.3.11)

October 20, 2016

Section 9.3.11 Zinc Injection System

Zinc injection system (ZNIS) is added to be available at startup to provide defense-in-depth with HWCS

- Uses GEZIP system to continuously inject small amounts (through dissolution of depleted zinc oxide pellets) into the recirculation loop around the feedwater pumps (instrumentation provided for manual injection)
- Reduces occupational exposure to plant personnel by forming a protective oxide layer on stainless steel piping and components
- Corrosion inhibition effects reduce soluble Cobalt-60 build-up
- Periodically tested to ensure proper operation of controls, trips, interlocks, and component alarm functions

A ZNIS is added for dose rate reductions.

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Offsite Power Surge Protection & Switchyard Configuration (Chapter 8)

October 20, 2016

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Introduction (Surge Protection & Switchyard Design)

- Surge protection departure (DEP 8.1-2)
- Revised switchyard configuration (DEP 8.1-1 and Exemption 2)

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Surge Protection Departure

- DCD refers to RG 1.204,"Guidelines for Lightning Protection of Nuclear Power Plants," (which references IEEE C62.23, "Application Guide for Surge Protection of Electric Generating Plants,") for the off-site power system
- North Anna switchyard was designed and constructed in 1970s using Dominion transmission system standards, prior to RG 1.204 issuance
- As a result, North Anna switchyard design conforms to part, not all, of RG 1.204; departure from DCD (DEP 8.1-2)

Conclusion: Off-site power system and switchyard meet interface requirements in DCD. Departure does not affect DCD design functions or performance requirements.

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Revised Switchyard Configuration

- Revised FSAR switchyard Figures 8.1-1R (Departure 8.1-1 and Exemption 2) and 8.2-201 to reflect location of the main generator circuit breaker and the intermediate transformer in the intermediate switchyard

Conclusion: Changes continue to meet interface requirements in DCD. Departure does not affect DCD design functions or performance requirements.

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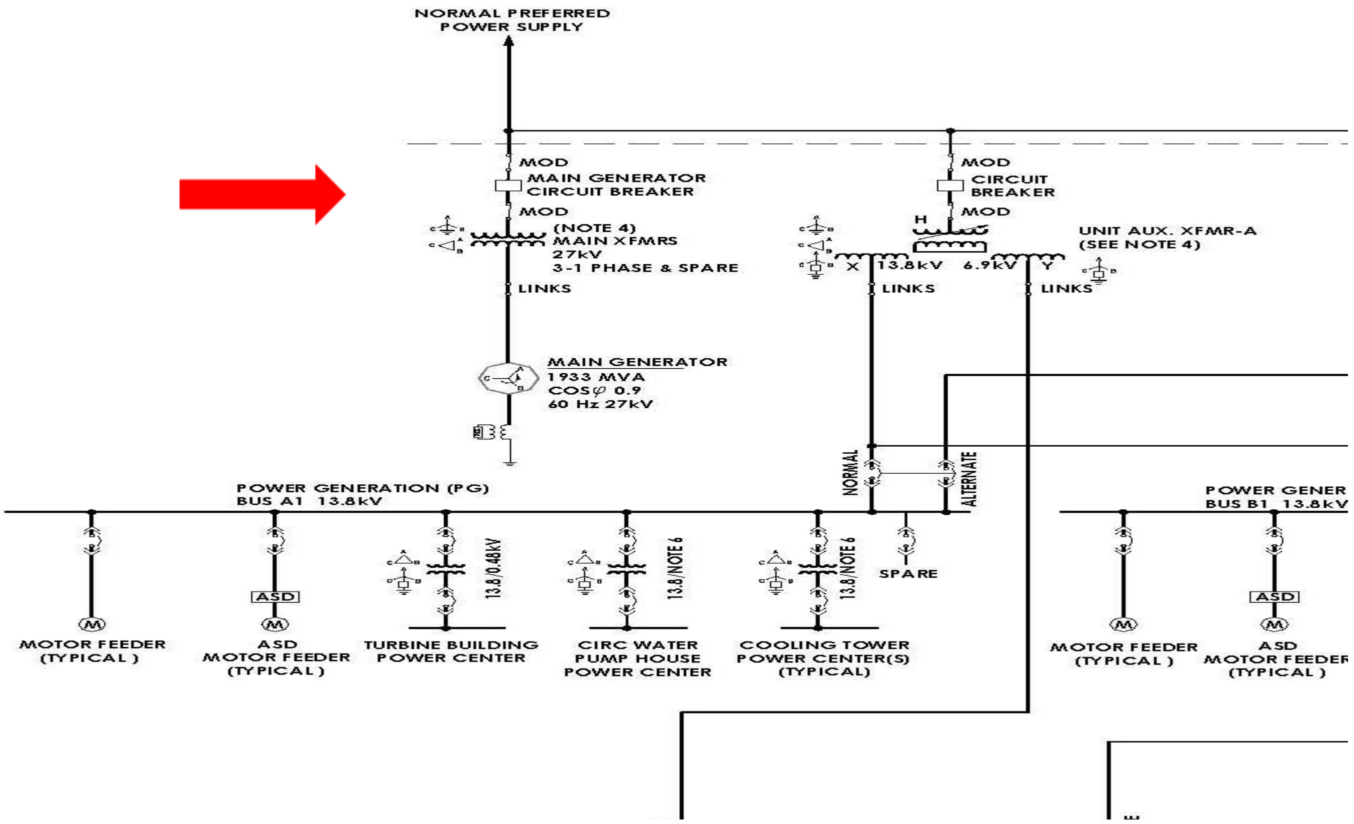
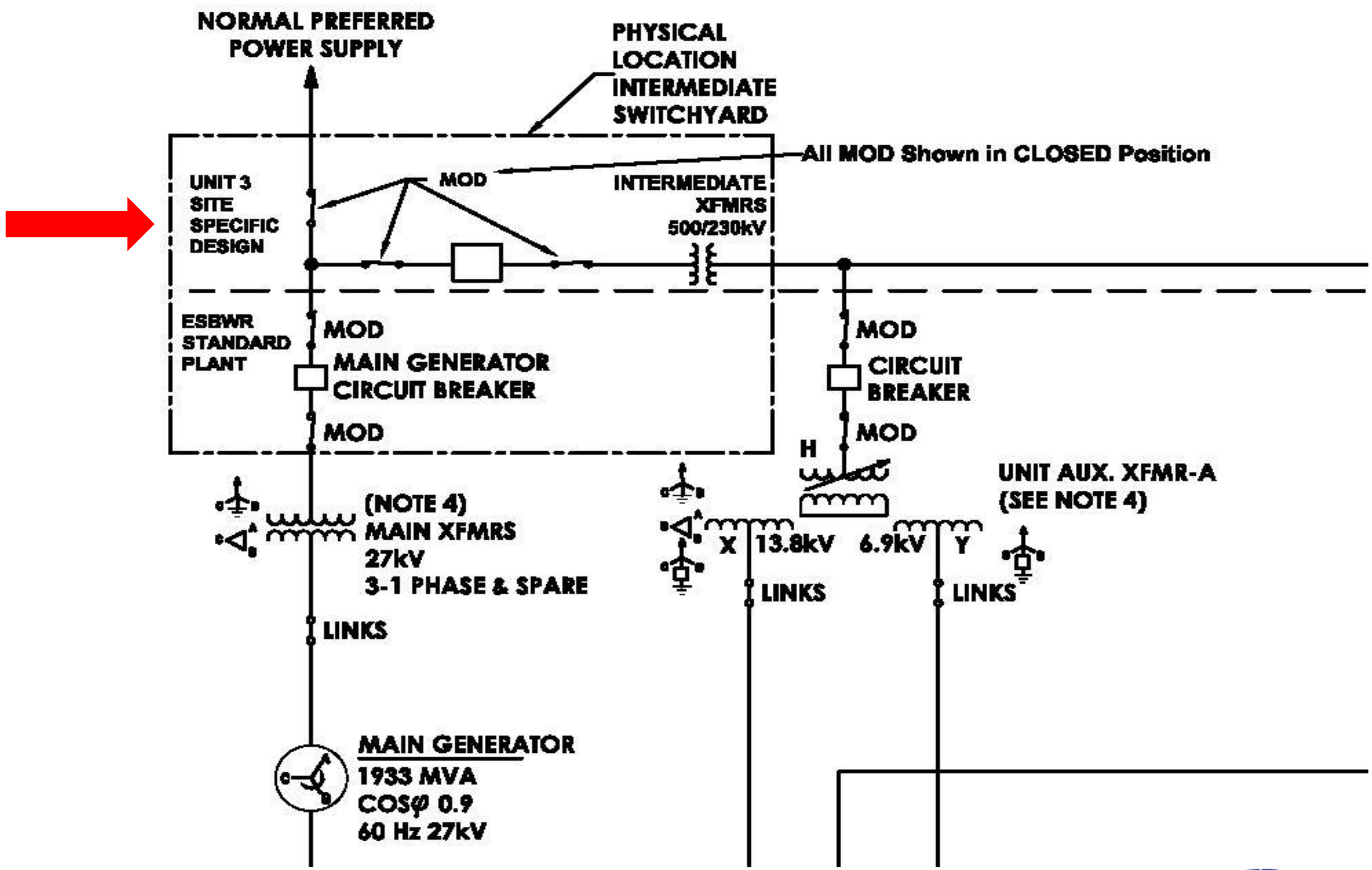
Revised Switchyard Configuration

DCD Figure 8.1-1



Revised Switchyard Configuration

NA3 FSAR Figure 8.1-1R



North Anna 3

North Anna Unit 3 COLA

ACRS ESBWR Subcommittee Meeting

Conclusions

October 20, 2016

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Conclusions

- Dominion implemented the design-centered review approach to maximize standardization
- Site-specific issues that were identified have been evaluated and resolved
- North Anna site is adequate to support the construction and operation of NA3

Acronym List

ARS	Acceleration Response Spectra
APWR	Advanced Pressurized Water Reactor
AWWA	American Water Works Association
BE	Best Estimate
BTP	Branch Technical Position
CB	Control Building
CDI	Conceptual Design Information
CEUS-SSC	Central and Eastern United States Seismic Source Characterization
CFR	Code of Federal Regulations
COLA	Combined License Application
CSDRS	Certified Seismic Design Response Spectra
CST	Condensate Storage Tank
CT	Cooling Tower
CVSZ	Central Virginia Seismic Zone
DCD	Design Control Document
DF	Diaphragm Floor
DM	Direct Method
DRS	Design Response Spectra
ECC-AM	Extended Continental Crust - Atlantic Margin
EPRI	Electric Power Research Institute
EPRI-SOG	Electric Power Research Institute – Seismic Owners Group
ETSZ	Eastern Tennessee Seismic Zone
FB	Fuel Building
FE	Finite Element
FIRS	Foundation Input Response Spectra
FPE	Fire Pump Enclosure
FRP	Fiberglass Reinforced Polyester
FSAR	Final Safety Analysis Report
FWS	Firewater Storage Tank
FWSC	Fire Water Service Complex
GMM	Ground Motion Model
GMRS	Ground Motion Response Spectra
GW	Groundwater
HCLPF	High Confidence Low Probability of Failure
HF	High Frequency
HRHF	Hard Rock – High Frequency
HWCS	Hydrogen Water Chemistry System
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
ISRS	In-Structure Response Spectra

Acronym List (cont.)

ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
ISG	Interim Staff Guidance
LB	Lower Bound
LF	Low Frequency
LIP	Local Intense Precipitation
LOCA	Loss of Coolant Accident
LPZ	Low Population Zone
LWMS	Liquid Waste Management System
MAFE	Mean Annual Frequencies of Exceedance
MSM	Modified Subtraction Method
NAVD	North American Vertical Datum
OI	Open Item
PBSRS	Performance-Based Surface Response Spectra
PCCS	Passive Containment Cooling System
PGA	Peak Ground Acceleration
PMP	Probable Maximum Precipitation
PRA	Probabilistic Risk Assessment
PSHA	Probabilistic Seismic Hazards Analysis
PSWS	Plant Service Water System
RAI	Request for Additional Information
RB/FB	Reactor Building/Fuel Building
RC	Reinforced Concrete
RCCV	Reinforced Concrete Containment Vessel
RLME	Repeated Large Magnitude Earthquake
RG	NRC Regulatory Guide
RSW	Reactor Shield Wall
RTNSS	Regulatory Treatment of Non-Safety Systems
RW	Radwaste
SC	Seismic Category
SMA	Seismic Margin Analysis
SRP	Standard Review Plan
SRV	Safety Relief Valve
SSAR	Site Safety Analysis Report
SSC	Structures, Systems, and Components
SSHAC	Senior Seismic Hazard Analysis Committee
SSI	Soil-Structure Interaction
SSSI	Structure-Soil-Structure Interaction
UB	Upper Bound
UHRS	Uniform Hazards Response Spectra
V/H	Vertical/Horizontal
VW	Vent Wall
ZNIS	Zinc Injection System

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Protecting People and the Environment

Presentation to the ACRS Subcommittee

Staff Review of North Anna 3 ESBWR Combined License Application

October 20, 2016

North Anna 3 Application Summary

- September 25, 2003, North Anna ESP submittal
- November 26, 2007, North Anna 3 ESBWR R-COL Application
- June 28, 2010, Dominion revised its application to the US-APWR
- August 23, 2011, Mineral Virginia Earthquake
- April 25, 2013, Dominion reverted back to the ESBWR
- August 30,2013, submitted RAI S-COL RAI reconciliation from Fermi R-COL after May, 2010, through May 31, 2013
- June 24, 2014, Dominion revised application that incorporated by reference the ESBWR DCD, Revision 10
- January 23, 2015, Dominion followed the design center approach and reviewed the recent Detroit Edison Company Fermi 3 COL application updates
- October 22, 2014, Dominion submitted its Seismic Closure Plan
- June 22, 2016, Dominion submitted Revision 9 FSAR incorporating the staff reviewed FSAR markups from RAI responses

North Anna 3 Post Phase 2 COLA Review Summary

- **ACRS Phase 2 Letter** - October 23, 2009, ACRS Letter to EDO Phase 2 SER (ML092890370)
- **Staff SER Phase 2 Open Items** - Closed by incorporation of approved RAI response In the North Anna 3 FSAR, Revision 8, June 2014 (71 Items)
- **Staff SER Phase 2 Confirmatory Items** - Incorporated in FSAR, Revision 6, July 2013 (40 Items)
- **Staff SER Phase 4 Confirmatory Items** - Staff confirmation in progress in FSAR, Revision 9, June 2016 (34 Items) - Phase 6 FSER
- **Tier 1 [Fukushima] recommendations SECY-11-0137, as modified in SECY-12-0025** - Applicable to North Anna 3 COL review SER Chapter 20

North Anna 3 ACRS Subcommittee Focus

- Site Specific Non-Seismic Information:
  - Geography and Demography
  - ETE
  - Meteorology and Hydrology
  - Ground Water Accident Release
  - Hazardous Chemicals
  - Switchyard, Off-Site Power
  - Hurricane Missiles

- Site Specific Seismic Information:
  - Seismology
  - Seismic Structures
  - Fuel Pool Racks
  - Reactor Design

- DCD Topics As Requested By ACRS:
  - Digital I&C, Single Phase

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North Anna 3 COLA Review

NRC Panel 1 - Presenters

- **Sections 2.1, 2.2 - Rao Tammara**
- **Evacuation Time Estimates - Bruce Musico**
- **Section 2.3 - Kevin Quinlan**
- **Section 2.4 - Joseph Giacinto**
- **Section 8.2-1 Departure - Bob Fitzpatrick**
- **Chapters 11, 12 Departures - Steve Williams**
- **Chapter 19 Departures - Ryan Nolan**
- **Fiberglass Reinforced Piping - James Shea**

Section 2.1 - Geography and Demography

- Site Location and Description - Coordinates, site boundaries, orientation of principal plant structures, location of highways, railroads, waterways that traverse the exclusion area

- Exclusion Area Authority and Control - Legal authority, control of activities unrelated to plant operation, arrangements for traffic control

- Population Distribution - Current and future population projections, characteristics of the Low Population Zone (LPZ), population center distance, and population density

- The above information needed to address DCD COL Items 2.0-2-A, 2.0-3-A, 2.0-4-A is included in SSAR Sections 2.1.1, 2.1.2 and 2.1.3 of ESP application, and are incorporated by reference with some minor supplemental information pertaining to location and authority and control

Section 2.2 - Nearby Industrial, Transportation, and Military Facilities

- Identification of potential hazards in site vicinity:
  - Maps of site and nearby significant facilities and transportation routes
  - Description of facilities, products, materials, and number of people employed
  - Description of pipelines, highways, waterways, railroads, and airports
  - Projections of industrial growth

- The above information needed to address DCD COL Item 2.0-5-A is included in SSAR Sections 2.2.1 and 2.2.2 of ESP application which are incorporated by reference with some minor supplemental information

Section 2.2 - Nearby Industrial, Transportation, and Military Facilities

- Explosions and Flammable Vapor Clouds - Truck Traffic, Pipelines, Waterway Traffic, Railroad Traffic

- Release of Hazardous Chemicals - Transportation Accidents, Major Depots, Storage Areas, Onsite Storage Tanks

- Fires - Transportation Accidents, Industrial Storage Facilities, Onsite Storage

- The above information needed to address DCD COL Item 2.0-6-A is included in SSAR Section 2.2.3 of ESP application which is incorporated by reference for the evaluation of potential impacts from gasoline delivery truck, onsite storage of hydrazine, and hydrogen storage tanks and delivery of 13,000 gallons of liquid hydrogen by delivery truck

Section 2.2 - Control Room Habitability

❖ Table 1 - North Anna Unit 3 Chemical Analysis

Foot Notes:
(a) Asphyxiating limit

(b) Oxygen-enriched limit

(c)TWA is defined as a threshold limit value 8-hour time weighted average whereby an employee's exposure to a substance shall not exceed the 8-hour TWA given for that substance in any 8-hour work shift of a 40-hour work week (29 CRF 1919.1000 2006)

(d)The applicant's calculation results show that the distance to TWA is 1065 ft that is shorter than the distance to Unit 3 Control Room. Therefore the applicant did not calculate the control room concentration.

Chemicals	Nearest Distance to CR Intake	IDLH	MCR Concentration (Applicant)	MCR Concentration (Staff)	Notes
Liquid Hydrogen	1004 ft	71,400 ppm[(a)]	12,700 ppm	12,700 ppm	
Nitrogen	806 ft	714,000 ppm[(a)]	36,000 ppm	36,000 ppm	
Oxygen	1009 ft	235,000 ppm[(b)]	35,700 ppm	71,300 ppm	
Gasoline	1078 ft	750 ppm	167 ppm	167 ppm	
Ammonium Hydroxide (30%)	1228 ft	300 ppm	33.6 ppm	33.6 ppm	Open Country
Ammonium Hydroxide (30%)	1228 ft	300 ppm	14.9 ppm	4.49 ppm	Urban or Forest
Carbon Dioxide	1146 ft	40,000 ppm	7,090 ppm	7,090 ppm	
NOVEC 1230	2180 ft	150 ppm (TWA[(c)])	Foot Note (d)	17.5 ppm	No IDLH Defined

Section 2.2 - Nearby Industrial, Transportation, and Military Facilities

- Evaluation of potential accidents:
  - The staff reviewed whether the applicant addressed the additional site specific evaluations of potential accidents. Staff also performed independent confirmatory calculations in confirming the applicant's conclusions that the potential impacts due to potential accidents from these additional sources addressed would not impact adversely the safe operation and safe shutdown of the North Anna 3.
  - Based on the review of the applicant provided information, responses to the RAIs, staff evaluations and staff's independent confirmatory analyses.
  - The staff found the applicant's conclusions to be acceptable as the evaluations are in accordance with the guidance provided in NUREG-0800 Section 2.2.3, and meet regulatory requirements of 10 CFR 100.20(b).

Evacuation Time Estimate (ETE)

- 10 CFR 50.47(b)(10):
  - ETE developed and updated
- 10 CFR 50, Appendix E.IV.2-7:
  - Develop, provide to State and local authorities, and use ETE
  - Evaluate ETE annually
  - Update criteria established
  - COL review 365 days before fuel load

Section 2.3 - Meteorology

- 2.3.1 - Regional Climatology:
  - Design Basis Dry and Wet Bulb Temperatures
    - Not all site characteristic temperatures included in ESP
    - All NAPS site characteristic temperatures are bounded by the ESBWR DCD site parameters
  - NAPS ESP VAR 2.3-1
    - Recalculated NAPS 3 tornado site characteristic values
  - Extreme Winter Precipitation
- 2.3.2 - Local Meteorology:
  - Addressed the Cooling Tower-Induced Effects on Temperature, Moisture, and Salt Deposition
- 2.3.3 - Onsite Meteorological Measurement Programs:
  - Confirmed that ESBWR plant structures located adequate distance from onsite meteorological tower

Section 2.3 - Meteorology

- 2.3.4 - Short-Term (Accidental) Diffusion Estimates:
  - EAB & LPZ accident χ/Q values incorporated from ESP SSAR
  - COL FSAR presented Control Room χ/Q values
  - ESBWR Control Room and offsite χ/Q values conservatively bound the NAPS site-specific values
- 2.3.5 - Long-Term (Routine) Diffusion Estimates:
  - NAPS ESP VAR 2.0-1
  - Updated analysis to incorporate use of both ground-level and mixed-mode releases
  - ESBWR routine release offsite χ/Q and D/Q values conservatively bound the NAPS COL site-specific values
- Conclusions:
  - All regulatory requirements have been satisfied
  - No "Open Items"

Section 2.4.2 - Local Intense Precipitation Flooding

- Maximum flooding evaluated in three drainage ditches surrounding powerblock:
  - Site runoff and runoff depth were maximized, culverts blocked
  - Localized flooding result of 288.4 ft NAVD88, 1.6 ft below the design plant grade and 0.6 ft below the ESBWR DCD site parameter for maximum flood level
  - No discharge to Units 1 and 2 area from Unit 3
- Maximum sheet-flow depths from roof runoff evaluated between powerblock buildings:
  - All roof drains clogged, roof scuppers designed to carry peak discharge during LIP remain unclogged and direct discharge to certain areas
  - Maximum flow depths from 0.2 to 0.8 ft.
  - In three of the analyzed areas, doorway elevations were below the maximum sheet-flow water-surface elevations - flood protection measures proposed for these doors (FSAR 2.4.10)
- Staff conclusions:
  - All Applicant followed applicable guidance and used current engineering practice methods with conservative assumptions that maximize water-surface elevations
  - Proposed measures provide required flood protection
  - The staff determined that ESP COL Action Items are closed

Section 2.4.3 - Lake Anna Probable Maximum Flood

- Staff accepted ESP Variance 2.4-4 to raise the normal pool elevation of Lake Anna by three inches (from 249.14 ft to 249.39 ft NAVD88)

- Staff's confirmatory analysis and review conclusions:
  - PMF on Lake Anna increases by 0.03 ft with the rise in the normal lake elevation
    - Staff accepted ESP Variance 2.4-5
  - The Lake Anna PMF elevation remains well below the DCD site parameter elevation of 1 ft below design plant grade

Section 2.4.12 - Groundwater

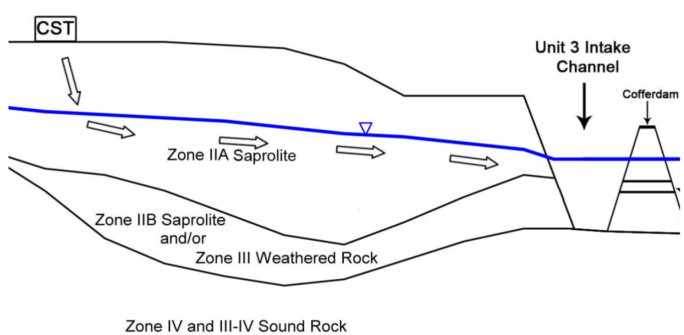
- Staff evaluated and accepted all groundwater-related variances

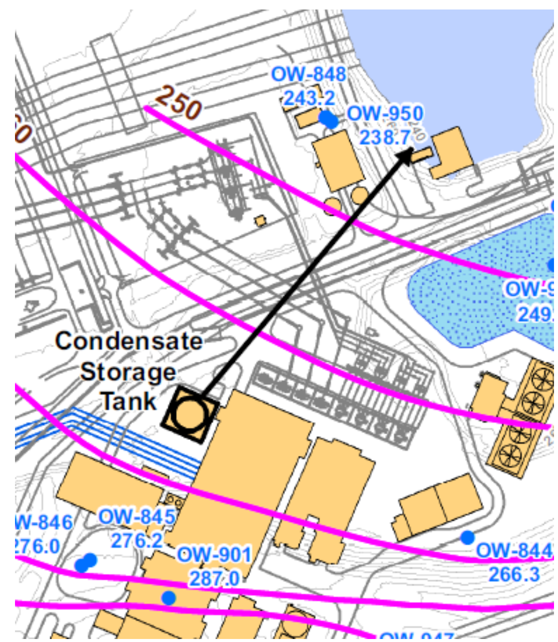
- Staff confirmatory analysis and review conclusions:
  - PMF Maximum groundwater level is 283.9 ft NAVD88 at the Ancillary Diesel Bldg.
  - Groundwater level is controlled by flow into the site drainage ditches
  - Applicant provided a detailed description of drainage ditch design, construction methods, and materials to ensure the function of the ditches in maintaining acceptable groundwater levels

Section 2.4.13 - Accidental Release of Radioactive Liquid Effluent in ground and Surface Waters

- Applicant described features to preclude radioactive releases into potential liquid pathways to satisfy ESP Permit Condition 3.E(3), but nonetheless analyzed an accidental release to groundwater from the condensate storage tank

- The staff confirmed that the shortest and most plausible pathway was to the Unit 3 intake channel. The staff concluded that:
  - Applicants analysis was appropriately conservative
  - Maximum radionuclide concentrations were below limits
  - Radionuclide concentrations would be further diluted in Lake Anna before reaching the exclusion area boundary





Section 2.4 - Staff Conclusions RE: Site Footprint

- As stated in SER Section 2.1.4, the site layout and boundary for proposed NA3 remains within the ESP proposed facility boundary
- In its hydrology-related review, the staff evaluated the applicant's NA3-specific analyses including those related to the LIP flood, the groundwater levels, and radioactive liquid effluent transport
  - The staff concluded that the LIP flood would remain below the ESBWR DCD site parameter for maximum flood level
  - The staff concluded that under the LIP sheet-flow depths, certain critical doors to safety-related buildings would require flood protection
  - The staff concluded that raising the normal pool elevation of Lake Anna by three inches would not result in any safety issues
  - The staff confirmed that the ultimate heat sink does not require an external source of safety-related make-up water, and that there are no safety-related issues associated with the intake, the discharge, or low Lake Anna water levels
  - The staff concluded that the maximum groundwater level would remain below the ESBWR DCD site parameter
  - The staff independently confirmed that maximum radionuclide concentrations from an accidental release to groundwater were below applicable limits

Section 2.4 - Staff Conclusions (Continued)

- The applicant:
  - Demonstrated that the site is suitable by satisfying the applicable regulatory requirements
  - Addressed the COL-specific information items identified in the respective sections of the ESBWR DCD, and the applicable ESP Permit Conditions
  - Performed the necessary hydrological analyses and determined the design basis flood as required with acceptable level of conservatism
  - Specified appropriate flood protection requirements for safety-related structures affected by local intense precipitation sheet flow flooding
- There are no post-combined license activities

Section 8.2-1 Departure - Surge Protection

- Staff evaluated the Section 8.2-1 departure:
  - Section 8.1.5.2.4 of the COL identifies a departure from RG 1.204 concerning surge protection for the switchyard (IEEE Std. C62.23)
  - Since RG 1.204 is part of the ESBWR DCD, the applicant, by taking exception to certain aspects of IEEE Std. 62.23, declared a departure
- During the review, the staff:
  - Issued RAI 08.02-61 to get the full details of the departure
  - Reviewed each exception and concurred with the applicant that either the subsection did not apply or the measures taken provided equivalent protection
  - The staff's detailed evaluation is provided in the SER
- Conclusions:
  - The departures from the RG 1.204 guidance were not significant and were either not applicable or the preference was to use their own established practices
  - This issue is being discussed because RG 1.204 is a part of the ESBWR DCD, not because of any significant technical issue

Exemption 2 - North Anna Switchyard

- Applicant requested an exemption from DCD, Tier 1, Figure 2.13.1-1, *Electronic Power Distribution System Functional Arrangement*, Sheet 1
- The staff evaluated this exemption and determined that the proposed exemption would not modify the function of the North Anna 3 switchyard from that described in the ESBWR DCD
- Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix E, Section VIII.A.4

Chapters 11, 12 Departures - Staff Evaluation

- Staff evaluated the radwaste discharge piping exemption/departure (NAPS DEP 12.3-1):
  - Tier 1 Change -
    - Exemption 4: Design of the Cooling Tower Blow-Down Line - The applicant proposed a site-specific Tier 1 DCD departure from DCD Tier 1, Section 2.10.1, “Design Description,” in regards to the design of the cooling tower blow-down line. Changing: “The LWMS either returns processed water to the condensate system or discharges to the environment via the circulating water system,” to “The LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline.”
  - Tier 2 Change -
    - Section 11.2.3.2: The Liquid Radwaste Effluent Discharge Piping Flow Path - The liquid effluent discharges from the LWMS to the environment will use only the liquid radioactive waste effluent discharge pipeline and not discharge the processed liquid effluent into the cooling tower blowdown line and then on to the environment.

Chapters 11, 12 Departures - Staff Evaluation

- Staff evaluated the liquid radwaste effluent discharge piping flow paths (NAPS DEP 12.3-1):
  - Design Certification Rule -
    - Issued This Tier 2 departure is permitted by 10 CFR 52.7 and Section VIII.A.3 of the Design Certification Rule. This Tier 2 departure from the ESBWR DCD describes the liquid radwaste effluent discharge piping flow path. The pipeline to transfer liquid radwaste from the Radwaste Building to the environment does not adversely affect any intended DCD design function. This departure evaluation was determined to comply with the requirements of the ESBWR Design Certification Rule, 10 CFR Part 52, Appendix E, Section VIII.B.5.b.

      The staff has reviewed this departure submittal and agrees with the applicant's determination concerning the departure to describe the liquid radwaste effluent discharge and that this Tier 2 departure does not change the function of this line as described in the ESBWR DCD. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the Radwaste Building directly to the environment only as necessary.

Chapters 11, 12 Departures - Staff Conclusion

- Staff evaluated NAPS DEP 12.3-1:
  - COL Change -
    - The staff finds that the requirements of 52.7 and 50.12 are met, including the existence of special circumstances, and that issuance of the requested exemption is warranted. This is based on the information provided in Tier 1 and Tier 2, Section 11.2.3.2 which describes that a release point dilution factor of 1000 (minimum) is maintained during a liquid effluent release, with dilution flow provided by either Unit's 1 and 2 circulating water system.

Chapter 19 Departures - Staff Evaluation

- Staff evaluated Exemption 5 (NAPS DEP 19A-1):
  - The ESBWR DCR contains an exclusion from finality for the effects of hurricane-generated missiles
  - The staff issued RAI 7471, Question 03.05.01.04-01, and RAI 7533, Question 03.05.01.04-02, requesting the applicant to address site-specific hurricane missiles based on RG 1.221
  - In response the applicant demonstrated that all seismic Category I structures are bound by the DCD tornado missiles (330 mph wind speed); however, for non-seismic Category I structures housing RTNSS equipment some site-specific hurricane missiles (140 mph wind speed) were not bound by the DCD
  - Therefore, Exemption 5 and NAPS DEP 19A-1 modify the DCD to specify RTNSS structures will be designed to the most limiting hurricane-generated missile (either from the DCD or site-specific value calculated from RG 1.221)

Chapter 19 Departures - Staff Conclusion

Hurricane Missile Parameters- DCD vs. Site-Specific					
	Automobile (3,965 lb)	Automobile (4000 lb)	8" Armor Piercing Shell (275 lb)	6" Schedule 40 Pipe (287 lb)	1" Steel Sphere
DCD Velocity	68 mph (h) 48 mph (v)	-	**68 mph (h)** 48 mph (v)	-	**68 mph**
Site-Specific Velocity (RG 1.221)	-	**74 mph (h)** **58 mph (v)**	-	55 mph (h) **58 mph (v)**	48 mph (h) 58 mph (v)

- Staff evaluated Exemption 5 (NAPS DEP 19A-1) and concluded:
  - The staff finds that Exemption 5 and NAPS DEP 19A-1 appropriately considered hurricane missiles from RG 1.221
  - The design requirements added by the departure ensure RTNSS structures will be designed to the most limiting hurricane missile

Fiberglass Reinforced Piping

- ESBWR COL Item 9.2.1-1-A: COL applicant to determine material selection and provide provisions to preclude corrosion and fouling of PSWS
- Applicant selected fiberglass reinforced polyester pipe (FRPP) for buried portion of PSWS to preclude corrosion
- The PSWS is a nonsafety-related system providing defense-in-depth decay heat removal capability. It is classified as RTNSS C
- Staff asked questions related to: QA provisions for use of FRPP, applicability of maintenance rule, appropriate codes and standards for use of FRPP

Fiberglass Reinforced Piping

- Applicant indicated:
  - Meets ASME B31.1, "Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals," now including FRPP standards (from ASTM and AWWA).
  - RTNSS systems are in scope of D-RAP and classified as high safety-significant (HSS) for the Maintenance Rule Program
  - Inclusion of FRPP design loads, applicable codes/standards, and pre-service testing and in-service inspection requirements, supplemented by the examination and repair criteria from portions of ASME Code Case N-155-2
  - Inclusion of the PSWS piping in the NEI sponsored, "Underground Piping and Tank Integrity Program," based on NEI 09-14, "Guideline for the Management of Underground Piping and Tank Integrity"
- Conclusion: Staff finds all open items resolved and closed

BREAK

10:00 - 10:15 a.m.

NRC Panel 2 - Presenters

- Sections 2.5.1, 2.5.3 - Alice Stieve, Ph.D.
- Section 2.5.2 - Vladimir Graizer, Ph.D.
- Sections 2.5.4, 2.5.5 - Weijun Wang, Ph.D.

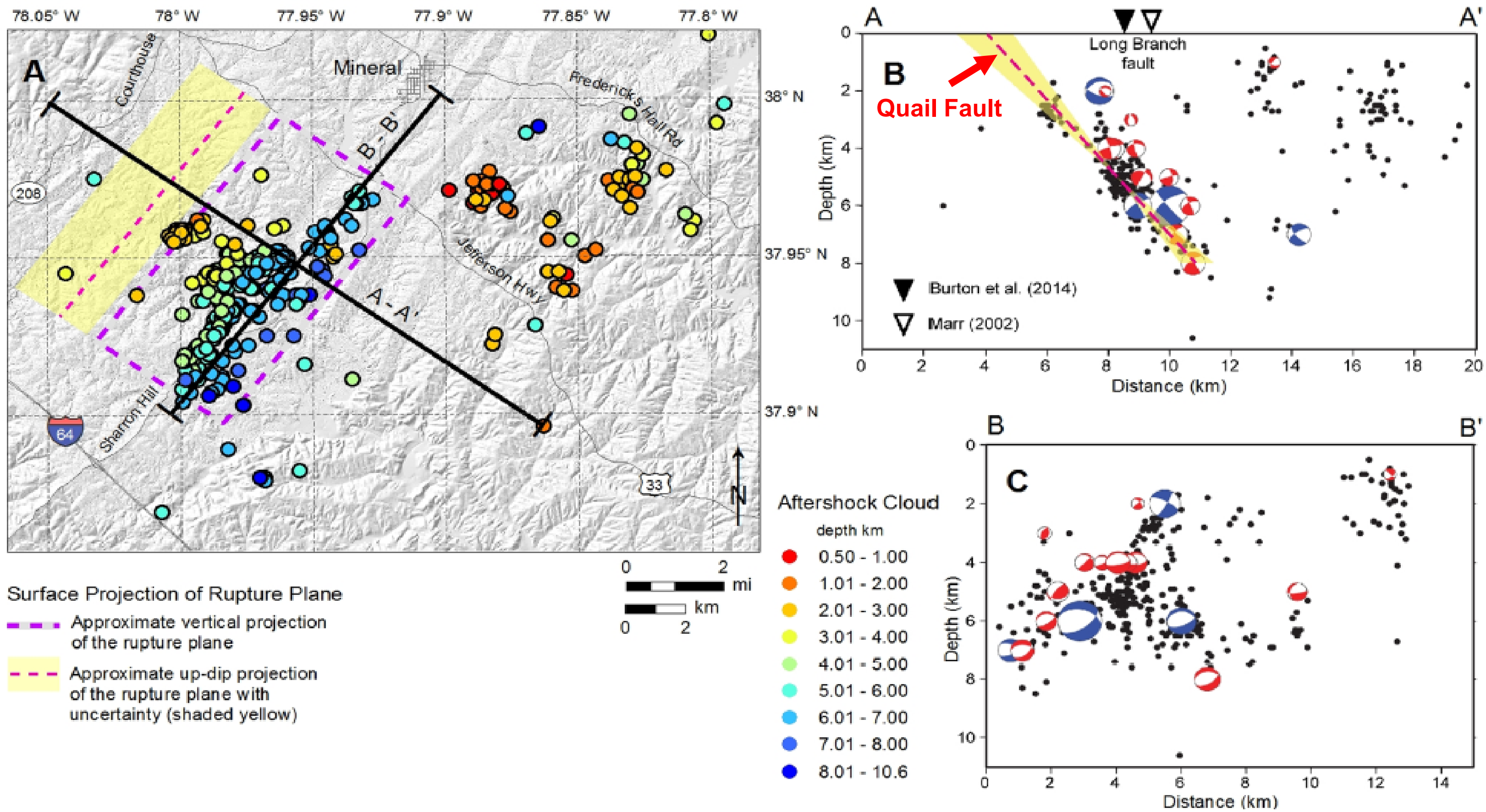
Section 2.5 - Geologic Information

- Geologic assessment of epicentral area of the 2011 Mineral VA EQ and the NAPS site area
- Supplemental information based on additional North Anna 3 site borings.
- Reviewed additional pertinent publications identified by staff.
- Conducted on-site audit for the evaluation of the geologic reconnaissance program implemented by Dominion, following the Mineral VA earthquake.

North Anna 3 COLA Review

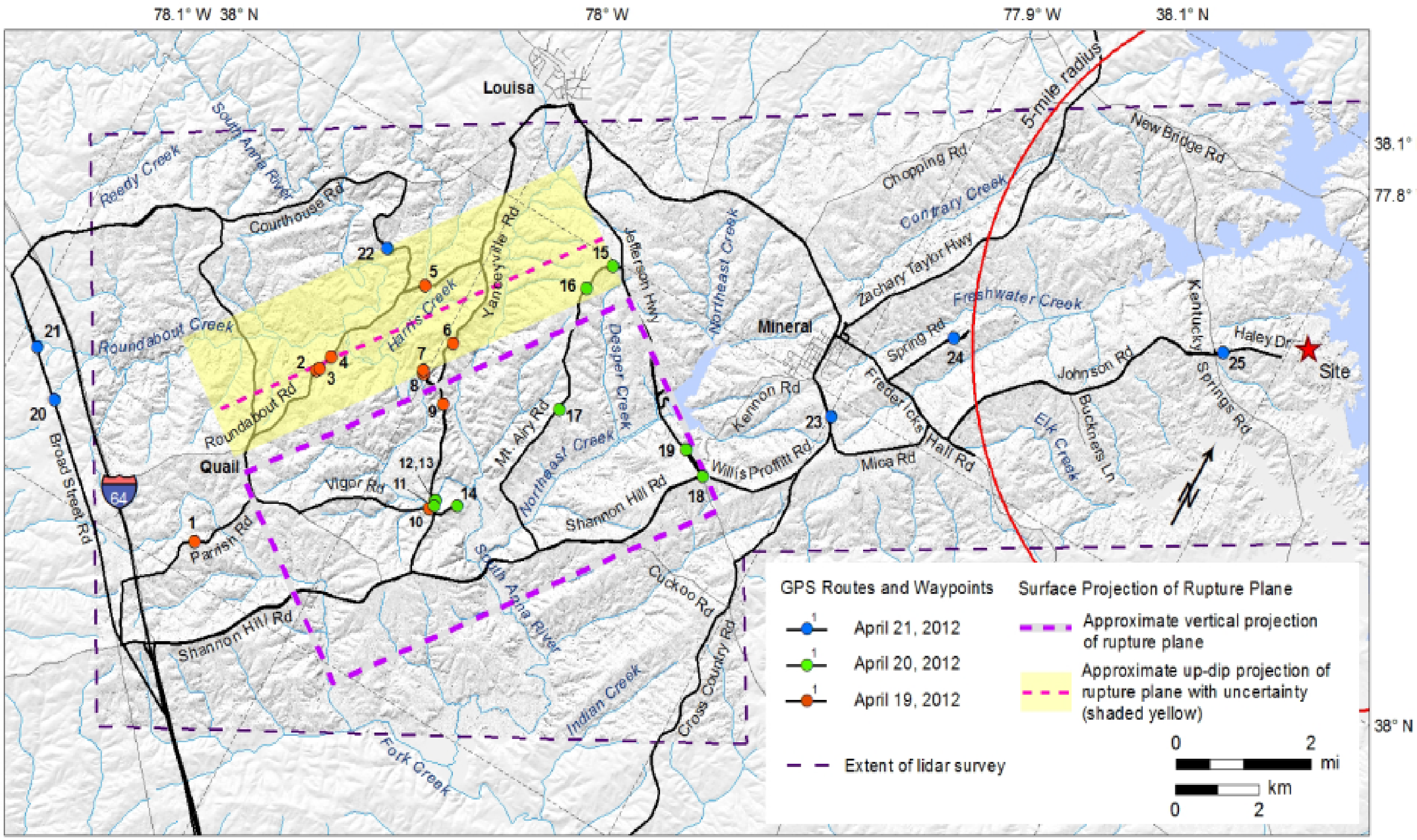
Map View

Cross Section Views



From NAPS FSAR Figure 2.5.1-209, based on data from McNamara et al. (2014) (FSAR Reference 2.5-392).

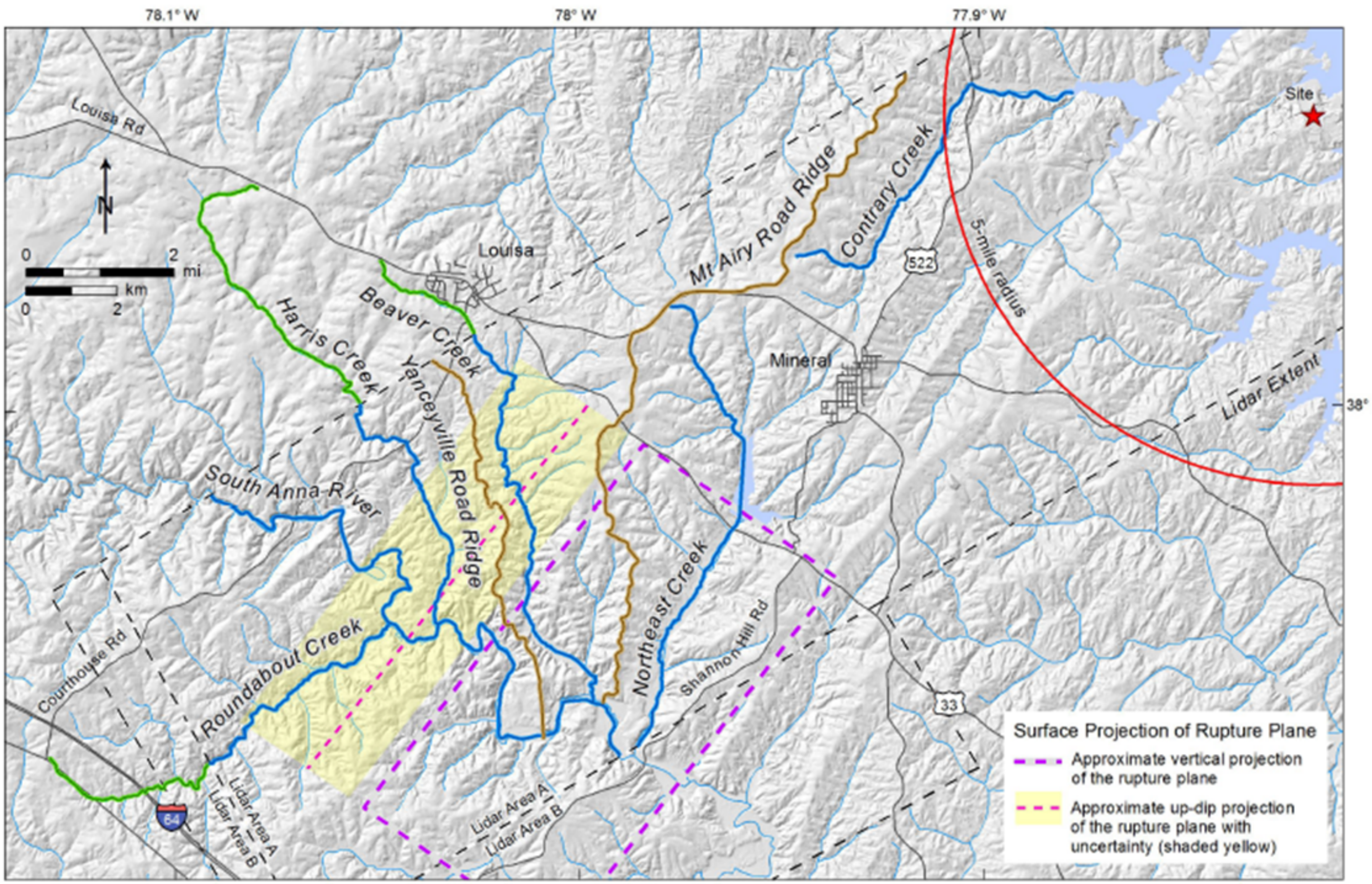
Geologic Field Reconnaissance Program: Epicentral Area, LiDAR Survey Extent, Routes, and Waypoints



From NAPS FSAR Figure 2.5.1-204

North Anna 3 COLA Review

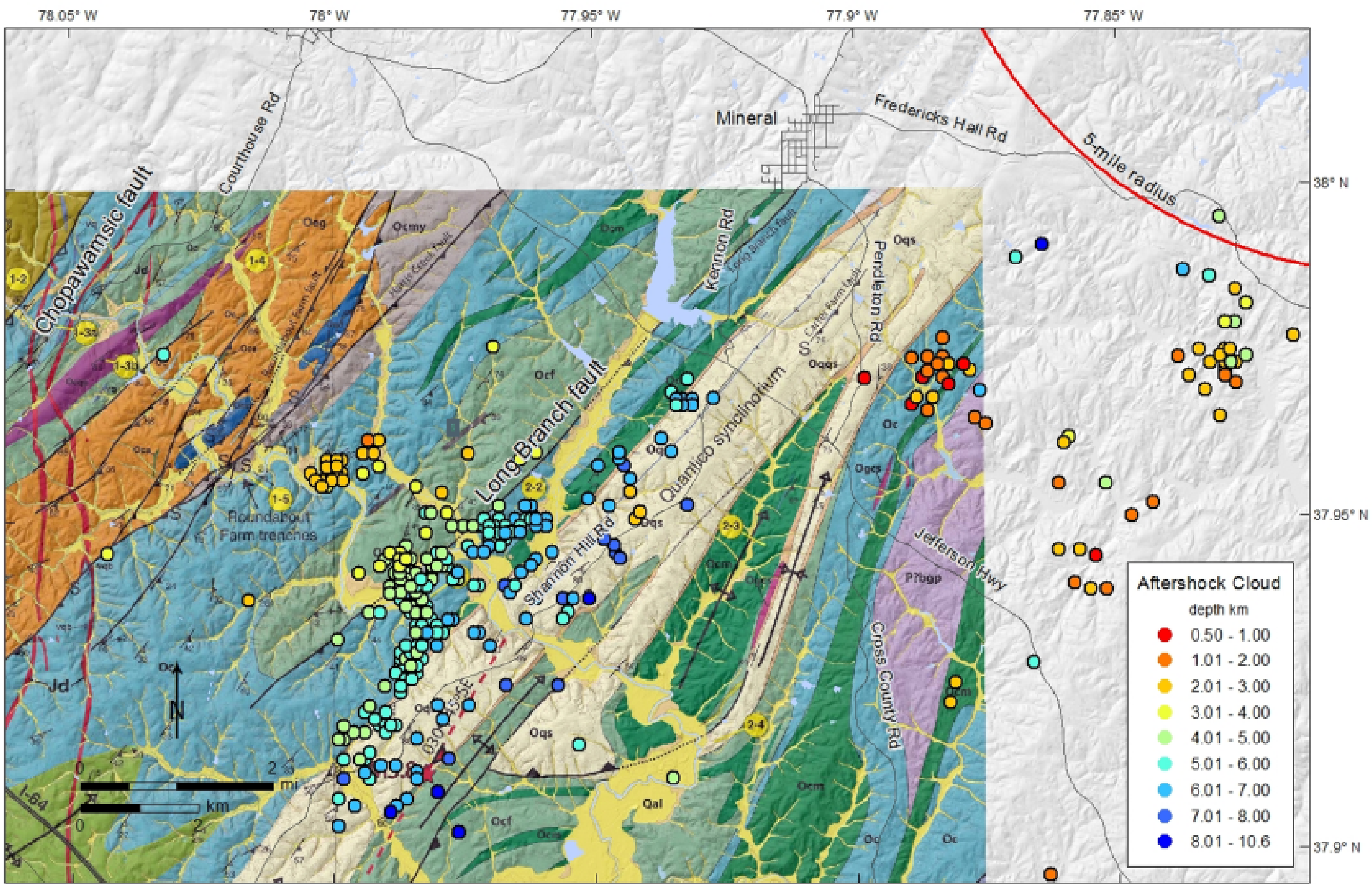
Location Map for Longitudinal Stream Profiles



From NAPS FSAR Figure 2.5.1-214

North Anna 3 COLA Review

Geologic Map of the Mineral VA Earthquake Vicinity, Burton et al, 2014



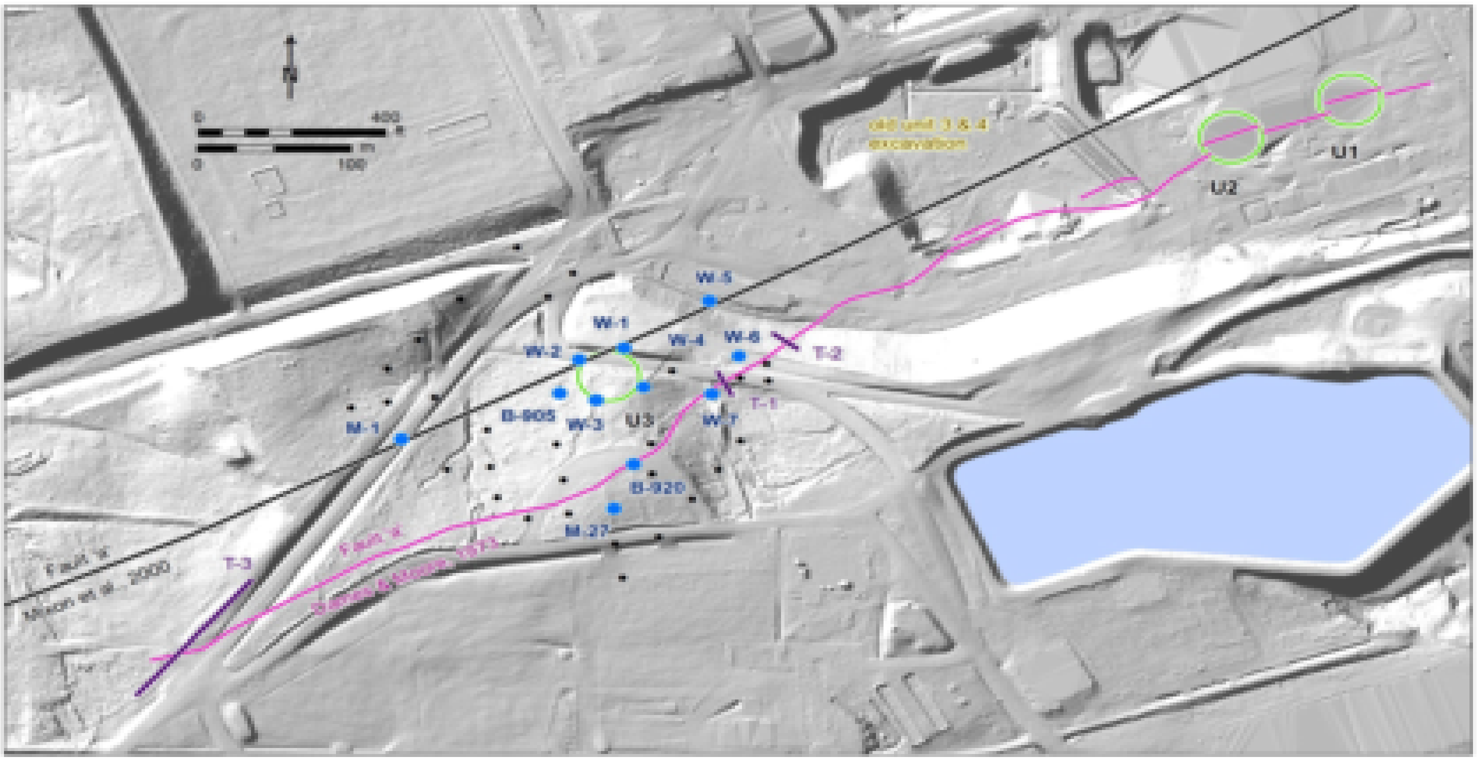
From NAPS FSAR Figure 2.5.1-210C

Section 2.5.1 - Geologic Mapping and Faults

- Chopawamsic fault:
  - Remapped by Burton et al, 2014
  - Structurally below the aftershock sequence
- Harris Creek and Roundabout Farm faults:
  - Newly identified by Burton et al, 2014
  - Trenches in soil/ saprolite reveal no quarterly deformation
- Longbranch fault:
  - Structurally higher than aftershock sequence
- Fault ‘a’:
  - No alignment of aftershock data with this fault
  - Field reconnaissance and LiDAR data confirm no reactivation of fault
  - Previous ESP SER concluded fault is certainly older than 1 Ma.

North Anna 3 COLA Review

Fault 'a' Near North Anna 3 Site



Map of fault 'a" showing 3 trenches from Dames and Moore, 1973, also reconnaissance level interpretation (Mixon et al, 2000). Basemap LiDAR-derived hillshade map showing locations of key Unit 3 borings. (from NA Response to RAI 7477 Question 2.5.1-6d, Figure 1).

From NAPS FSAR Figure 2.5.1-214

Sections 2.5.1, 2.5.3 - Conclusions

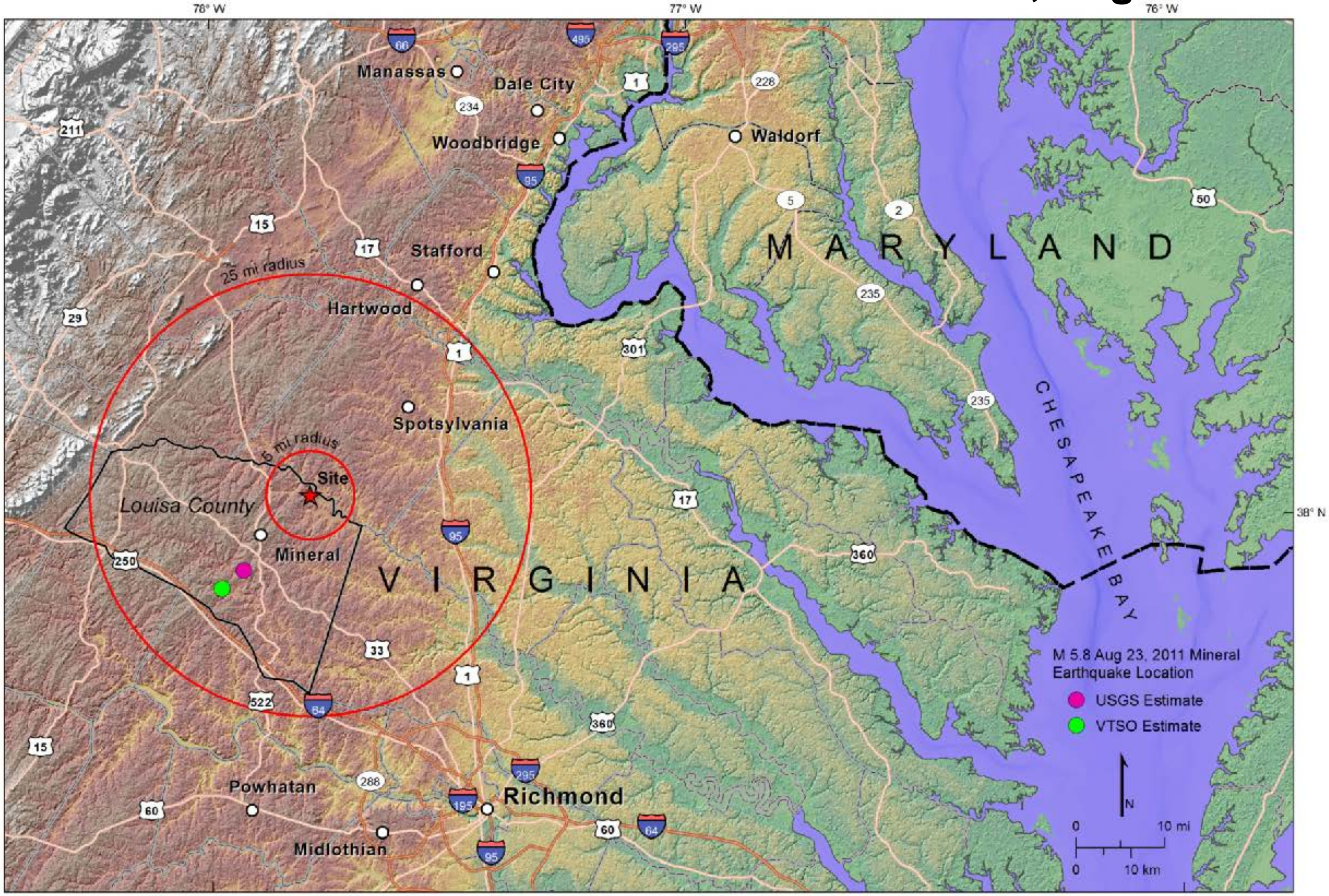
- The applicant's assessment for potential surface expression from the Mineral earthquake was sufficient and appropriate and reveals no measureable surface rupture based on:
  - A suite of geologic maps in consideration with earthquake aftershocks
  - Detailed topographic maps derived from LiDAR data
  - Specific field reconnaissance to determine presence or absence of surface rupture or displacement numerous river profiles and the South Anna river terrace profile
- Surface deformation at the North Anna 3 site is negligible:
  - Fault 'a' was previously found to be a geologically old structure (ESP SER)
  - Post Mineral VA earthquake field reconnaissance and examination of high resolution topographic maps reveal no rupture or deformation associated with fault 'a'

Section 2.5.2 - Vibratory Ground Motion

- New and significant information:
  - A Occurrence of August 23, 2011 Mineral Earthquake
  - Publication of the Central and Eastern United States Seismic Source Characterization (CEUS-SSC; NUREG 2115)
  - Publication of the new Ground Motion Models (EPRI, 2013)
  - Availability of additional site-specific geophysical information
- Mineral, Virginia Earthquake:
  - August 23, 2011
    - M5.8 earthquake approximately 11 mi (18 km) from NAPS Site
    - Located in Central Virginia Seismic Zone (i.e., known region of elevated seismicity, and small to moderate earthquake)
    - Exceeded SSE for currently operating Unit 1 (post-earthquake evaluations found no damage to plant SSCs)
  - Prompted staff to request reassessment of ESP PSHA
    - Using CEUS-SSC (NUREG-2115)

North Anna 3 COLA Review

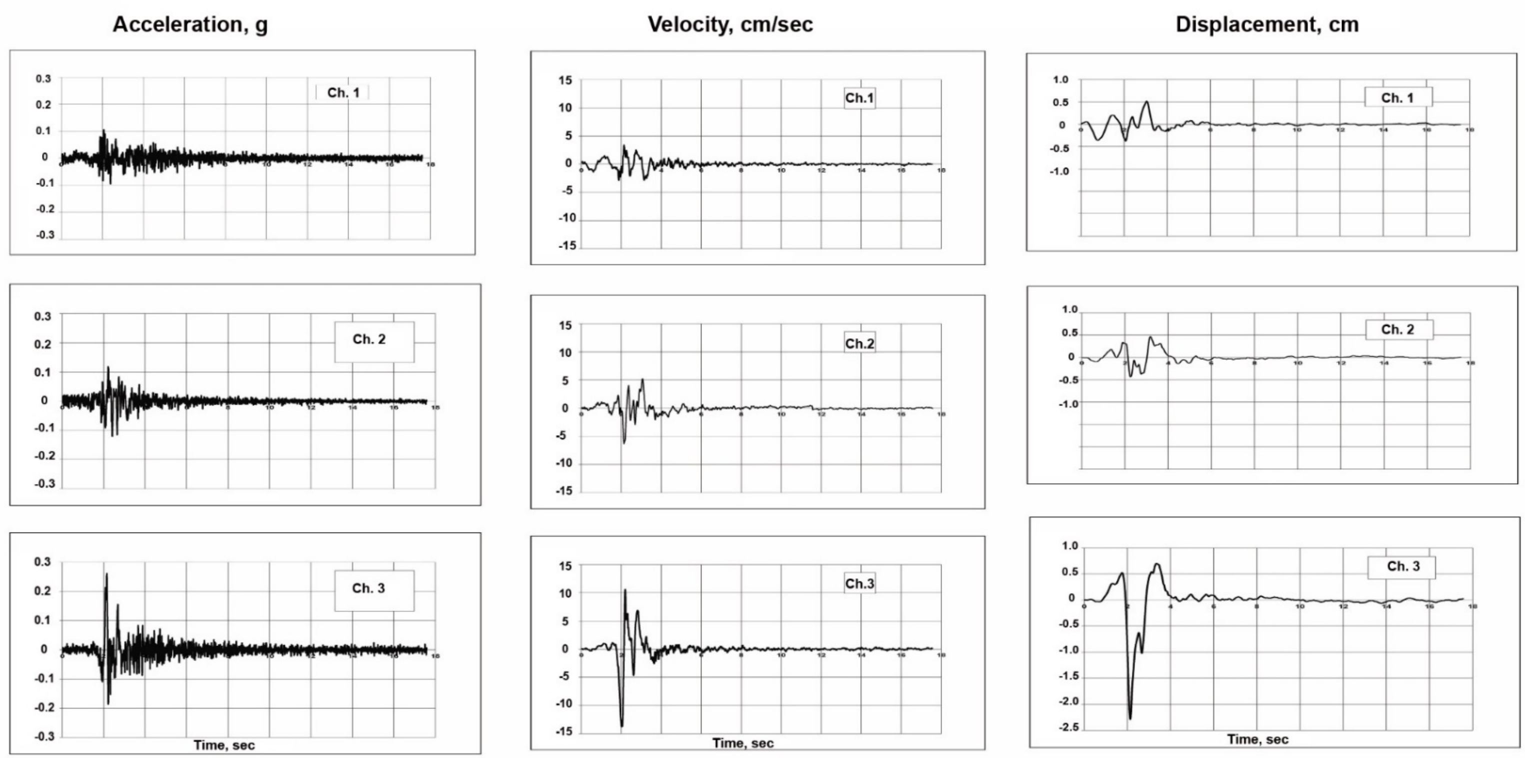
North Anna Site and Estimated Locations of the Mineral, Virginia Earthquake



From NAPS FSAR Figure 2.5.2-228

North Anna 3 COLA Review

Ground Motion Recorded at Unit 1 at Elevation 216 ft.



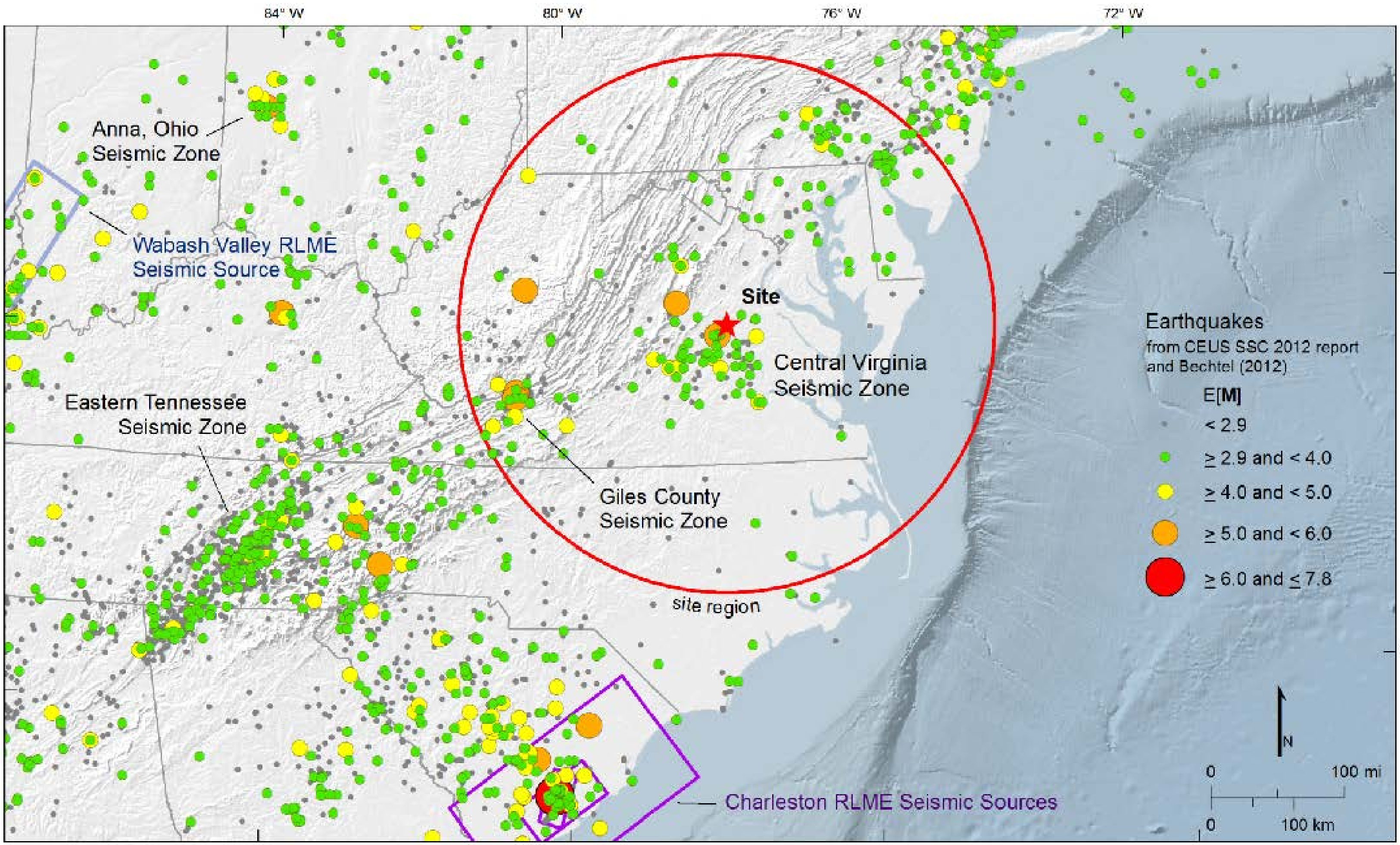
The records demonstrated a peak horizontal acceleration of 0.26 g, peak velocity of 13.8 cm/sec, and peak displacement of 2.3 cm. Record is characterized by a relatively short duration of strongest motion of about 2-3 sec.

Section 2.5.2 - Use of CEUS-SSC In Seismic Hazard Evaluation

- Applicant reevaluated PSHA using CEUS-SSC:
  - ESP used EPRI-SOG study (1986, 1089)
- Applicant updated seismicity:
  - Updated seismicity and recurrence rates to account for post NUREG 2115 seismicity
  - Increased minimum Mmax in host zone
- Applicant used most recently NRC approved ground motion model (EPRI, 2013)
- Staff performed independent PSHA and confirmed applicant's results

North Anna 3 COLA Review

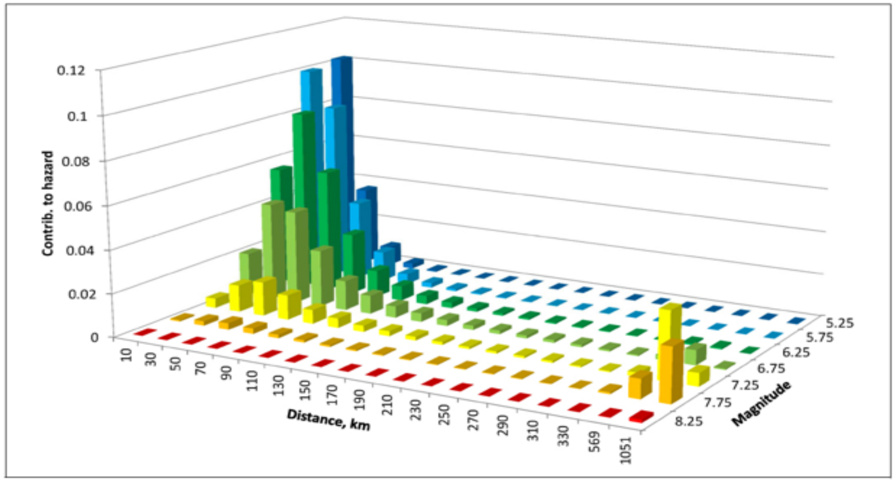
Seismic Zones and Seismicity Near the 200-Mile Site Region

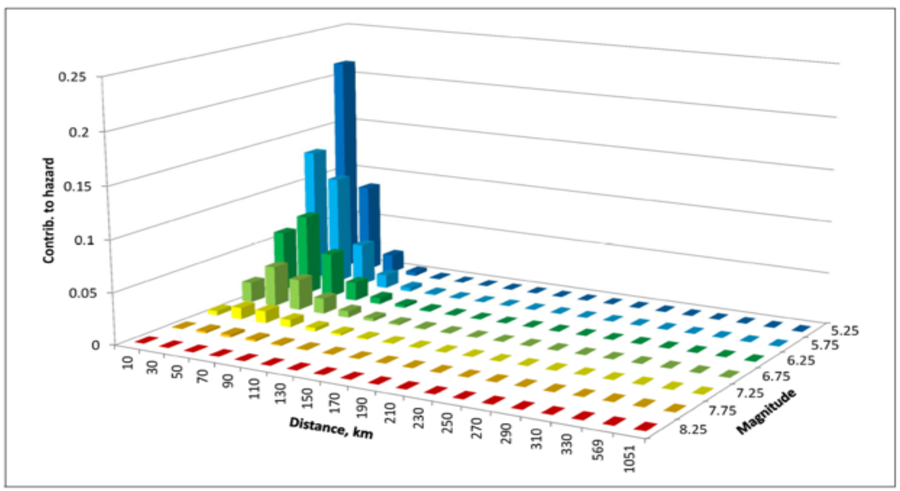


From NAPS FSAR Figure 2.5.2-222

North Anna 3 COLA Review

Deaggregation Results for LF and HF at the 10^{-4} Mean Annual Frequency of Exceedance Level





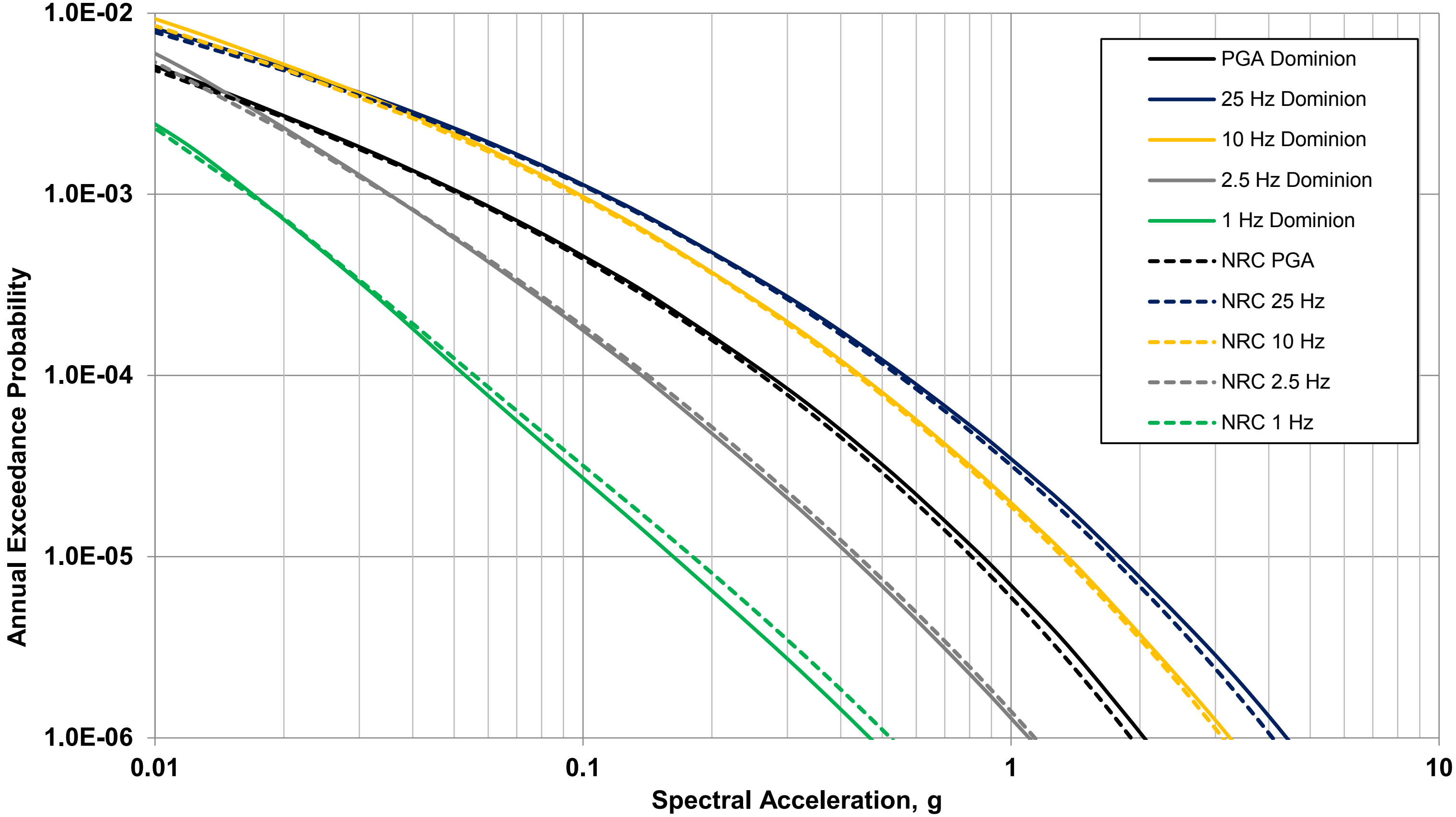
Deaggregation Earthquakes:

- M 5.9 at about 22 km, Local, High Frequency, 5 to 10 Hz
- M 7.1 at about 340 km (Charleston) - Low Frequency, 1 to 2.5 Hz

From NAPS FSAR Figure 2.5.2-250 and 2.5.2-251

North Anna 3 COLA Review

Staff's Confirmatory Rock Hazard Calculations



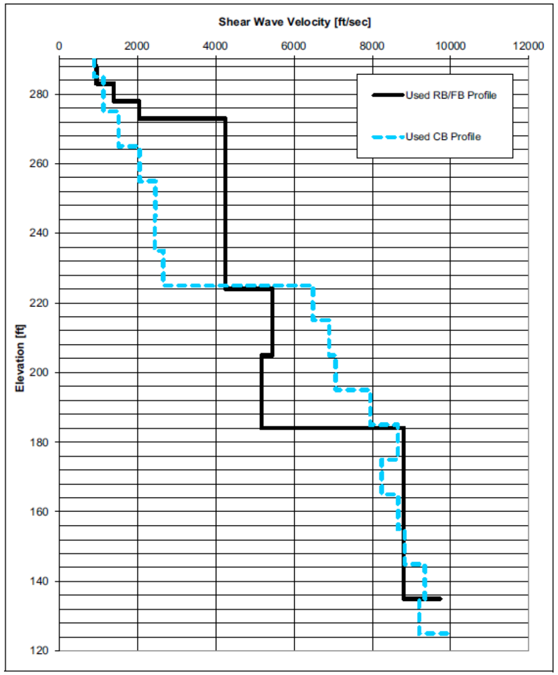
Staff's and Applicants rock hazard calculations are in agreement

Section 2.5.2 - Updating Site Characterization Info.

- Applicant conducted additional geophysical testing:
  - Resulted in a more complete characterization of subsurface structure
    - 'undulating' erosional contacts
  - Applicant considered appropriate subsets of geophysical data for each structure
  - Applicant defined GMRS as the envelope of site specific response spectra for Reactor Building/ Fuel Building, and the Control Building

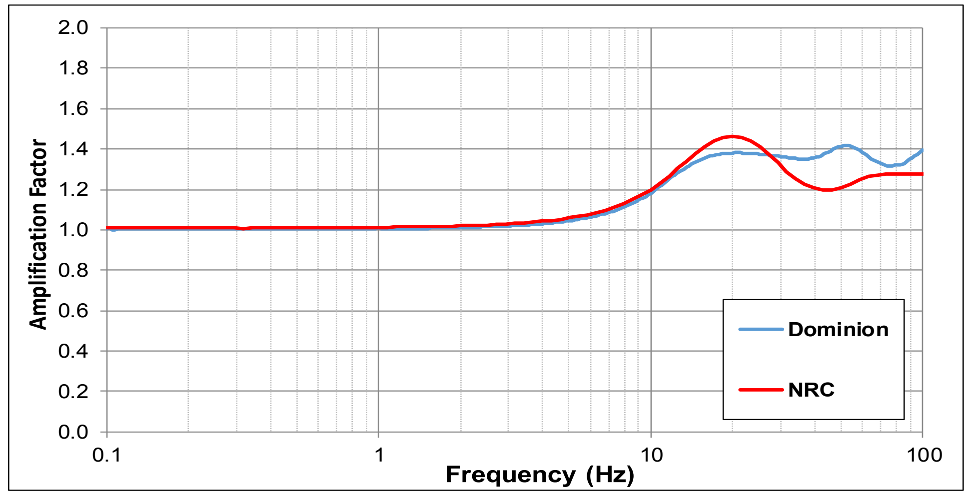
North Anna 3 COLA Review

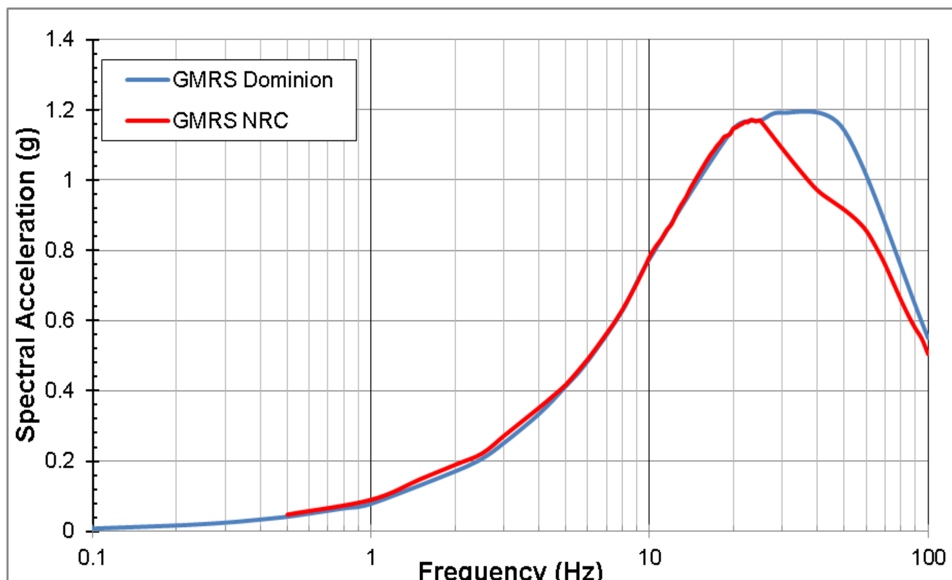
Confirmatory Site Response Analysis



Shear-wave velocity profiles for the RB/FB and CB buildings used for site response calculations (from FSAR Figure 2.5.2-259)

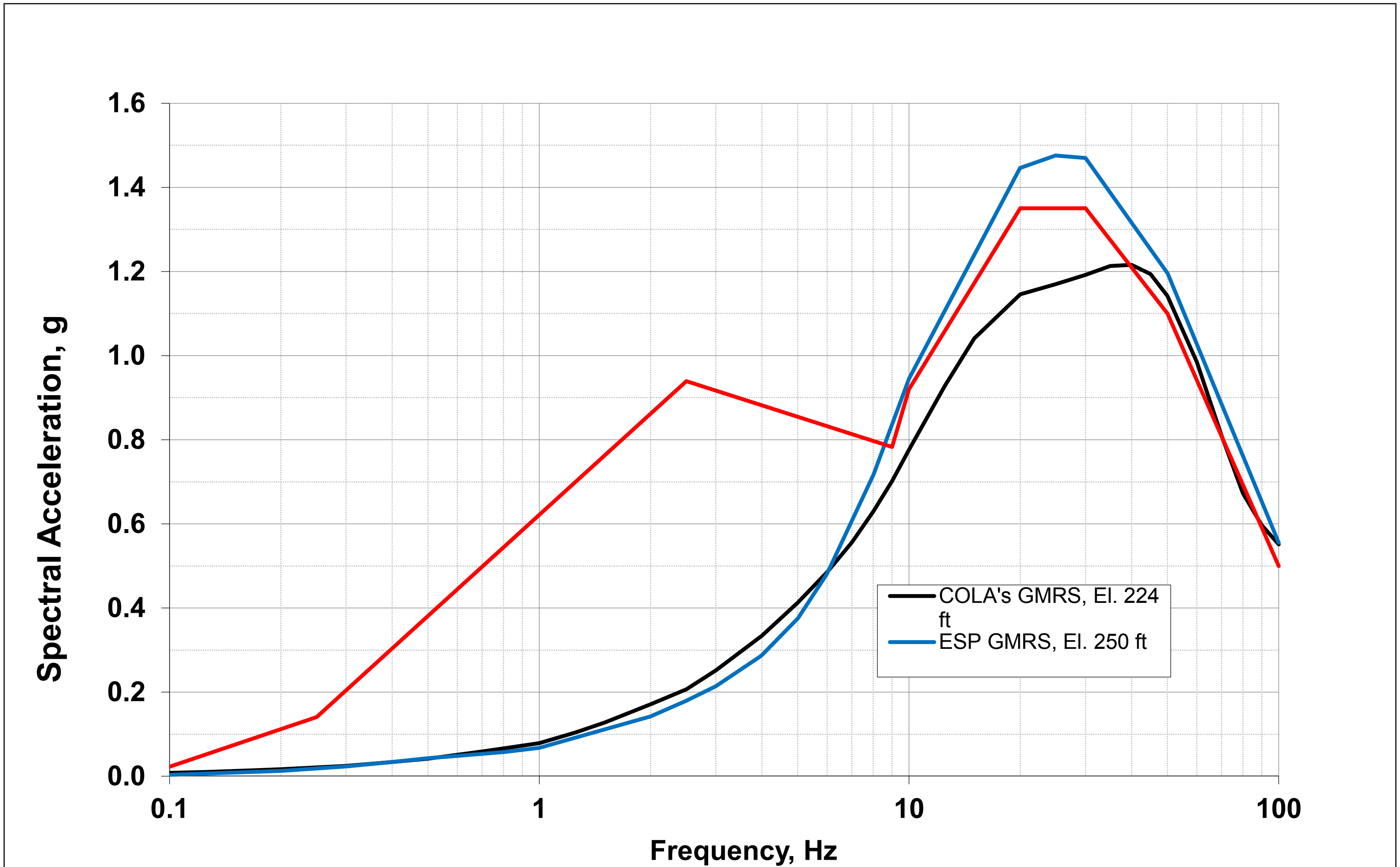
The staff performed an independent site response analysis and confirmed applicant's site amplification and GMRS calculations





North Anna 3 COLA Review

North Anna 3 GMRS and CSDRS



Section 2.5.2 - Conclusions

- The applicant adequately addressed new and significant information related to the Mineral, Virginia earthquake, the CEUS-SSC model, and additional pertaining subsurface geologic condition

- The site-specific GMRS adequately represents the seismic hazard at the North Anna 3 site and meets the relevant regulatory requirements provided in 10 CFR Parts 52 and 10 CFR 100.23

- The site specific vibratory ground motion meets the ESBWR DCD design criteria

Sections 2.5.4, 2.5.5 - Stability of Subsurface Materials & Foundations/ Stability of Slopes

- New Geotechnical Engineering related information:
  - The applicant drilled 38 additional borings from September to October, 2009 with additional SPT test and samplings
  - The applicant performed additional geophysical logging in two borings
  - The applicant conducted additional laboratory tests
  - The applicant validated, confirmed and fine-tuned the design parameters for subsurface materials based on new testing data
- Conservative PGA values used in foundation Stability Analyses:
  - The updated GMRS rock motions are lower than those from the EPRI (2004, 2006) GMM and result in lower site GMRS with lower peak ground accelerations
  - The foundation stability analyses and liquefaction potential evaluations used higher PGA values from original GMRS, therefore it was more conservative
- ITAACs for Backfills:
  - Evaluated the strength requirement for concrete fill under and around Cat 1 structures and associated ITAAC
  - Evaluated ITAAC for structural fill surrounding Cat 1 structures

Sections 2.5.4, 2.5.5 - Conclusions

- Properly characterized subsurface material properties and profiles underlying the North Anna 3 COL site with consideration of the new information

- Used adequate analytical methods with conservative input parameters in evaluation of stability of foundations and slopes, and the results meet ESBWR DCD requirements

- Provided adequate ITAACs to ensure the properties of concrete and structural fills meeting the design criteria

- Resolved all COL items and license conditions

- The evaluation of foundation and slope stabilities at the North Anna 3 COL site meets the applicable requirements of NRC regulations

LUNCH

12:15 - 1:15 p.m.

NRC Panel 3 - Presenters

- **Sections 3.7, 3.8 Departures - Manas Chakravorty**
- **Fuel Storage Rack Departure - Manas Chakravorty**
- **Chapter 4 Departures - James Gilmer**
- **SMA Update & RTNSS Structure Departures - Manas Chakravorty**

Sections 3.7, 3.8 Departures - Background & Scope

- Background:
  - FSAR incorporates ESBWR DCD Sections 3.7 and 3.8 by reference with a departure and supplements for Sections 3.7 and 3.8
  - The site-specific foundation input response spectra (FIRS) exceed the DCD certified seismic design response spectra (CSDRS)
  - The seismic inputs include both the CSDRS and site-specific FIRS for evaluation of RB/FB, CB, and FWSC
  - The applicant performed site-specific seismic analyses and design evaluations to demonstrate the adequacy of the ESBWR standard design at the NA3 site
- Review Scope:
  - The Review of seismic analyses and design evaluations of RB/FB, CB, FWSC, RCCV including PCCS Condenser, CIS, New and Spent Fuel Storage Racks
  - Review of applicable Tier 1 and Tier 2 information in the FSAR (NAPS DEP 3.7-1, COL Part 7 Departure Report), technical reports, RAI responses, and supporting calculations (during audits)
  - Confirmatory analyses of the seismic input motions, strain-compatible soil profiles, and SSI effect on FWSC
  - Review of V&V of seismic analysis codes for NA3 application

Sections 3.7, 3.8 Departures - Staff Review Results

- Applicable Regulations/ Staff Guidance:
  - 10 CFR Part 50, Appendix A, 10 CFR Part 50, Appendix S, 10 CFR 52.80(a)
  - NUREG-1966 (ESBWR DCD), NUREG-0800 (SRP)
  - DC/COL-ISG-01, DC/COL-ISG-017

- Results of Staff Review:
  - Staff issued 29 RAIs based on review of FSAR Rev. 7 and Rev. 8
  - In response to RAIs, the applicant modified its approach to performing certain aspects of the seismic analysis and developed a Seismic Closure Plan (SCP)
  - SCP included the tasks necessary to address the RAIs with an accompanying schedule
  - A key feature of the SCP was to provide information to the NRC as soon as it becomes available.
  - The applicant performed 18 SSI analysis cases for each of the RB/FB, CB, and FWSC, and 17 SSSI cases, for a total of 71 cases to establish the seismic demand at NA3

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North Anna 3 COLA Review

Sections 3.7, 3.8 Departures - Staff Review Results

- Results of Staff Review (Continued):
  - Staff conducted review in two phases: (a) Phase 1 for reviewing NA3 site-specific seismic demand, and (b) Phase 2 for reviewing the structural evaluation of the standard design for NA3 seismic demand
  - During the course of this review, the staff reviewed 39 technical reports and the RAI responses along with the accompanying FSAR revisions
  - The staff conducted two audits: Audit 1 to review the Phase 1 activities and Audit 2 to review the Phase 2 activities
  - The applicant completed site-specific evaluation of the ESBWR standard plant structures and submitted the COL FSAR Rev 9, on June 2016
  - The FSAR Appendix 3G shows that the standard design is adequate to resist the site-specific seismic demand except in a few instances in which design changes are required
  - The design changes include: modifying the arrangement of some steel reinforcements and shear ties, the size of a steel girder, weld size, and anchor bolt sizes. No changes to the thickness of the concrete walls and slabs were needed
  - The applicant developed site-specific ISRS, which exceed the standard design ISRS in some frequency ranges

Sections 3.7, 3.8 Departures - Conclusions

- Conclusions:
  - As documented in Chapter 3 of the FSER, the staff confirmed that the site-specific seismic design methodology for SSCs is acceptable. At the NA3 site, with the identified changes, the ESBWR standard design is adequate to meet the site-specific seismic demand
  - The site-specific ISRS that exceed the standard design ISRS, are used along with the standard design ISRS for seismic design and qualification of equipment and components
  - The staff has reviewed the NA3 COL application and the relevant information in the ESBWR DCD incorporated by reference and concludes that sufficient information has been provided to satisfy the NRC regulations and guidance

Fuel Storage Rack Departure - Evaluation

- Staff evaluated the Fuel Storage Rack (FSR) departure and determined that:
  - The applicant has performed a site-specific assessment of the structural design for the new and spent FSRs in the buffer pool and spent fuel pool using NA3 seismic demand
  - Standard design of spent FSRs in the spent fuel pool is adequate
  - For the spent FSRs in the buffer pool deep pit, changes in the size of the anchor bolts and welds were necessary
  - For the new FSR in the buffer pool, changes in the size of the anchor bolts were necessary

Chapter 4 Departures - Reactor Design

- Staff evaluated that:
  - Chapter 4 incorporates by reference the DCD, with the exception of Section 4.2 (Fuel System Design), which includes NAPS Departure 3.7-1
  - Site-specific seismic exceedances resulted in increased fuel and control rod loading
- Regulatory Requirements/ Guidance:
  - 10 CFR52, Appendix E, “Design Certification Rule for the ESBWR Design”
  - 10 CFR50, Appendix A, General Design Criterion 2, “Design bases for protection against natural phenomena”
  - 10 CFR50, Appendix S, “Earthquake Engineering Criteria for Nuclear Power Plants”
  - Standard Review Plan (SRP) 4.2, “Fuel System Design”, Appendix A, “Evaluation of Fuel Assembly Structural Response to Externally Applied Forces”
  - Regulatory Guide 1.92, “Combining Modal Responses and Spatial Components in Seismic Response Analysis”

Chapter 4 Departures - Background/ Review Scope

- Background:
  - Fuel and control rod capacity limits must bound seismic loading in combination with hydrodynamic loading resulting from design basis events
  - ESBWR Certified Design refers to fuel and control rod topical reports which document analyses and testing; both are based on CSDRS
  - Hydrodynamic loads (e.g., LOCA, SRV, chugging, and condensation oscillation) are documented in topical report NEDE-33261P
  - Methodology for combining seismic and other loads is provided in Topical Report NEDE-21175-3-P-A
  - Tier 1 ITAAC No. 15 is used to ensure as-built, site-specific evaluation is completed prior to fuel loading
- Staff Review Scope:
  - RAI 04.02-1 requested information that demonstrates that the site-specific loads remained bounded by the component design analyses and testing performed for the ESBWR design certification
  - RAI response provided NA3 site-specific technical reports with evaluation of the GE14E fuel assembly and control rods
  - Staff conducted an audit of these reports and all supporting references

Chapter 4 Departures - Results of Staff Review

- Results:
  - Staff confirmed that the methodology used to determine site-specific fuel accelerations was consistent with methods approved in the DCD
  - Staff confirmed that the methodology for combining loads was consistent with the DCD methodology and regulatory guidance
  - Tier 1 ITAAC 15 (Table 2.1.1-3) "ITAAC for the Reactor Pressure Vessel Internals" verifies that site-specific analyses are completed prior to fuel loading
  - COLA, Part 10, ITAAC 1 (Table 2.4.19-1), "ITAAC for the Control Rods" verifies that analyses of the control rod seismic and dynamic loads are completed prior to fuel loading and conclude that acceptance criteria are met
  - Staff assessed the results of the applicant's evaluation and agrees that the fuel and control rod capacities are sufficient to bound the site-specific exceedances, and as-built values will be confirmed by ITAAC
  - Scram insertion time testing was performed for ABWR control rods. The staff confirmed the applicant's assertion that this testing bounds the expected ESBWR control rod scram insertion times

Chapter 4 Departures - Staff Conclusions

- Conclusions:
  - The NA3 fuel assembly site-specific analyses demonstrate that the mechanical stresses remain bounded by the DCD tested values.
  - The NA3 control rod stresses and scram insertion times remain bounded by the DCD tested values.
  - ITAAC will confirm prior to fuel shipment that the above conclusions remain valid when detailed design and as-built information is incorporated in the analyses.
  - The NA3 fuel and control rods are in compliance with the regulations

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SMA Update & RTNSS Structure Departures

- Staff evaluated the applicants Seismic Margin Analysis (SMA) update and determined that:
  - The applicant has performed a site-specific SMA update using the site-specific FIRS in addressing departure NAPS DEP 3.7-1 relative to seismic exceedances of the CSDRS
  - The results are documented in FSAR Reference 19.1-201 which the staff reviewed and found acceptable to meet the guidance in DC/COL-ISG-020
  - NA3 has a plant level HCLPF on at least 1.67 times the peak ground acceleration of a site-specific SSE defined in FSAR Section 3.7.1
- Staff evaluated the applicants seismic considerations for RTNSS Structures and determined that:
  - At North Anna 3, Seismic Category I and II buildings are designed for SSE as defined in FSAR Section 3.7.1 to include both FIRS and the CSDRS

BREAK

3:00 - 3:15 p.m.

NRC Panel 4 - Presenters

- **Chapter 7 Instrumentation and Controls - Dinesh Taneja**
- **Byron Open Phase Event - Bob Fitzpatrick**
- **Staff Conclusion - Jim Shea**

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North Anna 3 COLA Review

Chapter 7 - Instrumentation and Controls (I&C)

- North Anna Unit 3 FSAR incorporates by reference the ESBWR I&C design without any departures
- Details of the ESBWR watchdog timers and voting logic were presented to the ACRS during the ESBWR design certification
- All I&C related changes were incorporated in Rev. 8 of the DCD and, specifically, the two topics in question (watchdog timers/ voting units) were addressed and closed
- Watchdog timers are discussed in DCD, Tier 2, Subsections:
  - 7.1.2.1.2.1 - RTIF-NMS Determinism Design Principle
  - 7.1.2.1.2.2 - SSLC/ESF Determinism Design Principle
  - 7.1.3.4 - Q-DCIS Testing and Inspection Requirements
  - 7.8 - Diverse Instrumentation and Control Systems;
  - 7.8.1 - System Description
  - 7.8.2.1 - Design Techniques for Optimizing Safety-Related Hardware and Software

Chapter 7 - Instrumentation and Controls (I&C)

- Voting logic timers are discussed in DCD, Tier 2, Subsections:
  - 7.1.2.1.1 - Independence Design Principle
  - 7.1.2.1.1.1 - RTIF-NMS Independence Design Principle
  - 7.1.2.1.1.2 - SSLC/ESF Independence Design Principle
  - 7.1.2.1.1.3 - ICP Independence Design Principle
  - 7.1.2.1.2 - Determinant Data Processing and Communication Design Principle
  - 7.8 - Diverse Instrumentation and Control Systems;
  - 7.8.1 - System Description
- Data communications and cyber security are discussed in DCD, Tier 2, Subsections:
  - 7.1.2.1.5 - Simplicity Design Principle and Subjective Attribute
  - Figure 7.1-1 - Redundant Firewall between Plant Computer Functions (PCF) Network and Outside World
  - 7.1.4.8.4 - Provide data support functions through a secure communications interface with the TSC, EOF, and the ERDS
  - 7.1.6.6.1.10 - Control of Access (IEEE Std. 603, Section 5.9)
  - 7.1.6.6.1.28 - Cyber Security (IEEE Std. 7-4.3.2)
  - 7B.1 – Software Development

Byron Open Phase Event

- The Byron Open Phase Event occurred January 30, 2012 at Byron Unit 2:
  - Not immediately detected
  - Both offsite and onsite electrical power systems were not able to perform their intended safety function if called upon
  - Presented a potential common cause failure event
  - Therefore, needed to be addressed across the entire reactor fleet
- NRC Staff Actions:
  - Special Inspection at Byron [ML12087A213]
  - Information Notice 2012-03 [ML120480170]
  - Bulletin 2012-01 [ML12074A115]
  - Summary Report including recommended actions [ML13052A711]

Byron Open Phase Event (Continued)

- NRC Requirements for Passive Plants:
  - Provide detection of single/double loss of phase events with/without a high impedance fault across all operating modes of the plant
  - Detection to be located on the high voltage side of the transformer(s) that feed offsite power into the plant's electrical distribution system
  - Provide dedicated alarm in the control room
  - Provide plant personnel (operations, maintenance) with training and procedures

Byron Open Phase Event (Continued)

- ESBWR Design Solutions:
  - DCD Rev. 10 formalizes the ESBWR design approach (accepted by the staff as part of that review) and includes the following:
    - Identified existing relays within their Distributed Control & Instrumentation System (DCIS) that can detect loss of loss of phase events with/without high impedance faults
    - These relays are located on the high voltage side of the Unit Auxiliary Transformers (UATs)and the Reserve Auxiliary Transformers (RATs)
    - Design utilizes these programmable relays to monitor both current and potential transformer outputs, per phase, on each of the three phases
    - DCD includes Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) to demonstrate that proper set points have been developed and that testing demonstrates full functionality
    - DCD also includes Interface Requirements for the Combined Operating License Applications (COLAs) to establish training and procedures per the Staff's position

Byron Open Phase Event (Continued)

- North Anna 3 Design-Specific Solution:
  - COLA Rev. 8 documents the following with respect to the loss-of-phase event:
    - The ESBWR design solution is incorporated by reference (DCIS plus ITAAC)
    - Plant operating procedures, including off-normal operating procedures, associated with the monitoring system will be developed in accordance with FSAR Subsection 13.5.2.1 at least six months prior to fuel load
    - Maintenance and testing procedures, including calibration, set point determination and troubleshooting procedures, associated with the monitoring system will be developed in accordance with FSAR Subsection 13.5.2.2.6.1 prior to fuel loading
    - Control room operator and maintenance technician training associated with the operation and maintenance of the monitoring system will be developed in accordance with FSAR Section 13.2.1 for Reactor Operators and FSAR Section 13.2.2 for Non-Licensed Plant Staff. Training will be completed before fuel load

Byron Open Phase Event (Continued)

- Summary:
  - NRC Staff has required the passive design plants to provide detection and alarm for a single or double loss of phase event with attendant procedures and training of plant personnel
  - NA-3 has incorporated the ESBWR design solution by reference (IBR) and has committed to developing the procedures and training
  - NRC Staff finds this issue acceptably resolved

Staff Conclusion

- Thank You!

- Staff addressed questions raised by the public during September 22, 2016, ACRS Information Session:
  - Erica Grey - Raised the issue of the North Anna 3 site footprint change. Addressed by Chapter 2 review staff.
  - Erica Grey - Raised the issue of the North Anna 1 & 2 being built on an ancient fault. Addressed by Chapter 2 review staff.
  - Stakeholder - Raised the issue of whether the Fermi Seismic Evaluation is based on the DCD or the new CEUS SSC seismic spectrum. Addressed during the previous ACRS Subcommittee meeting – Evaluation in Chapter 20 shows DCD still bounding for Fermi.

- Additional topics for the ACRS Full Committee Meeting?

- Turnover to ACRS Subcommittee Chairman

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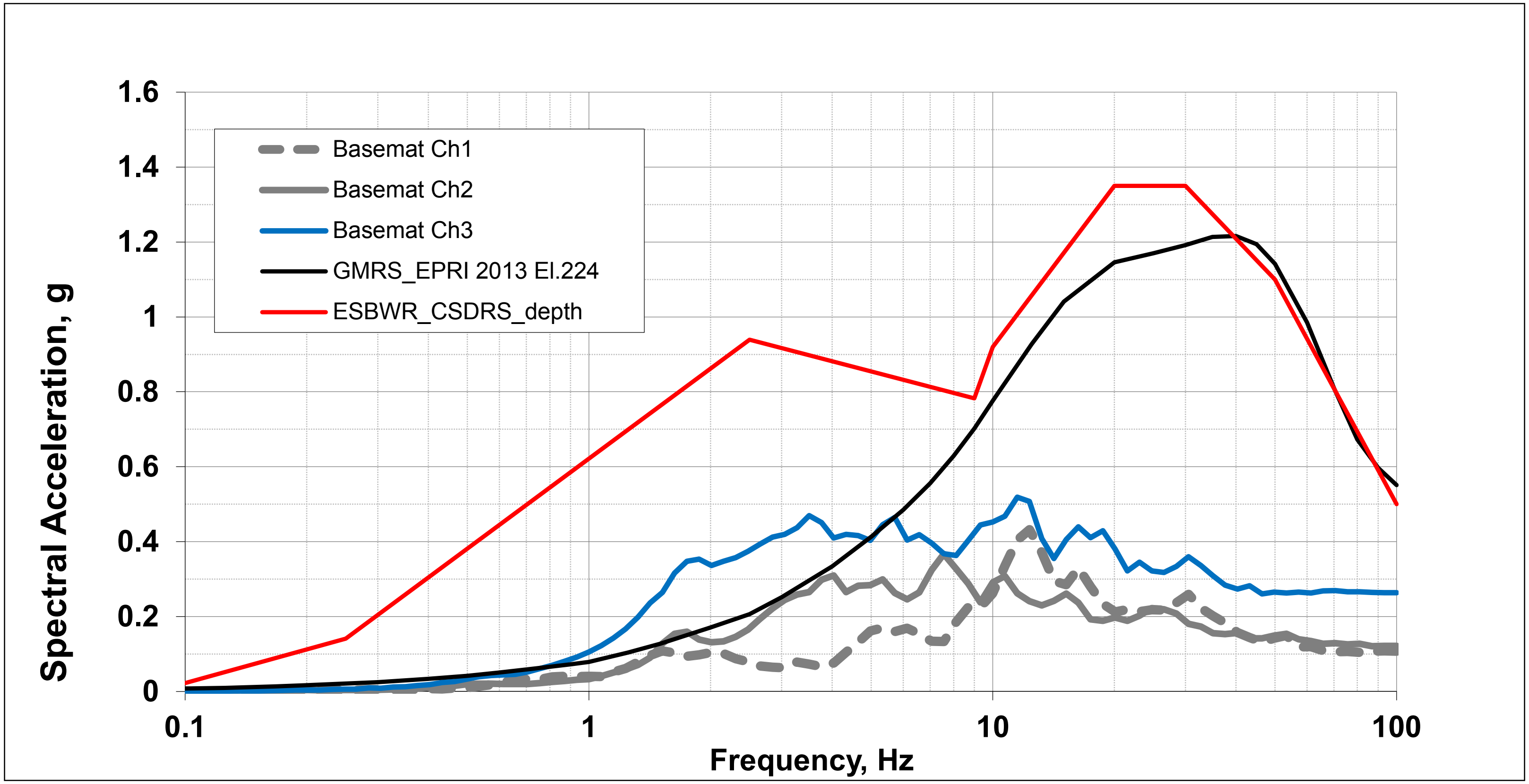
Backup Slides

List of Abbreviations Used

- ACRS – Advisory Committee on Reactor Safeguards
- ATWS – Anticipated Transient Without Scram
- BNL – Brookhaven National Laboratory
- CB – Control Building
- CCF – Common Cause Failure
- CIS – Containment Internal Structures
- COL – Combined License
- CSDRS – Certified Seismic Design Response Spectrum
- DBA – Design Basis Accident
- DCD – Design Control Document
- DPS – Diverse Protection System
- ESBWR – Economic Simplified Boiling Water Reactor
- ESF – Engineered Safety Feature
- FB – Fuel Building
- FIRS – Foundation Input Response Spectrum
- FSAR – Final Safety Analysis Report
- FWSC – Fire Water Service Complex
- GDC – General Design Criteria
- I&C – Instrument and Control
- I/O – Input and Output
- ICP – Independent Control Platform
- IEEE – Institute of Electrical and Electronics Engineers
- ISRS – In-Structure Response Spectra
- LTR – Licensing Technical Report
- N-DCIS – Non-Safety-Related Distributed Control and Information System
- NA3 – North Anna Unit 3
- NMS – Neutron Monitoring System
- NRC – US Nuclear Regulatory Commission
- PCCS – Passive Containment Cooling System
- Q-DCIS – Safety-Related Distributed Control and Information System
- QA – Quality Assurance
- RAI – Request for Additional Information
- RB – Reactor Building
- RCCV – Reinforced Concrete Containment Vessel
- SCP – Seismic Closure Plan
- SRP – Standard Review Plan
- SSC – Structure, Systems, and Components
- SSI – Soil Structure Interaction
- SSSI – Structure Soil Structure Interaction
- V&V – Verification and Validation

North Anna 3 COLA Review

Mineral Earthquake Spectra Compared to GMRS and CSDRS



Appendix A to Part 50 – GDC requires appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area.